

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,

Petitioner

v.

TELEFONAKTIEBOLAGET L M ERICSSON (publ),

Patent Owner.

Case No. IPR2024-00728
Patent No. 7,151,430 B2

Before Daveina B. Williams, *Trial Paralegal*

**EXPERT REBUTTAL DECLARATION OF PAUL R. PRUCNAL
REGARDING VALIDITY OF U.S. PATENT NO. 7,151,430**

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Appendix A Curriculum Vitae of Dr. Paul R. Prucnal

I, Paul R. Prucnal, under the penalties of perjury, depose and state:

I. Introduction, Qualification, and Assignment

1. I have been retained as an expert in this *inter partes* review (“IPR”) by counsel for TELEFONAKTIEBOLAGET L M ERICSSON (“Ericsson”) to provide my opinions in connection with U.S. Patent No. 7,151,430 (the “’430 Patent”).

2. Since 1990, I have been and remain a Professor of Electrical and Computer Engineering at the University of Princeton. I earned an A.B. degree from Bowdoin College, *summa cum laude*, in 1974. I earned an M.S. degree from Columbia University, Electrical Engineering in 1976. I earned an M.Phil. degree from Columbia University in 1978. I earned my Ph.D. from Columbia University in 1979. My teaching and consulting experiences, honors, and patents for which I was an inventor are provided in c.v. attached hereto as Appendix A and incorporated herein by reference.

II. Foundational Information

3. I understand that Intel has challenged the validity of claims 1-21 of the ’430 patent (collectively, the “Asserted Claims”). I understand that Ericsson has disclaimed claims 20-21, and the same are no longer an issue in this proceeding.

4. I understand that Intel’s expert, Dr. Manos Tentzeris, Ph.D., has alleged that the Challenged Claims are invalid. I disagree with his opinions and

have been asked to write this Declaration in response.

5. In preparing this Declaration, I reviewed the materials and testimony that I believe are appropriate considering the evidence available at this time. I reviewed the '430 Patent, Intel's Petition (Paper 1), including all exhibits submitted therewith, Dr. Tentzeris' Declaration, certain documents produced in related proceedings such as those produced by Ericsson, Intel, and third parties, the parties' Markman briefs, the Markman Hearing transcript, deposition transcripts of numerous witnesses, and information obtained by interviews and discussions with people knowledgeable about these issues. A list of the documents I have reviewed in preparation of this Declaration and that I rely upon is attached in Appendix B or referred to in the text below. I understand that discovery is ongoing, and I reserve the right to supplement my Declaration, and plan to do so, should any new, relevant information become available to me.

6. I understand that the parties have proposed certain constructions for the terms, which I have considered.

7. This Declaration is based on information currently available to me. I reserve the right to supplement my analyses in response to any additional Declarations prepared on behalf of Intel. I also reserve the right to amend or supplement my opinions based on further discovery and information provided, particularly once I have had an opportunity to review whatever discovery is

ultimately provided. Any citation to evidence is intended to be exemplary, and not intended to be exhaustive. I reserve all right to discuss additional evidence, such as deposition or hearing testimony at the evidentiary hearing in this matter.

III. Legal Principles

8. I have been informed about certain aspects of the law that are relevant to my analyses and opinions. I have been informed of relevant legal principles and have been asked to assume these principles as true in evaluating whether the Challenged Claims are valid. My understanding is set forth below.

9. I understand that each claim of an issued patent is entitled to a statutory presumption of validity, and that the party challenging a patent's validity (Intel in this case) must present clear and convincing evidence to overcome the statutory presumption of validity. I also understand that a patent claim may be held invalid for a number of reasons, including anticipation, obviousness, indefiniteness, and lack of patentable subject matter.

10. I understand that a patent claim is invalid for obviousness if the invention described in the claim would have been obvious to a person of ordinary skill in the art ("POSITA") at the time the invention was made. I understand that the fundamental question in an obviousness analysis is whether the claimed invention would have been obvious to a person of ordinary skill in the art, taking into account (1) the scope and content of the prior art, (2) the differences between

the prior art and the claimed invention, (3) the level of ordinary skill in the art, and (4) any secondary considerations of nonobviousness, including commercial success of products or processes using the invention, long-felt need for the invention, failure of others to make the invention, industry acceptance of the invention, licensing of the invention, initial skepticism aimed at the invention, statements of acclaim for the invention, and unexpected results achieved by the invention.

11. I understand that obviousness of a patent cannot be properly established through hindsight, and that elements from different prior-art references or different embodiments of a single prior-art reference cannot be selected to create the claimed invention using the invention itself as a roadmap. The claimed invention as a whole must be compared to the prior art as a whole, and courts must avoid aggregating pieces of prior art through hindsight which would not have been combined absent the inventor's insight.

12. I further understand that references can be combined with one another, or with the knowledge of a person of ordinary skill in the art, to render the claimed invention obvious. However, obviousness is not established simply because all of the elements of a patent claim can be found in the prior art. A party challenging the obviousness of a patent must demonstrate that a reason would have existed at the time of the invention to prompt a person of ordinary skill in the relevant field to combine the elements in the same way as the claimed new invention. In addition,

the patent challenger must also demonstrate that a person of ordinary skill in the art would have had a reasonable expectation of success in combining the prior-art references. I understand that the need to demonstrate a reason for the combination, and the need to demonstrate a reasonable expectation of success, are two separate requirements that must both be satisfied.

13. It is my understanding that an invention is not obvious simply because all of the claimed limitations were known in the prior art at the time of the invention. It is my understanding that any invention may look obvious once someone has made it and found it to be useful, but working backwards from that invention, with the benefit of hindsight, once one is aware of it does not render it obvious. It is my understanding that obviousness does not merely ask whether a skilled artisan could combine the references, but instead asks whether they would have been motivated to do so. It is my understanding that identifying a motivation to combine the prior art is important because inventions in most, if not all, instances rely on building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known.

14. It is my understanding that, where a party only relies on prior art considered by an examiner in its invalidity contentions, the party must overcome the deference that is due a qualified government agency presumed to have properly done its job, which includes one or more examiners who are assumed to have some

experience in interpreting the references and whose duty it is to issue only valid patents.

15. I understand a claim is unpatentable under 35 U.S.C. § 103 if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” I also understand the question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective evidence of non-obviousness.

16. It is my understanding that an obviousness determination based on a combination of references requires finding both that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so. I understand an assertion of obviousness cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.

17. I understand that in an IPR, the petitioner has the burden from the

onset to show with particularity why the patent it challenges is unpatentable. This burden of persuasion never shifts to Patent Owner. Therefore, I understand that Intel must explain how the proposed combination of prior art would have rendered the challenged claims unpatentable.

18. I understand that a reference qualifies as prior art for a determination under § 103 when it is analogous to the claimed invention. I understand that two separate tests define the scope of analogous art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved. I understand a reference is reasonably pertinent if . . . it is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem. If a reference disclosure has the same purpose as the claimed invention, the reference relates to the same problem, and that fact supports use of that reference in an obviousness rejection. Lastly, I understand that whether a prior art reference is "analogous" is a question of fact.

IV. Summary of Opinions

19. I am prepared to testify regarding the validity of the '430 Patent. I reviewed the Petition (Paper 2), including Exhibits 1001 through 1041 submitted,

therewith, and specifically the Declaration of Dr. Tentzeris' (EX1003), and the documents listed in Appendix B and everything else cited through this Declaration.

20. Intel only asserts two main theories of invalidity. First, obviousness by Taniguchi (alone or in combination with Rostoker, Brooks, or Rostoker and Brooks). Second, obviousness by Midya in combination with Raghavan, Raghavan and Gardner, Raghavan and Brooks, or Raghavan, Gardner, and Brooks. Neither of the above two grounds for invalidity are persuasive.

21. Therefore, it is my opinion that Intel has failed to show that a single claim of the '430 Patent is invalid. Intel's analysis fails, in particular, because it fails to show that the prior art anticipates or renders obvious any of the following claim limitations with respect to the grounds he asserts.

22. The following Table summarizes the reasons why Intel's Petition fails to demonstrate a prima facie case of obviousness.

ASSERTED GROUNDS	SUMMARY OF REASONS
1. Taniguchi under § 103	Taniguchi is non-analogous art that teaches away from the '430 Patent. Taniguchi is directed to antennas, not inductors. Taniguchi is directed to antennas that increase coupling with devices (<i>e.g.</i>, RFID tags) at a distance, not to inductors that reduce coupling with other inductors at a distance. Taniguchi's antennas are orders of magnitude larger than inductors on

ASSERTED GROUNDS	SUMMARY OF REASONS
	semiconductor chips.
	Taniguchi does not disclose or render obvious a first inductor having a reduced far field. [1A] and [11A]
	Taniguchi does not disclose or render obvious a second loop connected to first loop, having a substantially similar size and shape to the first loop, the second loop arranged such that a magnetic field emanating therefrom cancels the magnetic field emanating from the first loop. [1A2] and [11A2]
	Taniguchi does not disclose or render obvious two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals. [1B] and [11B]
	Taniguchi does not disclose or render obvious [1B.1] a second inductor positioned at a predetermined distance from the first inductor, [1B.2] wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field
2. Taniguchi and Rostoker under 103.	Rostoker is directed to antennas, not inductors. A POSITA would not have been motivated to combine Taniguchi with Rostoker.
3. Midya and Raghavan	Midya is of record in the '430 Patent and, therefore, already was considered

ASSERTED GROUNDS	SUMMARY OF REASONS
	by the examiner. Midya and Raghavan do not disclose or render obvious two closely spaced terminals connected to the first loop . . . [1B] and connecting two closely spaced terminals to the first loop . . . [11B]
4. Midya, Raghavan, and Gardner	Gardner does not disclose or render obvious those elements from the Challenged Claims 2 and 11-16 missing from Midya and Raghavan. Gardner teaches away from connecting two closely spaced terminals to a first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals as recited in claims 1 and 11.
5. Taniguchi and Brooks	A POSITA would not have been motivated to combine or alter Taniguchi in view of Brooks to obtain the claimed invention.
6. Taniguchi, Rostoker, and Brooks	Intel relies on the addition of Brooks to Ground 2 in an effort to show the “closely spaced” and “minimizing magnetic field contributions from the terminals” limitations of claims 1 and 11. Brooks does not show “closely spaced” or “minimizing magnetic field contributions from the terminals,” and, therefore, does not provide these teachings missing from Taniguchi and Rostoker. Consequently, Intel’s proposed combination in Ground 6 fails to correct the deficiencies in Ground 2.
7. Midya, Raghavan, and Brooks	Intel relies on the addition of Brooks to Ground 3 in an effort to show the

ASSERTED GROUNDS	SUMMARY OF REASONS
	“closely spaced” and “minimizing magnetic field contributions from the terminals” limitations. Brooks does not show “closely spaced” or “minimizing magnetic field contributions from the terminals,” and, therefore, does not provide these teachings missing from Midya and Raghavan.
8. Midya, Raghavan, Gardner, and Brooks	See Grounds 4 and 7.

23. I reserve the right to supplement this report as additional discovery comes to light and I have had an opportunity to review that discovery.

V. Level of Ordinary Skill in the Art

24. It is my opinion that a person of ordinary skill in the art (“POSITA”) relative to the ‘430 patent would have a bachelor’s degree in electrical engineering, physics, or a similar discipline, and either a master’s degree in one of these fields of study or a minimum of two years of experience working in the wireless communications industry.

25. I understand that Intel’s Expert has provided his own opinion of what a POSITA is for the ’430 patent. My analysis in this Declaration is unchanged whether the Patent Trial and Appeal Board (“Board”) accepts his opinion or mine regarding the level of ordinary skill in the art.

VI. Problem The Inventor Sought to Solve

26. The inventor of the '430 Patent sought to solve the problem of undesired altering of a signal generated by a circuit on a semiconductor chip due to mutual magnetic coupling between an inductor of the circuit and an inductor of another circuit on the same semiconductor chip. To solve this problem, the inventor sought to minimize the magnetic field emitted by an inductor of a circuit on a semiconductor chip to reduce the mutual magnetic coupling of the inductor to an inductor of another circuit on the same semiconductor chip.

VII. Taniguchi Relative To The Problem The Inventor Sought To Solve

27. Taniguchi is not from the same field of endeavor as the claimed invention. Taniguchi is directed to antennas that have dimensions on the order of a large fraction of a meter or greater than one meter (a POSITA could have determined this from, *e.g.*, typical sizes of the commodities 207 and the gates 208 and 209 respectively housing Taniguchi's radio guidance antennas, EX1005 at FIG. 21 and [0003]-[0004]) and are used in retail establishments as, *e.g.*, part of an antitheft system (*Id.* at [0084]); Taniguchi is not directed to inductors used on semiconductor chips and having dimensions measured in microns.

28. Furthermore, Taniguchi is not reasonably pertinent to the particular problem the inventor of the '430 patent sought to solve. Taniguchi is directed to solving the problem of too little mutual magnetic coupling between antennas in a retail setting. Taniguchi is not directed to solving the problem of too much mutual

magnetic coupling between inductors on a semiconductor chip.

VIII. Taniguchi Relative To The References Of Record In The ‘430 Patent

29. Taniguchi is less material than the references of record during prosecution of the ‘430 patent. For example, US 6,194,987 (Zhou), over which the patent examiner initially rejected the claims, disclosed an inductor (not an antenna) with counterpropagating currents in two loops such that the magnetic fields generated by the counterpropagating currents cancelled each other. EX2008. US 6,512,422 (Dufour) disclosed a method for reducing coupling between a VCO and external (to the VCO) magnetic interference by forming the VCO with two pairs of counterpropagating spiral inductors (not antennas), where the centers between the pairs of inductors overlap so that the inductors appear to be symmetric from an external perspective. EX2003. US 6,664,606 (Estes) disclosed a method for orienting inductors (not antennas) to minimize electromagnetic coupling. EX2004. US 6,891,444 (Jacobsson) disclosed using mutual inductance, via a transformer-like structure, to magnetically couple inductors (not antennas) that are components of two different LC oscillators. EX2005. US 6,894,598 (Heima) disclosed an inductor (not an antenna) formed in multiple metal layers of a semiconductor and generating an inductor current that flows in opposite directions in each layer to reduce magnetic coupling between the inductor and the semiconductor substrate

(not between two antennas). EX2006. WO 98/05048 (Midya) is directed to planar inductors (not antennas) for a printed circuit board. EX1007. WO 2003/084295 (Bhailis) is directed to a decoupling structure for reducing unwanted EM coupling between inductors on a printed circuit board. EX2007. Last, WO 2004/012213 (Enzinger) disclosed a figure-eight inductor that generates opposing magnetic fields that cancel and reduce interference. EX1017.

IX. Technical Background Of The '430 Patent

30. United States Patent No. 7,151,430 patent, titled “Method of and Inductor Layout for Reduced VCO Coupling,” issued on December 19, 2006, to inventor Thomas Mattsson. EX1001.

31. The '430 patent issued from Application No. 10/919,130, filed on August 16, 2004. *Id.*

32. The technical field of the subject matter disclosed and claimed in the '430 patent is generally related to inductors implemented within a semiconductor chip.

33. The invention, as stated in the Summary of the Invention, is: “An inductor design for reducing mutual EM coupling between VCO resonators and a method of implementing the same on a single semiconductor chip.” EX1001 1:57-61. As further explained in the Summary of the Invention, the inductors are structured and positioned in a way that tends to cancel out the magnetic fields that

are generated and reduce the amount of current that might otherwise be induced inside one inductor because of the presence of another inductor. EX10011:61-2:2.

34. Existing inductor designs were optimized for maximum Q-factor given such constraints as silicon area and the required size of the conductive elements. And the positions of terminals for supplying current to the inductor were optimized for connection to other circuits on the chip, with little attention paid to electromagnetic coupling caused by these connections. As a result, typical designs for inductors on a semiconductor chip included the configuration shown in Fig. 1 and the layout shown in FIG. 3 of the '430 patent. EX1001 3:60-4:4.

35. The '430 patent claimed invention went against the conventional wisdom in the art. Spiral, O-shaped, and octagonal inductors and inductors with terminals positioned far apart were generally used in ASIC's because they were easier to make, easier to connect, took up less space, and provided higher inductance and Q values for an inductor than more complicated geometries. The claimed invention makes use of a geometry that is more complex, but the resulting inductors are manufacturable and can be more easily integrated in an inductor layout because the distance between these inductors can be reduced.

X. State of the Art

36. The invention, as stated in the Summary of the Invention of the '430 Patent, is: "An inductor design for reducing mutual EM coupling between

VCO resonators and a method of implementing the same on a single semiconductor chip.” EX1001, 1:57-61. As further explained in the Summary of the Invention, the inductors are structured and positioned in a way that tends to cancel out the magnetic fields that are generated and reduce the amount of current that might otherwise be induced inside one inductor because of the presence of another inductor. EX1001 at 1:61-2:2.

37. Existing inductor designs were optimized for maximum Q-factor given such constraints as silicon area and the required size of the conductive elements. And the positions of terminals for supplying current to the inductor were optimized for connection to other circuits on the chip, with little attention paid to electromagnetic coupling caused by these connections. As a result, typical designs for inductors on a semiconductor chip included the configurations shown in FIGS. 1 and 3 ‘430 patent below. EX1001, 3:60-4:4.

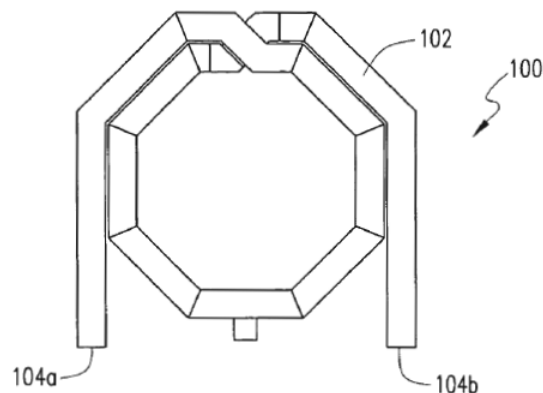
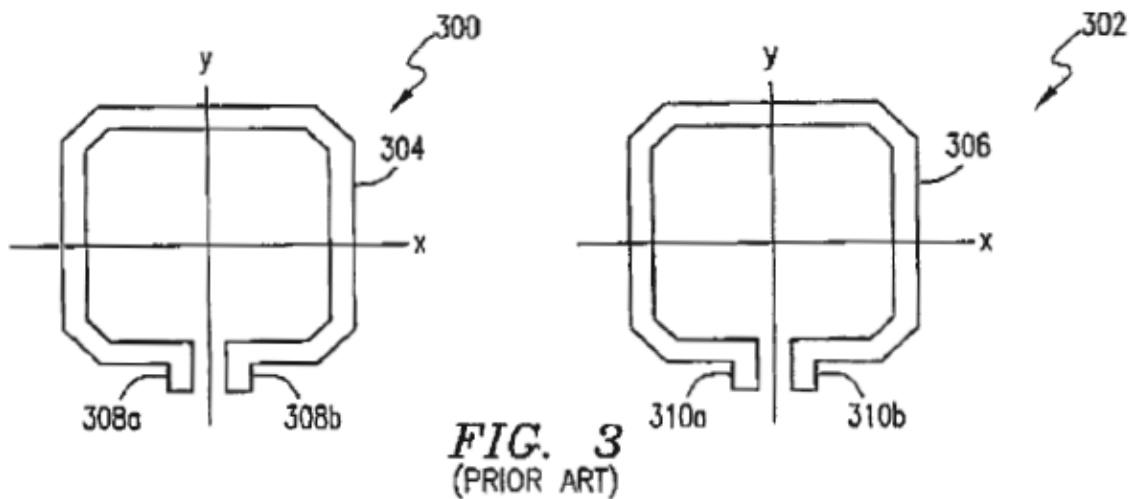


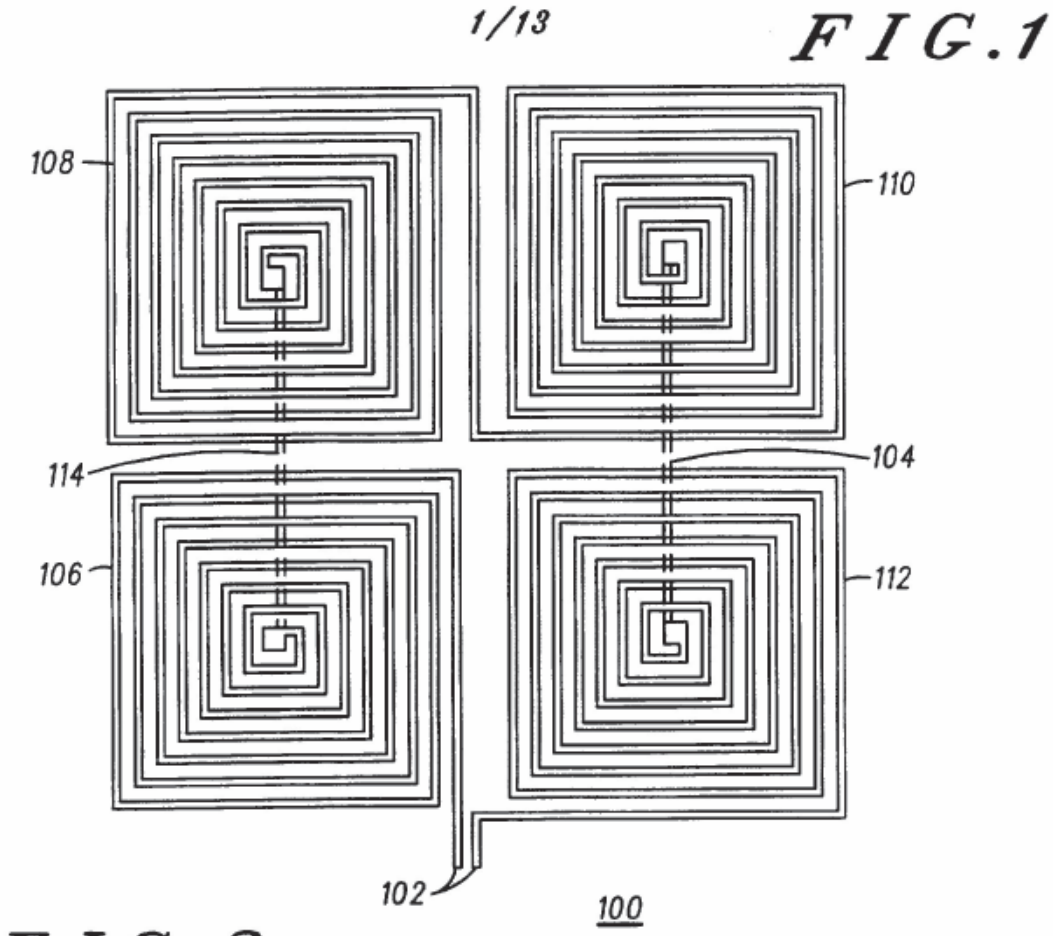
FIG. 1
(PRIOR ART)



38. The claimed invention went against the conventional wisdom in the art. Spiral, O-shaped, and octagonal inductors and inductors with terminals positioned far apart were generally used in Application Specific Integrated Circuits (ASICs) because they were easier to make, easier to connect, took up less space, and provided higher inductance and Q values for an inductor than more-complicated geometries. EX1001, 3:60 – 4:4. The claimed invention makes use of a geometry that is more complex, but the resulting inductors are manufacturable and can be more easily integrated in an inductor layout because the distance between these inductors can be reduced. *See, e.g.*, EX1001, 7:19 – 33.

39. Art in the field at the time taught away from the inventions claimed in the '430 patent. References that actually describe inductors formed on a semiconductor die teach spiral inductors or O-shaped inductors instead of inductors formed from a pair of loops. *See, e.g.*, EX1007-Midya, FIG.1; EX1008,

FIGS. 2-3. Generally, in references alleged by Intel to teach an inductor having two sections or “loops,” the terminals are not closely spaced because the actual points of contact on the “loop(s)” to two conductors that supply electrical current are spaced apart. *See, e.g., -EX1007, FIG. 1; EX2008, FIG. 3* (reproduced below).



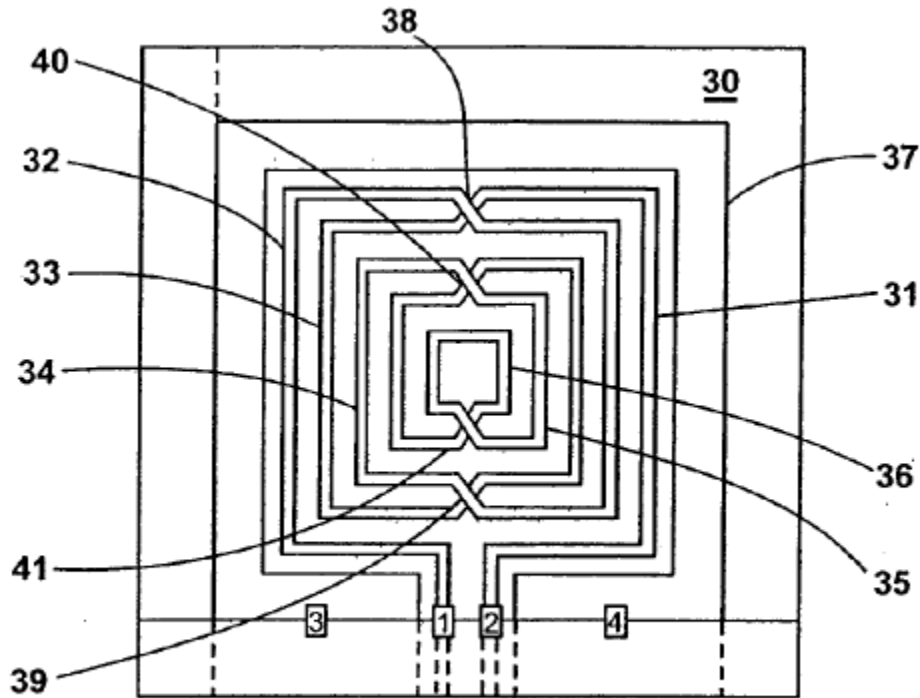
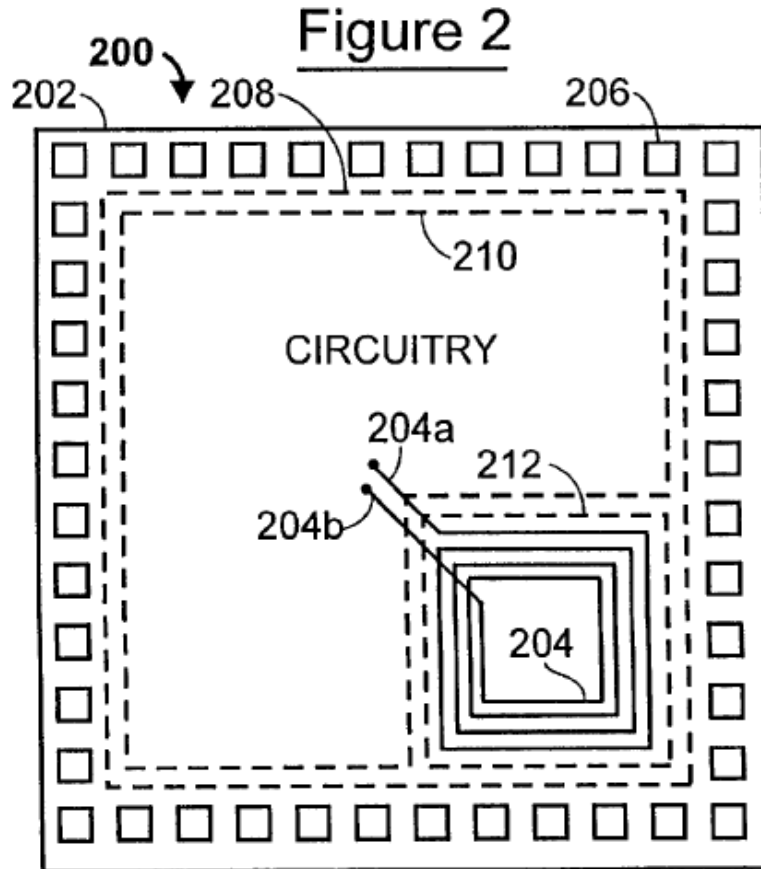
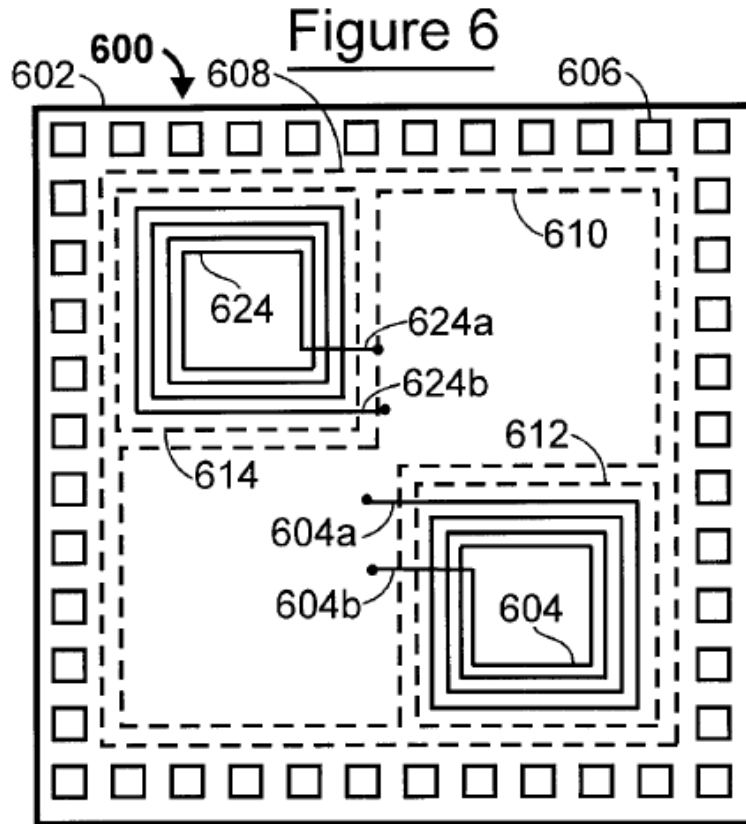


FIGURE 3

40. Moreover, several references relied on by Intel teach antennas instead of inductors, and these antennas perform a completely different function than the claimed inductor layout of the '430 Patent. For instance, Taniguchi and Rostoker teach use of components designed to radiate an electromagnetic field for facilitating a more efficient antenna system. EX1005, FIG. 3, [0022]; EX1006, 11:50 - 55. These references are not relevant prior art and teach away from the '430 patent because they have nothing to do with reducing coupling between a pair of inductors in a layout on a semiconductor die. Instead, these antenna references describe coils that emit electromagnetic radiation in products designed, for example, for an RFID tag or other communication applications.

41. In view of the differing purpose, design, and applications for these antenna coils, a POSITA would not have been motivated to modify Taniguchi or Rostoker or combine them with different references to create a layout with reduced coupling between a pair of inductors on a semiconductor die. And when a POSITA did implement an antenna coil on a semiconductor die, the antenna coils were formed in conventional spiral or O-shaped configurations. EX1006, FIGS. 2 and 6 (reproduced below).





42. Additionally, references such as Brooks (EX1010), which is limited to printed circuit board (PCB) design, are too general and a POSITA would instead apply the more relevant and precise design rules for analog integrated circuits. The claimed inductor layout the '430 Patent is used in RF transceivers on a single semiconductor die, and an exemplary RF frequency referred to in the specification is 3.7 GHz. Although Brooks teaches reducing EMI radiation by spacing a signal and its return close together (EX1010, p. 157), Brooks also teaches that capacitively coupled crosstalk and inductively coupled crosstalk between traces on a printed circuit board increase the closer the traces are to one another, and teaches that a technique for reducing crosstalk is to “spread the traces

further apart.” *Id.* at p. 222. As a result, a POSITA would have understood, from Brooks, that more spacing may be prudent between two terminals to address problems with noise, capacitance, and complexity of conductive traces. As an example, capacitive crosstalk between the interconnect lines on a chip was a problem that engineers had to address. A POSITA would know that signal lines may have to be shielded from each other by putting ground lines between them or by allowing more space to reduce coupling. Another reason that a POSITA would have understood that more spacing may be prudent between two terminals is because parasitic capacitance between the leads of an inductor can increase with reduced spacing between the leads, and an increase in such parasitic capacitance can reduce an inductor’s resonance frequency and be undesirable where the inductor is to be used in a VCO. EX1001, 3:60-62.

XI. Taniguchi Alone Does Not Render The ‘430 Patent Obvious Under § 103 (Ground 1)

43. Intel directs Ground 1 at claims 1, 3-5, 7, 10-11, 13-15, 17, 19-21. Again, Ericsson has disclaimed claims 20-21, and I do not address them here. EX2001. My discussion below relates to several claim limitations that exist in each of the challenged claims of Ground 1. I focus on independent claims 1 and 11 and show why Taniguchi does not render them obvious under § 103. I understand that if independent claims like claims 1 and 11 are not invalidated by a reference, then the claims depending therefrom are necessarily also not rendered invalid.

44. Taniguchi relates “to a radio guidance antenna, a data communication method, and a non-contact data communication apparatus, which make use of such antenna, and more particularly, to a radio guidance antenna for use in non-contact identification apparatus such as physical distribution systems, electronic coupon ticket systems, and the like, a data communication method, and a non-contact data communication apparatus, which makes use of such antenna.” EX1005, [0001]. Taniguchi is less material to the claims of the ‘430 Patent than the references cited on the face, and considered during prosecution, of the ‘430 Patent.

45. Taniguchi does not anticipate or render obvious any Challenged Claim of the ’430 patent whether considered individually or in any permissible combination with any other prior-art reference cited by Intel, including Rostoker and Brooks, for at least the reasons set forth below.

46. Taniguchi is directed to a radio antenna system that is non-analogous art. Taniguchi does not mention or teach a first “inductor” or a second “inductor” or an inductor layout. Instead, Taniguchi only refers to and teaches a radio guidance antenna that includes a first antenna and a second “antenna.” The radio guidance antennas are installed to face each other as “gates” that detect the passing of a device that has an RFID tag. EX1005, FIGS. 13A-B, FIGS. 15A-E, [0081], and [0084]. As shown in Taniguchi’s FIG. 21, the RFID tags 201 and 202 that pass between the antenna gates 208 and 209 (a POSITA would have understood

that the antenna gates 208 and 209 each include a radio guidance antenna) have coils 203 and 204.

47. The entire purpose of the antenna system in Taniguchi is to generate a strong enough electromagnetic field at a distance from the radio guidance antennas to detect any tags.

48. The most important point required for such radio guidance antennas is to ensure the magnetic-field intensity necessary for communication in all locations in a read area. Communication between a read and write device of the non-contact identification apparatus and the tags 201, 202 makes use of mutual inductance coupling between radio guidance antennas for transmission and reception and loop antennas 203, 204 formed in the tags 201, 202. EX1005, [0004].

49. Taniguchi's radio guidance antenna includes elements 1 and 2, which Taniguchi always refers to as "antennas." The function of antennas 1 and 2 in Taniguchi's radio guidance antenna is opposite to and teaches away from the claimed inductor layout of the '430 Patent, which layout functions to reduce mutual electromagnetic coupling between a first inductor and a second inductor (positioned at a predetermined distance from the first inductor) as a result of the first inductor having a reduced electromagnetic field.

50. The first and second inductors in '430 patent have a completely different configuration than the first antenna 1 and second antenna 2 in Taniguchi.

This results in completely different functions and results.

51. As shown in Figs. 4-5, 6, 8, and 12 of the '430 Patent, the first and second inductors in the inductor layout on a semiconductor die are “positioned at a predetermined distance from” each other, *i.e.*, the “center distance” between the two inductors is far enough away to reduce the electromagnetic coupling between them. Ex1001 at FIG. 6, FIG. 8, FIG. 12, 6:60-61, 7:20-21, 9:3-5. In contrast, the non-contact identification apparatus in Taniguchi works only because the second antenna 2 (of Taniguchi’s radio guidance antenna) is “arranged so that the sum of mutual inductances between it and the first antenna is minimized.” EX1005, [0057], [0058], [0061], & claims 1 and 8-10. This is accomplished because both of Taniguchi’s antennas 1 and 2 are formed on the same plane or a parallel plane and must have their center points exactly coinciding and overlapping. *Id.* at FIGS. 6, 7, 8, 9, 10, 12. This complete overlap is the only way for Taniguchi’s two antennas 1 and 2 to be in close proximity without electromagnetic coupling with each other but to electromagnetically couple with a tag. As shown in Taniguchi’s FIG. 4, a tag 212 that is much further away than the antennas 1 and 2 are from one another “makes interlinkage with many lines of magnetic flux” from antenna 1. *Id.*, [0064]. And FIG. 14 shows the electromagnetic fields from antennas 1 and 2 in the area between the two antenna gates (*e.g.*, antenna gates 208 and 209 of Taniguchi’s FIG. 21) is sufficiently strong to communicate with the tags. EX1005. [0083].

52. Although Intel argues that one could substitute Taniguchi's antennas for the inductors claimed in the '430 patent (*see* Paper (002), pp. 31-32, 39), Taniguchi, viewed alone or in combination, would not have motivated a POSITA to substitute Taniguchi's radio guidance antenna, or any components thereof, for the claimed first or claimed second inductor in the '430 Patent. Taniguchi would not have motivated a POSITA to substitute Taniguchi's radio guidance antenna for the claimed first inductor or claimed second inductor in the '430 Patent because Taniguchi teaches that his radio guidance antenna would promote, not reduce, electromagnetic coupling between radio guidance antennas or between a radio guidance antenna and another antenna. *See* EX1005, FIGS. 14A – 14C, 20B, and 4. Furthermore, Taniguchi would not have motivated a POSITA to substitute Taniguchi's first antenna 1 for the claimed first inductor and Taniguchi's second antenna 2 for the claimed second inductor in the '430 Patent because Taniguchi teaches a reduced coupling between his first antenna 1 and his second antenna 2 only when first and second antennas are aligned as shown, *e.g.*, in Taniguchi's FIG. 3, and are on top of one another as shown, *e.g.*, in FIGS. 8A – 8E. *See* EX1005, FIG. 3, FIGS. 8A – 8E, and [0057] - [0058]. And Taniguchi would not have motivated a POSITA to substitute Taniguchi's first antenna 1 for the claimed first and second inductors or Taniguchi's second antenna 2 for the claimed first and second inductors not only because Taniguchi fails even to consider the coupling

between two first antennas 1 spaced apart a predetermined distance or between two second antennas 2 spaced apart a predetermined distance, but also because Taniguchi teaches away from using only antenna 1 and from using only antenna 2 because neither antenna 1 by itself nor antenna 2 by itself provides the desired level of coupling to all tags 211, 212, and 213. EX1005, FIG. 4, FIG. 5, and [0064] - [0065].

53. For these and other reasons, a POSITA would not have been motivated to take the antennas from Taniguchi to use them as inductors for the purpose of the '430 patent.

A. CLAIM 11 of the '430 Patent

54. [11.P] "A method of reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die, comprising:"

55. Antenna 1 and antenna 2 of Taniguchi are not inductors. They are not on a semiconductor die. The coupling between each antenna and the coils 203 and 204 in tags 201 and 202 is not reduced.

56. [11.A] forming the first inductor to reduce a far field, said step of forming the first inductor comprising:

57. Antenna 1 of Taniguchi is not an inductor. The electromagnetic field at a certain distance from a first inductor is not reduced.

58. [11A.1] forming a first loop having a shape that is substantially symmetrical about a first predefined axis;

59. [11A.2c] orienting the second loop in relation to the first loop such that a magnetic field emanating from the second loop tends to cancel a magnetic field emanating from the first loop; and

60. Taniguchi fails to show cancellation of the magnetic field emanating from the first antenna 1 at a predetermined distance away from the first antenna. Instead, every embodiment of an antenna in the non-contact identification apparatus in Taniguchi is able to provide the magnetic-field intensity necessary for mutual inductance coupling between antenna 1 and the coils 203, 204 in tags 201, 202. EX1005 at FIG. 4. For example, Figure 4 shows a tag 211 that is relatively far away “makes interlinkage with many lines of magnetic flux” from antenna 1. EX1005, [0064]. Similarly, FIG. 14 shows that the electromagnetic field A emanating from antenna 1 in the area between the two gates is sufficiently strong to allow for communication with tags containing coils. EX1005, [0083]

61. Furthermore, the opposing fields of Taniguchi’s antenna 1 are not designed to cancel at a distance, but rather are designed to induce opposing currents in Taniguchi’s antenna 2, which is concentric with antenna 1. EX1005, FIG. 3, [0015], [0019] - [0021], [0057], [0060], and [0095]. Taniguchi states that the opposing fields of antenna 1 inducing opposing currents in antenna 2 enables

electric power to be efficiently converted to an electromagnetic field. EX1005, [0095].

62. [11A.3] connecting two closely spaced terminals to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals; and

63. Although there is some space between the ends of antenna conductor 102 at feeding point 111 in FIG. 8B of Taniguchi (EX1005, FIG. 8), Taniguchi does not disclose or suggest that these ends are closely spaced or minimize the magnetic field contributions from these ends.

64. Per VII(27) *supra*, because the dimensions of Taniguchi's radio guidance antenna are on the order of a large fraction of a meter, or on the order of one or more meters, the ends of Taniguchi's antenna conductor 102 at feeding point 111 are not closely spaced relative to the semiconductor-die/chip environment described in the '430 Patent. EX1001, 1:28, 1:60, 2:16, 2:20, 5:47, 10:34, and 10:62.

65. Furthermore, Taniguchi fails to disclose or suggest that the spacing between the ends of antenna conductor 102 at feeding point 111 in FIG. 8B minimizes magnetic field contributions from conductors at the feeding point. Instead, Taniguchi indicates placement of feeding point 111 in FIG. 8B is at the lower side of insulation 10 so that the feeding point of the first antenna 1 will be

near the separate feeding point 112 of second antenna 2. The stated reason is “the two feeding points 111, 112 are nearer to each other, which is favorable in wiring.” EX1005, [0072]. Taniguchi does not teach or suggest that placing separate feeding conductors for two separate antennas “nearer” to each other will minimize magnetic field contributions from the combination.

66. [11B.1] positioning a second inductor at a predetermined distance from the first inductor, [11B.2] wherein the mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.

67. Antenna 2 of Taniguchi is not an inductor. EX1005, [0055]. A second inductor is not positioned at a predetermined distance from a first inductor.

68. The electromagnetic field at a certain distance from a first inductor is not reduced. There is not any reduction of mutual electromagnetic coupling between a first and second inductor as a result of a first inductor having a reduced electromagnetic field.

69. In the ‘430 Patent, the first and second inductors in the inductor layout on a semiconductor die are “positioned at a predetermined distance from” each other, *i.e.*, the “center distance” between the two inductors is far enough away to reduce the electromagnetic coupling between them. EX1001, FIG. 6, FIG. 8, and 2:19-24. In contrast, the non-contact identification apparatus in Taniguchi has a

second antenna that is “arranged so that the sum of mutual inductances between it and the first antenna is minimized.” *See* EX1005, claims 1 and 8-10. This is accomplished because both antennas are formed on the same plane or a parallel plane and must have their center points exactly coinciding or overlapping. *See* EX1005, FIGS. 6, 7, 8, 9, 10, and 12. This complete overlap is the only way for the two antennas to be in close proximity without electromagnetic coupling. As shown in FIG. 4, a tag 211 that is much further away from the first antenna 1 “makes interlinkage with many lines of magnetic flux” from the first antenna. EX1005, FIG. 4, [0064]. And FIG. 14 shows the electromagnetic fields from antennas 1 and 2 in the area between the two gates is sufficiently strong to communicate with the tags. EX1005, FIGS. 14A-14C, and [0083].

B. CLAIM 1 of the ‘430 Patent

[1P] An inductor layout having reduced mutual electromagnetic coupling, comprising: (*See* [11.P])

[1A] a first inductor having a reduced far field, said first inductor comprising: (*See* [11A])

[1A.1] a first loop having a shape that is substantially symmetrical about a first predefined axis; (*See* [11.A.1])

[1A.2a] a second loop connected to the first loop, [1A.2b} said second loop having a size and shape substantially identical to the first loop, [1A.2c] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop; and (*See* [11.A.2a, 11.A.2b, 11.A.2c])

[1A.3] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the

terminals; and (*See* [11A.3])

[1B.1] a second inductor positioned at a predetermined distance from the first inductor, [1B.2] wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field. (*See* [11B.1 and 11B.2])

C. [3] The inductor layout according to claim 1, wherein said first inductor and said second inductor are oriented in a same direction.

70. Antenna 1 and antenna 2 of Taniguchi are not inductors. And the orientation of coils 203 and 204 (EX1005, FIG. 21) is variable because these coils are contained in tags attached to commodities that pass through the antenna gates 208 and 209. EX1005, FIG. 21 and [003].

D. [4] The inductor layout according to claim 1, wherein said first inductor and said second inductor are oriented in different directions.

71. Antenna 1 and antenna 2 of Taniguchi are not inductors. And the orientation of coils 203 and 204 is variable because these coils are contained in tags attached to commodities that pass through the antenna gates. EX1005, FIG. 21 and [003].

E. [5] The inductor layout according to claim 1, wherein said first inductor and said second inductor share a common axis.

72. Antenna 1 and antenna 2 of Taniguchi are not inductors. And the axes of coils 203 and 204 are variable because these coils are contained in tags attached to commodities that pass through the antenna gates. EX1005, FIG. 21 and [003].

- F. [7] The inductor layout according to claim 1, wherein the second inductor also includes two loops, and said first inductor and said second inductor are substantially 8-shaped.**

73. Antenna 1 and antenna 2 of Taniguchi are not inductors.

74. Furthermore, with respect to the requirement in claim 7 that both a first inductor and a second inductor be substantially 8-shaped, Taniguchi teaches away from this limitation in the embodiments of FIGS. 3-8. In these embodiments, only the first antenna 1 has two regions for generating magnetic flux in reciprocal directions, whereas antenna conductor 103 is disposed “in a rectangular configuration to form an antenna 2.” EX1005, FIGS. 3-8 and [0067].

- G. [10] The inductor layout according to claim 1, wherein said first inductor and said second inductor are symmetrical about a second predefined axis.**

75. Taniguchi’s antenna 1 and antenna 2 are not inductors.

- H. [13] The method according to claim 11, wherein the step of positioning the second inductor includes orienting said first inductor and said second inductor in a same direction. (See Claim [3] *Supra*).**

- I. [14] The method according to claim 11, wherein the step of positioning the second inductor includes orienting said first inductor and said second inductor in different directions. (See Claim [4] *Supra*).**

- J. [15] The method according to claim 11, wherein the step of positioning the second inductor includes placing said first inductor and said second inductor on a common axis that is shared by said first inductor and said second inductor. (See Claim [5] *Supra*).**

- K. [17] The method according to claim 11, wherein the step of orienting the second loop in relation to the first loop includes**

placing the first and second loops in a substantially 8-shape. (*See Claim [7] Supra*).

- L. [19] The method according to claim 11, wherein the step of positioning the second inductor includes positioning said first inductor and said second inductor so that they are symmetrical about a second predefined axis. (*See Claim [10] Supra*).
- M. The Combination of Taniguchi and Rostoker Does Not Render Claims 2, 8, 11, 13-15, and 17-19 Invalid (Ground 2)

76. A POSITA would not have been motivated to combine or alter Taniguchi in view of Rostoker to obtain the claimed invention. Claims 2 and 11 require the inductors to be formed on a semiconductor die. EX1001, 10:31 & 61.

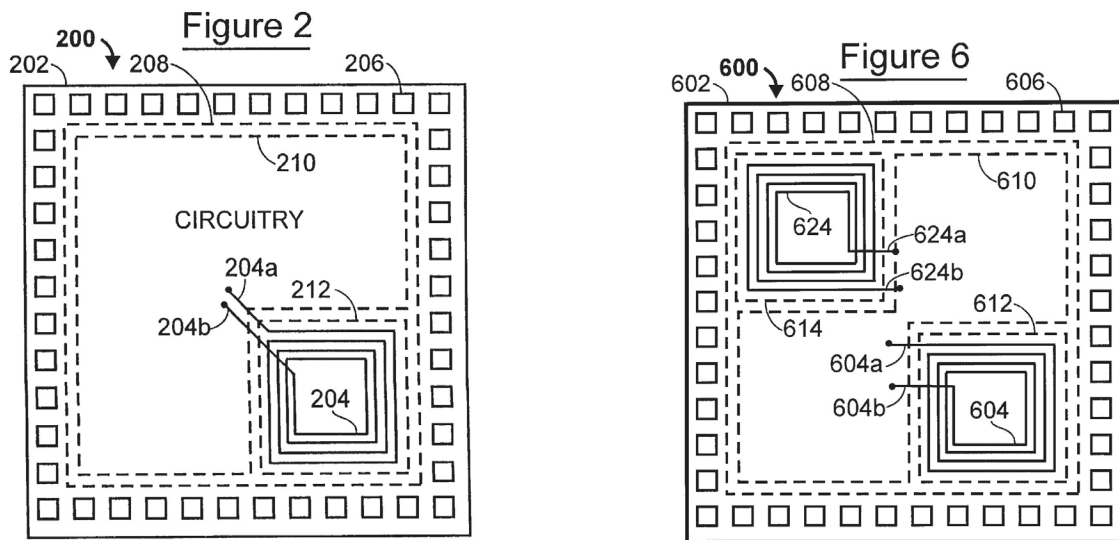
77. Rostoker is directed to antennas, not inductors, and all of Rostoker's antenna coils implemented on a semiconductor die are formed in conventional spiral or O-shaped configurations. *See, e.g.*, EX1006, FIGS. 2 and 6. Although Rostoker mentions inductors that may be integrated on an IC chip along with his antennas, Rostoker expressly distinguishes his "antennas" from "inductors," and describes only his antennas in any detail. EX1006, 4:21-22; 14:1-3; 14:28-30. The purpose and function of any antennas in Rostoker differ from the purpose and function of the two inductors in the '430 Patent's claimed inductor layout. According to Rostoker, 4:24-26, "[t]he invention has utility in communication applications such as pagers, cordless telephones, analog and digital cellular telephones and personal communication systems." If a POSITA were to substitute Rostoker's FIG. 6 antenna layout for the claimed inductor layout, the antennas

would not be functional inductors and the circuitry connected to the antennas would not function as intended.

78. Furthermore, a POSITA would not have had a reasonable expectation of success in combining or altering Taniguchi in view of Rostoker. Art in the field at the time that the '430 Patent was filed taught away from the inventions claimed in the '430 Patent. References that described inductors formed on a semiconductor die taught spiral inductors or O-shaped inductors instead of inductors formed from a pair of loops. *See, e.g.*, EX1007, FIG. 1 & EX1008, FIGS. 2-3. Generally, in references alleged by Intel to teach an inductor having two sections or “loops,” the terminals are not closely spaced because the actual points of contact on the “loop(s)” of the two conductors that supply electrical current are spaced apart. *See, e.g.*, EX1001, FIG. 1, 3:66-4:4 & EX1007, FIG. 1.

79. Moreover, several references relied on by Intel teach antennas instead of inductors, and these antennas perform a different function than the claimed inductor layout of the '430 Patent. For instance, Taniguchi and Rostoker teach use of components designed to radiate an electromagnetic field for facilitating a more efficient antenna system. EX1005, [0062] & EX1006, 1:25-27. Taniguchi and Rostoker are not relevant prior art and teach away from the '430 Patent because they have nothing to do with reducing coupling between a pair of inductors in a layout on a semiconductor die. Instead, Taniguchi and Rostoker describe coils that emit

electromagnetic radiation in products designed, for example, for an RFID tag or other communication applications. EX1005, FIG. 21, [0084] & EX1006 at 4:29-36. In view of the differing purpose, design, and applications for these antenna coils, a POSITA would not have been motivated to modify Taniguchi or Rostoker or combine them with different references to create a layout with reduced coupling between a pair of inductors on a semiconductor die. And when a POSITA did implement an antenna coil on a semiconductor die, the antenna coils were formed in conventional spiral or O-shaped configurations. EX1006, FIGS. 2 and 6 (reproduced below).



80. Additionally, instead of applying the teachings of Brooks (EX1010), which is limited to printed circuit board (PCB) design, a POSITA would have applied the more relevant and precise design rules for analog integrated circuits. EX2002, X(42) & X(N)(82) *supra*. The claimed inductor layout in the '430 patent

is used in RF transceivers on a single semiconductor die (EX1001, 10:31-33), and an exemplary RF frequency referred to in the specification is 4 GHz (EX1001, 8:37). A POSITA would understand that more spacing may be prudent between two terminals to address problems with noise, capacitance, and complexity of conductive traces. X(42) *supra*. As an example, capacitive crosstalk between the interconnect lines on a chip was a problem that engineers had to address. *Id.* A POSITA would have known that signal lines may have to be shielded from each other by putting ground lines between them or by allowing more space to reduce coupling. *Id.*

81. Contrary to Intel's contention, Saitoh would not have provided a POSITA motivation to combine or alter Taniguchi in view of Rostoker to obtain the claimed invention. Like Taniguchi and Rostoker, Saitoh (EX1023) discloses an antenna, not an inductor. And I disagree with Intel that Saitoh indicates that "adjusting the 'number of turns' in a transmitting antenna loop ensures that 'magnetic field intensity is high enough inside the communication zone,' . . . 'decrease[s]' the field 'outside the communication zone,' and helps zero out 'mutual inductance' between the two antennas." Paper 2, p. 64, last paragraph. EX1023, 12:9 – 12:22 indicates only that the number of turns of a loop coil of a transmitting antenna is one of many factors that may influence magnetic field intensity inside and outside of Saitoh's communication zone. And Saitoh does not

indicate that it is the number of turns in a transmitting antenna loop, but indicates that it is the proper determining of the loop diameter of Saitoh's receiving antenna 3 and the position of the receiving antenna relative to the loop coils 2a and 2b of the transmitting antenna, that cause cancellation of the mutual inductance between the receiving antenna 3 and the internal loop coil 2a and the receiving antenna and the external loop coil 2b. *Id.*, 5:4 – 5:11.

N. The Combination of Taniguchi and Brooks Does Not Render Claims 1, 3-5, 7, 10-11, 13-15, 17, and 19 Invalid Under Section 103 (Ground 5)

82. A POSITA would not have been motivated to combine or alter Taniguchi in view of Brooks to obtain the claimed invention at least because Brooks is limited to printed circuit board design and the section (EX1010, p. 157) relied on by Intel teaches forming a “twisted pair of wires” to move two wires closer together to reduce the EMI radiations emitted by the wires. X(42) *supra*. For an inductor layout used in RF transceivers on a single semiconductor die at relatively high frequencies, there are problems with noise, capacitance, and complexity of the conductive traces, such as capacitive crosstalk between the interconnect lines. *Id.* & EX1010, p. 222. Indeed, before the priority date of the ‘430 patent, integrated-circuit technologies typically involved hundreds of layout design rules, including rules about spacing, some designed to reduce crosstalk. As a result, a POSITA would be motivated to increase the distance, not reduce the

distance, between two signal lines to reduce coupling. X(42) *supra* & EX1010, p. 222.

O. The Combination of Taniguchi, Rostoker, and Brooks Does Not Render Claims 2, 8, 11, 13-15, & 17-19 Invalid Under § 103 (Ground 6)

83. Per sections X(42) and X(N)(82) *supra*, Brooks does not show “closely spaced” or “minimizing magnetic field contributions from the terminals,” and, therefore, does not provide these teachings missing from Taniguchi and Rostoker. Consequently, the combination of Taniguchi, Rostoker, and Brooks does not render any of claims 2, 8, 11, 13-16, or 17-19 invalid as obvious.

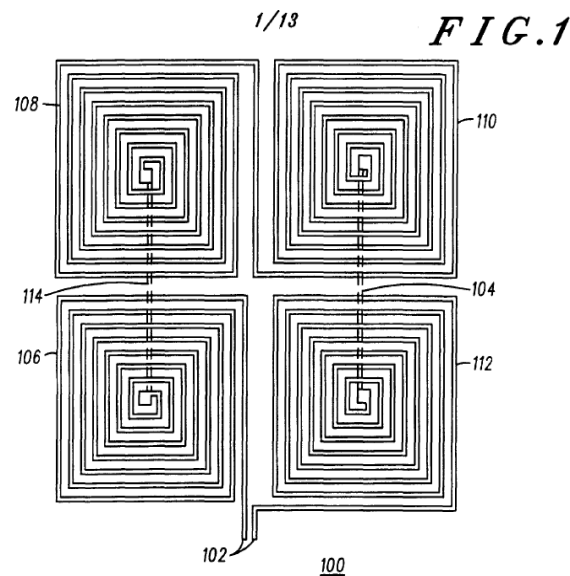
P. The Combination of Midya and Raghavan Does Not Render Claims 1, 3-6,9, 11-16 Invalid Under § 103 (Ground 3)

84. Claim recitations [1B] and [11B] of the ‘430 Patent require “two closely spaced terminals connected to the first loop . . .” and “connecting two closely spaced terminals to the first loop . . .” in claims 1 and 11, respectively. EX1001 at 10:22 & 11:7-8. These limitations in claims 1 and 11 require the two terminals be connected to the same loop. *Id.* But as discussed below, the combination of Midya and Raghavan does not disclose or suggest these claim recitations.

85. EX1007 (Midya WO 98/05048 to Pallab Midya et al. (“Midya”)) is titled “Low Radiation Planar Inductor/Transformer and Method.” Midya relates “generally to inductors and, more particularly, to substantially planar inductors.”

See, EX1007, 1:5-6. Midya was one of about a dozen or so references that were cited on the face of the '430 Patent. EX1001, Foreign Patent Documents.

86. Midya states “there is a need for a method and planar inductor/transformer that maximizes cancellation of a moment of the plurality of loops/spiral conductor coils over a predetermined range.” EX1007, 1:23-26. Unlike the '430 Patent, Midya does not disclose a figure-8 inductor to achieve its stated goals. Although Midya’s FIG. 12 “represents a radiation field pattern for a figure 8 shape” (*id.*, 3:20-22), the actual inductor of Midya’s FIG. 1 (reproduced below) describes a “4-loop single layer planar inductor in accordance with the present invention” (*id.*, 2:6-8).



87. Midya also states that the “present invention provides a planar magnetic field inductor/transformer that has a plurality of at least three planar adjacent loops/spiral conductor coils arranged one after another in a

simple/compound loop fashion.” *Id.*, 7:1-4. Midya makes high-level reference to two terminals (*e.g.*, EX1007 at FIG. 1 item 102 (*see* reproduction of FIG. 1 above)) but does not describe the spacing of the terminals or much else about them. *See, e.g., id.*, 8:8-12, 11:1-16, and 16:1-25.

88. The ‘430 Patent explicitly recites “a second inductor” in claims 1 and 11. EX1001, 10:26 and 11:11. These limitations in claims 1 and 11 require the first and second inductors, which are planar inductors, to be part of the same “inductor layout” in claim 1 and on the same “semiconductor die” in claim 11. EX1001, 10:11 & 10:61-62.

89. Midya fails to disclose the required pair of planar inductors in a layout or on the same semiconductor die. Instead, Midya expressly indicates the so-called “second” inductor is directly above the “first” inductor” on a completely different layer of a printed circuit board: “two layers may [sic] utilized to construct two non-interacting inductors disposed concentrically (FIG. 26, numeral 2600).” EX1007, 11:18-20. (Although Midya mentions in passing a “transformer generally includes at least two windings disposed on top of each other in a semiconductor substrate and separated by an electrically insulating film,” (EX1007, p. 7, lines 15-18) Midya’s detailed examples include inductors on a printed circuit board (EX1007, FIGS. 7, 8, and 10, 13:1-21 and 14:11-16). The dimensions of an inductor on a printed circuit board are typically several orders of magnitude larger

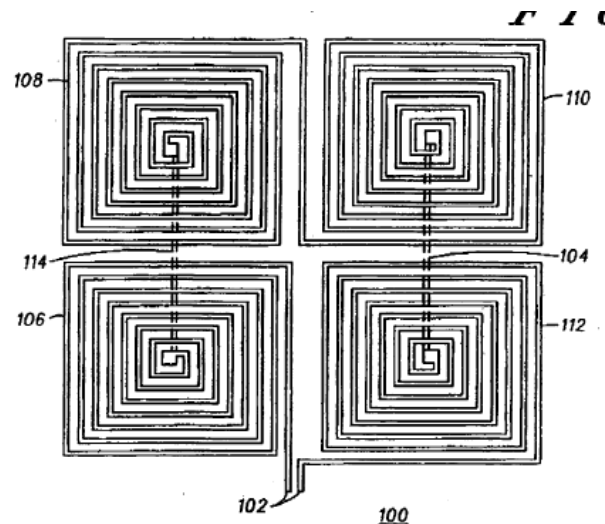
than the dimensions of an inductor on a semiconductor die. A POSITA would understand this “concentric” or “stacked” configuration of inductors on different planes is clearly not within the scope of this claim limitation. Every drawing, table, graph, embodiment, and description in the ‘430 patent specification makes clear that the two inductors must be on the same layer and that the distance measured between them is a lateral distance on the same semiconductor die. *See, e.g.,* EX1001, FIGS. 4-8 and 11-12 and Tables 1-3. A POSITA would not have looked to Midya for ways to position inductors on a semiconductor chip.

90. Before allowing claims 1 and 11 of the ‘430 patent to issue, the examiner considered the Midya reference and determined that the prior art did not teach these limitations. In the Office Action of May 22, 2006 for the ‘430 Patent, where the examiner indicated that the claims corresponding to ‘430 patent claims 1 and 11 were allowable over the prior art, the examiner indicated, “[c]laims 25 and 26 recite, *inter alia*, a second inductor positioned at a distance from the first inductor, wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.” May 22, 2006 Office Action (EX1002), p. 3 ¶ 3. These limitations of independent claims 1 and 11 of the ‘430 patent are neither disclosed nor suggested by Midya.

91. Claims 1 and 11 of the ‘430 patent recite “two closely spaced

terminals connected to the first loop” and “connecting two closely spaced terminals to the first loop,” respectively, which require the two terminals be connected to the same loop. EX1001, 10:23 and 11:7-8.

92. Midya fails to disclose the required two closely spaced terminals connected to the first loop. According to Midya’s description of FIG. 1 (reproduced below), “[t]he inductor has two terminals (102) and has two crossovers (104, 114) that connect the centers of each of the two pairs of spirals.” EX1007, 11:4-6.



93. Each of Midya’s two terminals 102 is connected to a different loop, not the same loop, in the inductor, *i.e.*, one terminal is connected to loop 106 and the other terminal is connected to loop 112. As a result, Midya results in two terminals that are connected to two different loops, not to the same loop, of the inductor as claims 1 and 11 require.

94. Moreover, electrical current is supplied to Midya’s four loops 106,

108, 110, and 112 (Midya's FIG. 1) by a combination of terminals, wires, and crossovers that are spaced far apart and that create an "additional loop," which is what the claim recitations ("two closely spaced terminals connected to the first loop" and "connecting two closely spaced terminals to the first loop,") of claims 1 and 11 of the '430 patent prevents. Still referring to Midya's FIG. 1, electrical current is supplied to adjacent loops 106 and 108 by three long vertical conductive lines, *i.e.*, by crossover 114 in the center of these two loops and by two conductive lines between the set of inductors 106 and 108 and the set of inductors 110 and 112. EX1007 at 11:1-6. Similarly, electrical current is supplied to adjacent loops 110 and 112 by a different group of three long vertical conductive lines, *i.e.*, by crossover 104 in the center of loops 110 and 112 and by two conductive lines to the far right of the set of inductors 110 and 112. *Id.*

95. As a result, Midya shows sets of conductive lines for supplying current to individual loops that are spaced apart by a distance that is comparable in size to the individual loops. *See* EX1007, FIG. 1.

96. Before allowing disclaimed claims 20 and 21 of the '430 patent to issue, the examiner considered the Midya reference and determined that the prior art did not teach these limitations. In the Notice of Allowability, page 2, paragraph 5, PTO Examiner Mai provided "reasons for allowance" of claims 21-22 of the patent application, which correspond to disclaimed claims 20-21 of the '430

patent. According to the examiner, “Claim 21 recites, inter alia, two closely spaced terminals connected to the first loop for supplying electrical current to the first second loops while minimizing magnetic field contributions from the terminals.” These recitations also appear in independent claims 1 and 11 of the ‘430 patent and, as PTO Examiner Mai agreed, are neither disclosed nor suggested by Midya.

97. Furthermore, a POSITA would have been motivated to select planar inductors having a design that is simple, easy to manufacture, used multiple times, small, and capable of being placed together with other components on an IC, not the complex inductors of the ‘430 Patent. The prior-art inductors, whether circular, octagonal, or spiral (*e.g.*, as described in Midya) in geometry, meet these design goals because the design is simple, more compact, more commonly used, and provides the desired inductance with fewer crossings of metal layers. Consequently, these design goals of the prior-art inductors do not meet the design goals of the inductors of the ‘430 Patent as discussed herein.

98. In contrast, the figure-8-shaped inductors described in the ‘430 Patent contain two separate loops and require additional crossings between the conductive segments of the inductor. As a result, the claimed inductors are more complex, harder to manufacture, more expensive, and larger in size. And if the claimed inductors do not provide the same inductance value L and Quality-Factor Q as

prior-art inductors of the same size, their electrical performance would be worse and would be accompanied by undesired power consumption and heating.

99. A POSITA would not have been motivated by Midya (already considered by the examiner) alone, or to combine the teachings of Midya with Raghavan or with any of the other references that Intel used to challenge the claims, to implement the second inductor, much less one oriented in a different direction (dependent claims 4 and 14 of the '430 Patent (EX1001, 10:38-40 and 11:27-29)) for the reasons I discussed *supra*, including but not limited to the fact that it might not make sense. A POSITA would understand that there are many considerations in play when spacing chip components, and including a second inductor oriented in a different direction would not necessarily work in this particular context. And there may be other considerations that come into play that may be more important than the orientation of the inductors *vis a vis* each other.

100. Raghavan, considered in combination with Midya, does not render obvious any challenged claim of the '430 Patent whether considered individually or in any permissible combination with any other prior art reference cited by Intel, including Midya, Gardner, and Brooks, for at least the reasons set forth below.

101. To begin with, Raghavan is typical of the prior art in that the inductors it describes are O-shaped inductors or spiral inductors instead of inductors formed from a pair of loops. *See* EX1008, FIG. 2, FIG. 3, [0002], [0007], and [0008].

Raghavan points out that conventional spiral inductors, such as the inductors shown in the Midya reference relied on by Intel, are asymmetrical and can cause signal degradation. Raghavan states that “[p]lanar spiral inductors . . . have been designed with an intrinsic asymmetry since one terminal of the inductor is at the outside of the spiral, while the other terminal is on the inside. This asymmetry usually does not have any substantial effects on circuits using single- ended signals, *i.e.*, where the signal voltage is relative to ground or a fixed potential. However, many new circuits and systems use differential signals where the signal voltage is the difference between two terminals. Any asymmetry in circuits using differential signals (differential circuits) has the effect of degrading the signal quality, and is thus very undesirable.” EX1008 at [0004].

102. In Raghavan, the configuration and function of the symmetric spiral inductors shown in FIGS. 2 and 3, which inductors are respectively formed from concentric circles or square windings, is completely different from the configuration and function of the inductors claimed in the ‘430 Patent. Raghavan’s spiral inductors have only a single “loop” with circular or square windings that are configured for “eliminating signal degradation due to inductor asymmetry.” EX1008, [0018] and [0021]. There is no mention made of mutual electromagnetic coupling between any two inductors and no attempt is made to reduce the electromagnetic field emanating at a certain distance from one inductor

where a second inductor is positioned.

103. Raghavan teaches a particular design for a spiral inductor without mentioning any “inductor layout” or any configuration of “a first inductor and a second inductor on a semiconductor die.” If a POSITA designed an inductor layout on a semiconductor die using the symmetric spiral inductors shown in FIGS. 2 and 3 of Raghavan (EX1008 at FIGS. 2 & 3), then there would be no reduction in mutual electromagnetic coupling between those inductors.

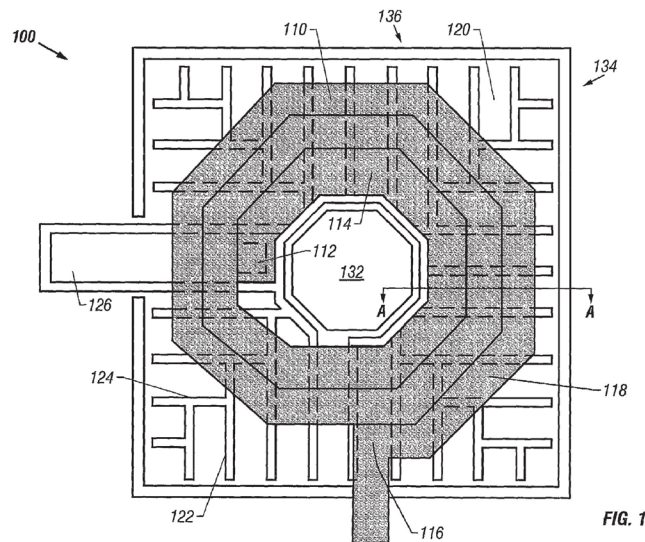
104. For these and other reasons, Intel has failed to demonstrate by clear and convincing evidence that the combination of Midya and Raghavan discloses or renders obvious claim 1 or claim 11 of the ‘430 Patent, any of claims 3-6 and 9, which depend from claim 1, or any of claims 12-16, which depend from claim 11.

Q. The Combination of Midya, Raghavan, and Gardner Does Not Render Claims 2, 11-16 Invalid Under § 103 (Ground 4)

105. I incorporate my prior arguments regarding Midya and Raghavan. X(P) *supra*. Gardner does not disclose or render obvious those elements from the Challenged Claims 2 and 11-16 missing from Midya and Raghavan.

106. Gardner teaches away from connecting two closely spaced terminals to a first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals as recited in claims 1 and 11 of the ‘430 Patent. EX1009, FIG. 1 and [0023]. As shown in Gardner’s FIG. 1 (reproduced below), the only inductor disclosed in Gardner is implemented

by a traditional spiral-shaped conductor 110. *Id.*



107. The terminals and connections for supplying electrical current to this spiral inductor are spaced far apart. *Id.* As shown in Gardner's FIG. 1, one end of the spiral coil corresponding to innermost node 112 is provided with electrical current by a conductive underpass 126 extending to the left of the figure.

Meanwhile, the other end of the spiral coil conductive corresponding to outermost node 116 has a conductive connection that extends to the bottom of the figure.

108. Claim 2 of the '430 Patent depends from independent claim 1. EX1001, 10:32. Claims 12-16 depend from independent claim 11. EX1001, 11:16-12:4. For the reasons set forth above regarding independent claims 1 and 11, combining Gardner with Midya and Raghavan does not render claims 2 and 11-16 obvious.

R. The Combination of Midya and Raghavan and Brooks Does Not Render Claims 1, 3-6, 9, 11-16 Invalid Under § 103 (Ground 7)

109. Intel relies on the addition of Brooks to Ground 3 in an effort to show the “closely spaced” and “minimizing magnetic field contributions from the terminals” limitations. PAPER 2, 104. But as discussed above in Sections X(42), X(M)(80), and X(N)(82) *supra*, Brooks does not show “closely spaced” or “minimizing magnetic field contributions from the terminals,” and, therefore, does not provide these teachings missing from Midya and Raghavan. Consequently, Intel’s proposed combination in Ground 7 fails to correct the deficiencies in Ground 3 for reasons similar to those discussed above in Sections X(42), X(M)(80), and X(N)(82) *supra*.

S. The Combination of Midya, Raghavan, Gardner and Brooks Does Not Render Claims 1, 11-16 Invalid Under § 103 (Ground 8) (Grounds 4, 7, and 8)

110. Intel relies on the addition of Brooks to Ground 4 in an effort to show the “closely spaced terminals” and “minimizing magnetic field contributions from the terminals” recitations in claims 1 and 11 of the ‘430 Patent (Ground 8, PAPER 2, 104). Intel’s proposed combination in Ground 8 fails to correct the deficiencies in Ground 4 as discussed below.

111. I incorporate my prior arguments regarding Midya, Raghavan, and Gardner (Section X(Q) *supra*) and incorporate my prior arguments regarding Brooks. X(42), X(M)(80), & X(N)(82) *supra*. As discussed above in Sections

IX(42), X(M)(80), & X(N)(82) *supra*, Brooks does not show “closely spaced terminals” or “minimizing magnetic field contributions from the terminals,” and, therefore, does not provide these teachings missing from Midya, Raghavan, and Gardner. Consequently, the addition of Brooks to the references (Midya, Raghavan, and Gardner) in Ground 4 (to form Ground 8) fails to correct the deficiencies in Ground 8. *Id.*

In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed July 9, 2024 in Princeton, NJ.


Paul R. Prucnal, Ph.D.

PAUL R. PRUCNAL

Personal Information:

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Citizenship: U.S.

Education:

Ph.D. 1979 Columbia University
M.Phil. 1978 Columbia University
M.S. 1976 Columbia University, Electrical Engineering
A.B. 1974 Bowdoin College, *summa cum laude*

Experience:

1990-Current Princeton University, Professor
1992 Visiting Professor, University of Parma (Sabbatical)
1991 Visiting Professor, RCAST, University of Tokyo (Sabbatical)
1989-1991 New Jersey Advanced Technology Center for Photonics and
Optoelectronic Materials, Founding Director
1988-1990 Princeton University, Associate Professor
1984-1988 Columbia University, Associate Professor
1979-1984 Columbia University, Assistant Professor

Consulting:

- Phillips Laboratories (1979-1981)
- Optical Information Systems, Inc (1982)
- GTE Labs (1983-1984)
- AT&T Bell Laboratories (1985-1986)
- IBM (1987-1988)
- Dove Electronics (1987-1989)
- Siemens Corporate Research (1992-1995)
- Center for Computing Sciences (1996-Present)
- Sun Microsystems (1998-2001)
- SAIC (1999-2000)
- Multi Link Technologies, Inc. (1999-2002)
- Alphion, Inc. (2000-Present)
- Ultra Fast Optical Systems (2000-2002)
- Kailight Inc. (2003-2006)
- NEC Laboratories (2004-2011, 2020-present)
- Princeton Optronics (2005-2006)
- Access Optical Networks (2010-2018)
- Bascom Hunter Technologies (2010-present)
- Luminous Computing (2019-present)

Current Research Activities (experimental and theoretical): Optical networks, photonic switching, optical signal processing, RF photonics, optical interconnects, silicon photonics, neuromorphic photonics.

Honors:**Invited Plenary Speaker**

- 9th International Conference on Computer Communications, Tel Aviv, October 1988
- Topical Meeting on Photonic Switching, Salt Lake City, March 1989
- Congreso de Informatica y Telecomunicaciones, Berisso, Argentina, April 1989
- IEEE Communications Society Local Chapter Talks, 1989
- IEEE International Conference on Communications, Atlanta, April 1990
- LEOS Annual Meeting, Boston, November 5, 1990
- IEEE Computer Communications Workshop, October 1992
- IEEE Optical Fiber Communications Conference, February 1993
- OSA Optical Computing Topical Meeting, March 1993
- IEEEOSA Topical Meeting on Photonic Switching, March 1993
- IEEE LEOS Conference, November 1993
- Rank Prize Symposium, April 1994
- Workshop on Massively Parallel Processing using Optical Interconnects, April 1994
- Keynote Address, Viva a Ciencia, Symposium commemorating the 25th Anniversary of Submarine Cables in Portugal, October 1994
- IEEE Optical Fiber Communication Conference, February 1995
- European Fiber Optic Communication & Networking Conference, June 1995
- IEEE LEOS Conference, October 1995
- IEEE LEOS Conference, October 1996
- IEEE Computer Society, May 1996
- ECOC, September 1997
- IEEE LEOS, November 1997
- Sarnoff Symposium, March, 1998
- Rank Prize Symposium, April 1998
- ECOC, September 1998
- XIth Slovak/Czech/Polish Optical Conference on Wave and Quantum Aspects of Contemporary Optics, September 1998
- American Physical Society Annual Meeting, invited tutorial, March 2000
- American Physical Society Annual Meeting, Minneapolis, MN, March 2000
- CLEO/PR-2001, Makahuri Messe, Chiba, Japan, June 2001
- OSA Topical Meeting-Integrated Photonics Research, Vancouver, Canada, July 2002
- WOCC 2002, Newark, NJ, April 2002
- Photonics Prague 2002, Prague, Czech Republic, May 2002
- Europe-U.S.-Japan Symposium on Ultrafast Photonic Technology, Chiba, Japan, July 2003
- ECS'03 Bratislava, Slovakia, September 2003
- IEEE Photonics in Switching Topical Meeting, Versailles France, September, 2003

- "From Smoke Signals to All-Optical Communications," Given at University of Žilina, Žilina, Slovakia, October 24, 2005
- "RF Photonics," DSA, Holmdel, NJ, February 22, 2005
- "Reconfigurable universal transceivers," U.S. Army Communications Electronics Command, Fort Monmouth, NJ, March 11, 2005
- "All-optical signal processing; Progress and applications," Distinguished speaker seminar series, University of Arizona, Tucson, AZ, April 15, 2005
- "Reconfigurable, asynchronous, incoherent optical CDMA networks," O-CDMA PI Review, Key West, FL, May 2, 2005
- "All-optical signal processing; Progress and applications," Center for Communications Research, Princeton, NJ, May 18, 2005
- Plenary Lecture, "All-optical signal processing: Progress and applications," Ninth Canadian Workshop on Information Theory, McGill University, Montreal, June 6, 2005
- "Flexible access techniques for fiber-to-the-home," O-CDMA systems Workshop, Key West, FL, May 3-4, 2005
- "Advanced technology for next-generation networks," NJ Legislative Caucus on Science and Technology: Shaping New Jersey's Telecommunication Future, Princeton, May 20, 2005
- "All-optical signal processing: Progress and applications," Center for Computing Sciences, Bowie, MD, June 30, 2005.
- "Advanced optical signal processing techniques for communications and computing," NEC, Tamagawa Labs, Tokyo, August 24, 2005
- "All-optical signal processing: Challenges and applications," Tokyo University, August 25, 2005
- "All-optical signal processing: Challenges and applications," Chinese University of Hong Kong, August 26, 2005
- "All-optical signal processing: Challenges and applications," Tsinghua University, Beijing, August 31, 2005
- "All-optical signal processing: Challenges and applications," The Cooper Union, New York City, December 13, 2005
- Keynote Speaker at PRISM/NJCST Summit, May 20, 2005
- "Design of an avionics platform for Lockheed-Martin based on incoherent optical CDMA," Sarnoff Symposium, Princeton, NJ, March 27-28, 2006
- "How optics has changed data communications," 15th Czech-Slovak-Polish Optical Conference on Wave and Quantum Aspects of Contemporary Optics. Liberec, Czech Republic, September 11-15, 2006
- "The roll of optics in optical communications," 15th Czech-Slovak-Polish Optical Conference on Wave and Quantum Aspects of Contemporary Optics. Liberec, Czech Republic, September 11-15, 2006
- "OCDMA-an alternative for optical communications?" Optical Communications, OK 2005, Prague, Czech Republic, September 20-21, 2005
- "Is optical CDMA viable technique for broadband networks?," Photonics Prague 2005, Prague, Czech Republic, June 8-11, 2005
- "Reconfigurable asynchronous incoherent OCDMA", PI annual meeting, Chicago, IL August 2006

- Workshop on Optical and Wireless Communications Technologies & *"Princeton testbed for optical and wireless communications"*, PRISM – University-Industry Research Symposium, Princeton University, February 3, 2006
- Seminar of *"Effective Teaching Methods"*, McGraw Center, Princeton University, March 15, 2006
- *"All-Optical Signal Processing: Challenges and Applications"*, Universita Komenskeho, Bratislava, May 31, 2006
- All-Optical Signal Processing: Technologies for Network Applications, Polytechnic University, New York, NY, November 30, 2006
- All-Optical Signal Processing: Technologies for Network Applications, Globecom Access '06 Business Forum, San Francisco, November 29, 2006
- Concordia University, Montreal, Canada, 5th Workshop on Optimization of Optical Networks, May 8, 2008
- Princeton, NJ Workshop on Modeling and Analysis of Computer and Communication Networks, May 9, 2008
- Santa Fe, NM 2008 Workshop on Interconnections within High Speed Digital Systems. May 18-21, 2008
- Lockheed Martin, Cherry Hill, NJ Seminar presentation and research presentation. July 11, 2008
- St. Thomas, US Virgin Islands ICCCN 2008 August 3, 2008
- Baltimore, MD MIRTHE Summer Workshop, August 5, 2008
- College Park, MD Research seminar at Laboratory for Physical Sciences. October 1, 2008
- "Truly-Asynchronous, Scalable and Survivable Optical CDMA Networks with Heterogeneous QoS," at the 2009 IEEE Lasers and Electro-Optics Society Summer Topical Meeting (LEOS), Newport Beach, CA, USA, July 20-22, 2009
- "Physical layer network security based on optical processing using compact passive devices," OECC 2009, Hong Kong, July 2009.
- Invited panel member, "Quality of Service Performance and Switching Implementation in Optical Networks," at AH-ICI2009, November 2009.
- "Undergraduate Studies and Research in Electrical Engineering at Princeton," at The Lincoln School, Kathmandu, Nepal, November 2009.
- "Physical Layer Security in Data Networks using Optical Signal Processing," 2009 ACP, Shanghai, China, November 2009.
- *"Photonic Neurons for Terahertz Pulse Processing,"* 9th International Conference on Optical Communications and Networks (ICOON 2010), Nanjing, China, October 24-27, 2010.
- *"Ultrafast optical processing and information security,"* L3 Communications Telemetry East, Bristol, PA, February 23, 2011.
- *"Ultrafast optical processing and information security,"* IEEE World Wide Security and Mobility Conference (WWSMC 2011), Princeton, NJ, July 27, 2011.
- *"Fiber optic networks technology tutorial,"* Center for Communication Research, La Jolla, CA, August 9, 2011.

- *"Lightwave neuromorphic signal processing,"* University of Delaware, Newark, DE, October 25, 2011.
- School of Engineering and Applied Science, Leadership Council Speaker, April 5, 2012.
- *"Using technology to protect our information infrastructure,"* The Lotus Club, April 27, 2012.
- *"Photonic Neuromorphic Signal Processing and Computing,"* 2012 International Workshop on Information Physics and Computing in Nano-scale Photonics and Materials (IPCN), Orleans, France, September 7, 2012.
- *"Photonic neuromorphic spike processor for ultrafast and low energy cognitive computing,"* Bell Labs/Alcatel-Lucent Green ICT Summit, Murray Hill, NJ, USA, January 2013.
- *"Photonic neuromorphic spike processing for ultrafast cognitive computing,"* IEEE North Jersey Section Computer Chapter and Signal Processing Chapter, Teaneck, NJ, USA, September 2013.
- *"Integrated photonic spike processing,"* Sandia Labs Beyond Moore Device Physics Workshop, Albuquerque, NM, USA, January 2014.
- *"Photonic spike processing,"* Neuro-Inspired Computational Elements Workshop, Albuquerque, NM, USA, February 2014.
- *"Lightwave neuromorphic processing,"* AFCEA C4I Technology Review Days, Utica, NY, USA, June 2014.
- European Conference Optical Communication (ECOC), Rome, Italy, September, 2018.
- European Conference Optical Communication (ECOC), Brussels, Belgium, December 6, 2020.
- *"Photonics for Neuromorphic Computing,"* 2021 IEEE Photonics Conference (IPC, formerly the IEEE LEOS Annual Meeting), Vancouver, Canada October 19, 2021. Virtual.
- *"Silicon Neuromorphic Photonics,"* 26th OptoElectronics and Communications Conference (OECC), Hong Kong, (July, 2021). Virtual.
- *"Photonics for Neuromorphic Computing,"* 24th European Conference on Integrated Optics, Milan, Italy, May 4, 2022.
- *"Photonics for Neuromorphic Computing,"* Rank Prize Symposium, Windermere, UK, Feb 2023
- *"Photonics for Neuromorphic Computing"* Photonics and Electromagnetics Research Symposium, The Prague Congress Centre, Prague, Czech Republic, July, 2023
- *"Photonics for Neuromorphic Computing,"* 2023 Artificial Intelligence Photonics Conference, San Sebastián, Spain, Sept. 2023

Professional Societies:

- Fellow of the IEEE (January, 1992)
- Fellow of the OSA (February, 1997)
- Fellow of the National Academy of Inventors (December, 2017)

Academic Societies and Awards:

- Phi Beta Kappa (Alpha of Maine Chapter, 1973)
- Citation for Outstanding Achievement, School of Engineering and Applied Science, Columbia University 1976)
- Eta Kappa Nu (Gamma Lambda Chapter, 1978)
- Sigma Xi (Kappa Chapter, 1979)

- Rudolf Kingslake Medal and Prize, SPIE, for the most noteworthy original paper in Optical Engineering, 1990
- Gold Medal Award from the Faculty of Mathematics, Physics and Informatics at the Comenius University, for leadership in the field of Optics 2006
- Princeton University Graduate Mentoring Award 2006
- E-Council Excellence in Teaching for ELE 203 Fall 2006
- E-Council Excellence in Teaching for ELE 454 Spring 2008
- Walter Curtis Johnson Prize for Teaching Excellence June 2009
- School of Engineering and Applied Science Distinguished Teacher Award, June 1, 2009
- Awards for undergraduate research in my lab:
 - Bryan Bosworth '09 received the Peter Mark Prize from the EE Department at Class Day, June 2009, for the "best undergraduate research" in the area of electronic materials and devices.
 - John Chang '10, J. Rich Steers Award from the New York City Post of the Society of American Military Engineers, December 2009
- Honored by Shirley Tilghman at the event "Celebrate Princeton Invention"
- CNSA selected by the National Security Agency as a "Center of Excellence in Research in Information Assurance." The award was presented in June at the NSA by Howard Schmidt, Obama's Cybersecurity Coordinator. This honor has just been highlighted in the news on the Princeton University webpage.
<http://www.princeton.edu/main/news/archive/S29/01/99S63/index.xml?section=topstories>
- Awards for research in my lab:
 - John Chang, Graduate advisee, J. Rich Steers Award, February 5, 2010
 - Bhavin Shastri, PostDoc, IEEE Photonics Society 2011 Fellowship
 - Vinayak Venkataraman '11, recipient of 2011 John Ogden Bigelow Jr. Prize in Electrical Engineering
 - Mary Catherine Wen '11, recipient of 2011 Newport Research Undergraduate Award for Excellence in Photonics
- "Princeton named cyber security hub by National Security Agency," News at Princeton, November 22, 2010 and SEAS website, December 6, 2010
- "Fiber-optic photonic neurons to be developed in collaboration between Princeton University and Lockheed Martin," Laser Focus World Magazine, July 20, 2011
- "Photonic neuron may compute a billion times faster than brain circuits," Princeton University website, News at Princeton, July 18, 2011
- "For students, blazing fast lab work," Princeton Alumni Weekly Magazine, September 14, 2011, Vol. 112, No. 1
- 2012 Honoree, The Lotos Club, New York City
- Lifetime Achievement Award for Excellence in Teaching, awarded by the Princeton Engineering Council 2015
- The President's Award for Distinguished Teaching 2015
- Featured on November 18, 2016 in the MIT Technology Review, in an article titled "Silicon photonic neural network unveiled."
 Ref: arxiv.org/abs/1611.02272: Neuromorphic Silicon Photonics
- Awards for research in my lab:

- Lamia Ateshian: 2018 Optical Engineering Award, Princeton
- Alexander Tait: 2017 IEEE Photonics Society Graduate Student Fellowship
- Matthew Chang: 2016 CLEO pitch panel winner
- Alexander Tait: 2016 SEAS award for excellence
- Alexander Tait: 2016 IEEE Summer Topical Meeting Series Best Student Poster Award (first place).
- Mitchell Nahmias: 2015 IEEE Summer Topical Meeting Series Best Student Poster Award (first place).
- National Academy of Inventors (NAI) Fellow, December 2017.

Patents:

	Patent Number	Issue Date	Title
1.	US 4,744,623	05/17/1988	Integrated fiber optic coupler for VHSIC/VLSI interconnects
2.	US 4,791,407	12/13/1988	Alternate mark/space inversion line code
3.	US 4,887,879	12/19/1989	Fiber optic tap
4.	US 5,060,305	10/22/1991	Self clocked, self routed photonic switch
5.	US 5,073,980	12/17/1991	Photonic Switch employing Shared data Transmission Facility
6.	US 5,493,433	02/20/1996	Terahertz Optical Asymmetric Demultiplexer
7.	US 5,825,519	10/20/1998	Optical Mach-Zehnder Time Division Demultiplexer
8.	US 5,828,474	10/27/1998	Optical Apparatus for Transmitting Data of an Electrical Signal
9.	US 5,841,560	11/24/1998	System for Optical Pulse Train Compression and Packet Generation
10.	US 5,917,979	06/29/1999	Asymmetric Optical Loop Mirror Exhibiting Threshold Discrimination for Separation of Input Pulses of Differing Magnitudes
11.	US 6,265,999	07/24/2001	High Speed Serial-to-Parallel Analog-to-Digital Conversion
12.	US 6,433,715 B2	08/13/2002	High-Speed Serial-To-Parallel and Analog-to-Digital Conversion
13.	US 6,448,913	09/10/2002	Toad Based Optical Data Format Converter
14.	US 6,535,662	03/18/2003	TOAD Having Enhanced Extinction Ratio of the Switching Window
15.	US 7,035,550	04/25/2006	All Optical 3R Regeneration using the Sagnac and Mach-Zehnder Versions of the Terahertz Optical Asymmetric Interferometer (TOAD)

16.	US 7,068,894	06/27/2006	An All-Optical Wavelength Converter Based on Sagnac Interferometer with an SOA at Asymmetric Position
17.	US 8,315,489	11/20/2012	Optical Sensor Array (AON)
18.	US 8,456,730	06/04/2013	Directly modulated spatial light modulator (AON)
19.	Israel 173226	03/01/2014	All-Optical Wavelength Converter based on Sagnac Interferometer with an SOA at Asymmetric Position
20.	US 8,682,170	03/25/2014	System and Method for Broadband RF Interference Cancellation
21.	US 8,693,810	04/08/2014	Optical Counter-Phase System and Method of RF Interference Cancellation
22.	US 8,749,874	06/10/2014	Optical Integration System and Method
23.	US 8,917,960 B2	12/23/2014	Optical Switch Using a Michelson Interferometer
24.	US 9,344,125	05/17/2016	Remote Interference Cancellation for Communications Systems (Bascom Hunter)
25.	US 9,444,502	09/13/2016	Interference Cancellation System for Cancelling Interference in the Optical Domain (Bascom Hunter)
26.	US 9,571,205	02/14/2017	Systems Approach to Interference Cancellation
27.	US 9,838,125 B2	12/05/2017	Multibeam Radio Frequency Photonic Beamformer Using a Multi-Signal Slow Light Time Delay Unit
28.	US 10,009,135	06/26/2018	System and Method for Photonic Processing
29.	Filed US 62/664,386	4/30/2018	Design of High Channel Count Two-Pole Photonic Microring Weight Banks
30.	Filed US 62/663,057	4/26/2018	Excitable Laser Processor in a III-V Photonic Integrated Circuit Platform
31.	Filed US 62/647,393	3/23/2018	Photonic Tensor Machine
32.	Filed US 62/669,097	5/9/2018	Photonic Circuit Total Laboratory Automation, Data Management and Virtualization
33.	Filed US 62/667,058	5/4/2018	Method for Linear Analog Photonic Processing Using Mode Filters
34.	Filed US 62/719,516	8/17/2018	Feedback Control for Microring Weight Banks
35.	Filed US 62/690,393	6/27/2018	Optically Accelerated FPGA
36.	Filed US 62/690,425	6/27/2018	Nonlinear Remodulation Unit with Electronic Amplification

37.	Filed US 62/949,912	12/18/2019	Organic Light-Emitting Diode Neuron
38.	US 10,670,860	06/02/2020	Design of High Channel Count Two-Pole Photonic Microring Weight Banks
39.	Filed US 63/045,660	06/29/2020	Integrated Neuromorphic Computing System
40.	Filed US 63/045,720	06/29/2020	Thin Film Neuromorphic Computing System
41.	Filed US 17/125,287	12/17/2020	Light-Emitting Diode Neuron
42.	Filed US 17/360,155	06/28/2021	Integrated Neuromorphic Computing System
43.	Filed US 63/237,223	08/26/2021	Real-time RF fingerprinting using continuous- time recurrent neural network algorithm on FPGA
44.	US 11,187,963	11/30/2021	System and method for programmable nonlinear silicon photonic circuit
45.	US 11,269,179	3/8/2022	Photonic Filter Bank System and Method of Use
46.	Filed US 63/318,968	3/11/2022	Neuromorphic Opto-Electronic System
47.	Filed US 63/318,957	3/11/2022	Reconfigurable Thin-Film Photonic Filter Banks
48.	Filed US 17/896,251	8/26/2022	System and Method for Real-time RF Fingerprinting
49.	Filed US 63/374,655	9/6/2022	In-Plane Convolutional Preprocessor
50.	Filed US 63/374,661	9/6/2022	Multiplane Hardware Neural Network
51.	Filed US 18/050,539	10/28/2022	Reconfigurable Thin-Film Photonic Filter Banks for Neuromorphic Optoelectronic Systems and Methods
52.	Filed 10-2022-0153376	11/16/2022	Reconfigurable Thin-Film Photonic Filter Banks for Neuromorphic Optoelectronic Systems and Methods
53.	Filed US 20230157061 A1	05/01/2023	Reconfigurable thin-film photonic filter banks for neuromorphic opto-electronic systems and methods

- | | | | |
|-----|------------------------|-----------|---|
| 54. | Filed
US 63/508,074 | 6/14/2023 | Light Emitting Device, System, and Method |
| 55. | Filed
US 63/374,661 | 9/06/2023 | Multiplane Hardware Neural Network |
| 56. | Filed
US 18/461,801 | 9/06/2023 | In-Plane Convolutional Preprocessor |

Professional Activities: Associate Editor:

- IEEE Transaction on Communications, Area Editor, 1996 – present
- Proceedings of the IEEE, Review Editor, 1982-1985
- IEEE Circuits and Devices Magazine, 1988-1991
- IEEE Transactions on Communications, 1988-1996
- IEEE Lightwave Communications Magazine, 1989-1991
- Applied Optics, 1989-1994
- IEEE Networks Magazine, Special Issue on “Optical Multi-access Networks,” 3, No. 2, March 1989 (Guest editor)
- Photonics Technology Letters, 1990-1991
- Photonic Network Communications, Kluwer Academic Publishers, Nowell, MA (Prof. Harmen R. van As, Vienna University of Technology, Editor), Editorial Advisory Board, 1996-
- Optical Fiber Technology, (Dr. Emmanuel Desurvire, Alcatel, Editor), Editorial Advisory Board, 1998-
- Journal of Lightwave Technology, Special Issue on "Photonic Packet Switching Technologies, Techniques and Systems", vol. 16, no. 12, December 1998, Guest Editor
- IEEE Journal of Selected Topics in Quantum Electronics, Primary Guest Editor, 2018

Program Committees:

- IEEE/OSA Conference on Optical Fiber Communication, 1988
- IEEE/OSA Topical Meeting on Photonic Switching, 1989
- IEEE/OSA Conference on Lasers and Electro-optics, Subcommittee on Lightwave Communications, 1989
- IEEE/OSA Conference on Lasers and Electro-optics, Subcommittee on Optical Switching, Logic and Storage Systems, 1991
- IEEE/OSA Topical Meeting on Photonic Switching, 1991
- IEEE Princeton Section, Sarnoff Symposium, 1991
- OSA Regional Engineering Workshop, October 1991
- IEEE/OSA Topical Meeting on Optical Computing, 1993
- IEEE/OSA Topical Meeting on Photonics in Switching, 1993
- SPIE Conference on Multigigabit fiber communication systems, 1993
- IEEE (Princeton Section) Sarnoff Symposium, 1994
- IEEE/OSA Topical Meeting on Integrated Photonics Research, 1994
- IEEE Workshop on Massively Parallel Processing using Optical Interconnections, 1994
- ECOC'94, Photonics in Switching Joint Sessions, 1994
- ECOC'94, Florence, Italy, September 1994
- IEEE/OSA Integrated Photonics Research Topical Meeting, 1994
- IEEE/OSA MPPOI, 1995
- IEEE Princeton Central NJ Sarnoff Symposium, 1995
- IEEE/OSA Conference on Lasers and Electro optics, Subcommittee on Optical Switching, Logic and Storage Systems, 1995
- IEEE/OSA Topical Meeting on Photonic Switching, 1995
- IEEE/OSA Conference on Lasers and Electro optics, Subcommittee on Optical Switching, Logic and Storage Systems, 1996
- IEEE/OSA MPPOI, 1996
- IEEE/OSA MPPOI, 1998
- IEEE/OSA Conference on Optical Fiber Communication, 2000
- International Program Committee, IASTED international Conference on Communication, Internet and Information Technology, St. Thomas, USVI November 2006
- Organizer of upcoming PRISM/Complex Materials Center Workshop on "Optical and Wireless Communications"
- Optical Fiber Communications 2009
- 2010 IEEE Optical Fiber Communication and National Fiber Optic Engineers Conference (OFC/NFOEC), San Diego, CA, USA, March 21- 25, 2010.
- Summer Topical Meeting on Terabit Optical Ethernet, Hilton Montreal Bonaventure, Montreal, Quebec, Canada, 18-20 July 2011.
- Second Asian Himalayan International Conference on the Internet and Next Generation of Mobile, Wireless and Optical Communication Networks, 2011.

- International Program Committee, International Conference on Communication, Internet, and Information Technology (CIIT 2012).
- Advisory and program committee on Information Physics and Computing in Nanoscale Photonics and Materials Workshop in 2012 Unconventional Computation and Natural Computation Conference
- Technical committee for ICSPCS 2016 (2016 10th International Conference on Signal Processing and Communication Systems - ICSPCS)
- 2019 IEEE Summer Topical, Committee, Fort Lauderdale, Florida, 8-10 July, 2019

Conference or Subcommittee Chair:

- IEEE Summer Topical Meeting on Optical Multiple Access Networks, July 1990, Technical Co-chair
- IEEE/OSA Conference on Lasers and Electrooptics, Technical Subcommittee on Optical Switching, Logic and Storage Systems, 1992
- IEEE/OSA Conference on Lasers and Electrooptics, Technical Subcommittee on Optical Switching, Logic and Storage Systems, 1993
- IEEE Globecom'93, Session 51 on "Optical communication network systems"
- SPIE Conference on High-Speed Optical Switching, Devices, Networks and Systems, Los Angeles, January 1994
- IEEE/OSA Photonics in Switching Topical Meeting, Sendai, Japan, North American Conference Chair, April 1996
- OSA Photonics in Switching Topical Meeting, Stockholm, Sweden, Conference Program Chair, March 1997
- OSA Photonics in Switching Topical Meeting, Santa Barbara, Conference General Chair, July 1999. Organizer and General Chair, "O-CDMA Systems Workshop" Key West, FL May 3-4, 2005
- CLEO/Europe-EQEC, Co-organizer of Joint Symposium, Munich, Germany, 23-27, June 2019
- European Conference Optical Communication (ECOC), Brussels, Belgium, Workshop Organizer and Co-Chair, "Pathway to bringing photonics into high-performance computing: from materials to applications," December 2020.

Conference Session President:

- 1996 Conference on Information Sciences and Systems, Session FP-2 "Optical Networks"
- The 3rd International Conference on Massively Parallel Processing "Using Optical Interconnects, Session III, "WDM in MPP Systems"
- Conference on Information Sciences and Systems, Session on "Optical Communications," Princeton, March 1988, 1994
- IEEE Workshop on Computer Communications, "Optical Networks and Photonic Switching," Harriman, September 1988

- IEEE/OSA Topical Meeting on Photonic Switching, Session on "Packet Switching," Salt Lake City, March 1989
- IEEE Communication Theory Workshop, Session on "Optical communication," Hawk's Cay, April 1989
- IEEE/OSA Conference on Lasers and Electro-optics, Session on "Optical multi-access techniques for multiuser communication systems," 1989
- International Workshop on Digital Communications, Session on "Optical multiaccess networks," Tirrenia, Italy, September 1989
- IEEE/OSA Topical Meeting on Photonic Switching, Session on Logic and Control, Salt Lake City, UT, March 1991
- OSA Annual Meeting, Session on "Integrated and Guided-Wave Optics," Boston, MA, November 1990
- IEEE Princeton Section Sarnoff Symposium, Session on Optoelectronic Systems Applications, 1991
- LEOS Summer Topic Meeting on Optical Multiple Access Networks, Session on "Packet Switching," 1992
- Conference on Information Sciences and Systems, Session TA-1 on "Optical Communications," Princeton, March 1994
- IEEE Workshop on Massively Parallel Processing using Optical Interconnections, Session III, 1994
- Sarnoff Symposium, Session on "Novel optical systems," April, 1995
- 32nd Annual Conference on Information Sciences and Systems, Session Chair, March, 1998

Boards, Committees, Review Panels:

- Columbia Radiation Laboratory, 1979-1988
- Columbia Bioengineering Institute, 1979-1988
- NSF Review Panel on Optical Communications, March 1987
- 9th International Conference on Computer Communications, Plenary Session, Tel Aviv, (October, 1988)
- Executive Board, NSF Engineering Research Center in Telecommunications, 1985-1988
- NSF Review Panel, "Research Experiences for Undergraduates Program," January 9-10, 1989
- Board of Directors, Edwin H. Armstrong Foundation, 1982-
- LEOS Steering Committee, Optical Switching and Processing, 1990-1995
- President's Committee on U.S.-Japan Joint Opto-Electronics Fabrication Project 1981
- NSF Panel on Optical Networks, January 1993
- IEEE LEOS Standing Technical Committee on Optical Communications, 1994
- External Review Panel, Fiber Optic Signal Processing for EWRadar Applications Naval Research Lab 6 Basic Research Program, Washington, DC. December 8, 1995
- IEEE LEOS Standing Technical Committee on "Optical interconnects and processing systems," 1995-1996

- POEM Executive Committee, 1991-
- Scientific Advisory Board, Epitaxial Lab Inc., Stony Brook, NY; Jie Piao, Pres., 1995-
- Scientific Advisory Board, Institute for Defense Analysis, Center for Computing Sciences, 1996-
- Editorial Board, "Photonic Network Communications Journal, Kluwer Academic Publishers, 1996-
- IEEE MPPOL'96 Panelist, "Intrasystem optical interconnects: performance, cost, functionality."
- Research Group for Optical Soliton Communications (ROSC, Japan), Foreign member, 1997-
- Executive Council, University League Nursery School 1995-1998 (Treasurer)
- Trustee, University League Nursery School, 1998-
- Board of Directors (President), Glen Homeowners Association, 1995
- Technical Advisory Boards: Alphion, Kailight Photonics, and Access Optical Networks, Inc.
- School of Engineering and Applied Science: Helen Shipley Hunt fund selection committee, 2012
- Princeton University Schmidt Fund Selection Committee, 2011-2012
- Chair of Princeton University Schmidt fund selection committee, 2012- 2013
- Princeton University Committee of Seven, 2013
- Princeton University Dean of the Faculty's Committee on Online Education, 2012-2013
- Princeton University Committee on Undergraduate Admission and Financial Aid, 2013-2016
- Natural Sciences and Engineering Research Council of Canada – Reviewer 2016
- Bascom Hunter Technologies, Board of Directors, 2018-present
- Access Optical Networks, Advisor, 2018-20
- Luminous Computing, Advisor, 2019-20
- Princeton University Writing Program Executive Committee, 2012-present
- Princeton University Committee on Intellectual Property and Technology Licensing, 2011-present
- Princeton University Phi Beta Kappa Committee, 2012-present
- Princeton University School of Engineering and Applied Sciences Director of the PRISM Center for Network Science and Applications, 2021-present
- Princeton University School of Engineering and Applied Sciences Andlinger Center, Associated Faculty Member 2021-present
- Princeton ECE Faculty representative to IEEE Student Chapter, 2021-present
- Princeton ECE Graduate Committee, 2021-present
- Princeton ECE OPT Faculty Coordinator, 2021-present
- Princeton ECE Sophomore Advisor, 2021-present

- Princeton ECE Junior Advisor, 2022-present
- Princeton ECE Senior Advisor, 2023

Professional Societies:

- IEEE (Student '75, Member '78, Senior Member '90, Fellow '92)
- Optical Society of America, Fellow 1997; SPIE
- National Academy of Inventors, Fellow, 2017

Vice Chairman:

- Princeton LEOS Chapter, 1990-1991

Papers in conference proceedings based on peer review:

1. Prucnal, P.R. (1980), "A new generalized performance measure for single-threshold optical communication systems," in Opt. Comm. Sys., Proceeding of the NSF Grantee-User Meeting on Optical Communication Systems, pp. 27-33.
2. Prucnal, P.R. (1981), "Detection and estimation in signal-dependent noise," in Opt. Comm. Sys., Proceeding of the NSF Grantee-User Meeting on Optical Communication Systems, pp. 103-108.
3. Prucnal, P.R. (1982), "Wideband FSK optical communications experiment," in Opt. Comm. Sys., Proceeding of the NSF Grantee-User Meeting on Optical Communication Systems, pp. 58-61.
4. Prucnal, P.R. and Fan, T.R. (1983), "Frequency-shift-key modulation for fiber-optic communication," in Opt. Comm. Sys., Proceeding of the NSF Grantee-User Meeting on Optical Communication Systems, pp. 79-86.
5. Prucnal, P.R., Santoro, M.A. and Lockwood, T. (1985), "Spread spectrum local area network using optical processing," Proceeding International Tirrenia Workshop on Digital Commun., 5.2.
6. Prucnal, P.R., Fossum, E.R. and Osgood, R.M. (1986), "Integrated fiber optic coupler for VLSI interconnects," Proceeding Soc. Photoopt. Inst. Eng., 625, pp. 154-158.
7. Prucnal, P.R. (1986), "VLSI fiber optic LAN," Proceeding Int. Opt. Comp. Conference, 700, pp. 230-238.
8. Prucnal, P.R. (1986), "All-optical ultra-fast networks," SPIE Proceeding Fiber Telecomm. and Comp. Net., 715, pp. 42-47.
9. Prucnal, P.R. (1986), "VLSI optical interconnection networks," SPIE Proceeding Integ. And Pack. Of Optoelec. Dev., 703, pp. 106-115.
10. Prucnal, P.R. (1986), "Spread spectrum fiber-optic LANs," Proceeding FOCLAN 86, pp. 101-108.
11. Aide, R.W., Harstead, E.E., Cacouris, T., Fossum, E.R., Prucnal, P.R., and Osgood, R.M. (1986), "Direct connection of optical fibers to integrated circuits," Proceeding Internat. Elect. Packaging Soc.
12. Prucnal, P.R., Blumenthal, D., Perrier, P.A. (1987), "Self-routing optical switch with optical processing," Topical Meeting on Photonic Switching, Tech. Digest Series, 13, (Optical Society of America, Washington, DC), pp. 42-44.
13. Prucnal, P.R. (1987), "All-optical micro-area networks," Proceeding International Work. On High-Speed Opt. Processes and Opto-elect. Dev. Based on Compound Semicond. E5.

14. Prucnal, P.R. (1987), "All-optical integrated circuit micro-area network," Proceeding 95th Amer. Soc. Eng. Educ. Annual Conference, p. 85.
15. Blumenthal, D.J., Prucnal, P.R., Thylen, L. and Granestrand, P. (1988), "Self-routing of 12.5 Gbps data through an 8x8 lithium niobate optical cross bar matrix with gigahertz switching speed," Opt. Fiber Communic. Conference, Tech. Digest, 1, (Optical Society of America, Washington, DC), p. 183.
16. Harstead, E.H., Elby, S.D. and Prucnal, P.R. (1988), "Low-loss high- impedance integrated fiber-optic tap," Opt. Fiber Communic. Conference, Tech. Digest, 1, (Optical Society of America, Washington, DC), p. 161.
17. Perrier, P.A. and Prucnal, P.R. (1988), "Optical self-routing of 12.5 Gbps time-division-multiplexed data," Conference on Lasers and Electroopt. Tech. Digest Series, 7 (Optical Society of America, Washington, DC), pp. 74-75.
18. Prucnal, P.R. (1988), "Ultra fast fiber-optic networks using all-optical processing," IEEE International Conference on Communications, Conference Record, #3, (IEEE Press, NJ), pp. 1485-1489.
19. Prucnal, P.R. (1988), "Self-routing photonic switch with optical processing," Proceeding Franco-American Workshop on New Research Directions in Integrated Networks, p. 23.
20. Elby, S.E. and Prucnal, P.R. (1988), "Fiber-optic interconnect devices for VLSI micro-area networks," Proceeding Soc. Photoopt. Inst. Eng., (SPIE, Bellingham, WA), 994, pp. 77-91.
21. Prucnal, P.R. and Perrier, P.A. (1988), "Demonstration of a high- dimensionality local area network photonic switch," Proceeding 14th European Conference on Opt.Communic., 292, #1 (IEE, London), pp. 264- 267.
22. Prucnal, P.R. and Perrier, P.A. (1988), "Optical self-routing in a self-clocked photonic switch using pulse-interval encoding," Proceeding 14th European Conference on Opt. Communic., 292, #1 (IEE, London), pp. 259-263.
23. Perrier, P.A. and Prucnal, P.R. (1988), "Demonstration of high-dimensionality optical local area network switch," Optical Society of America, Tech. Digest Series, #11, (Optical Society of America, Washington, DC),p. 79.
24. Perrier, P.A. and Prucnal, P.R. (1988), "Self-synchronizing pulse-interval technique for optical routing control in a photonic switch," Optical Society of America, Tech. Digest Series, 11, (Optical Society of America, Washington, DC), p. 51.
25. Prucnal, P.R. and Perrier, P.A. (1988), "A new direction in photonic switching," Proceeding 9th International Conference on Comp. Communic., (North Holland, NY), pp. 149-154.
26. Maguire, G.Q. and Prucnal, P.R. (1989), "High-density optical storage using optical delay lines," Proceeding Soc. Photoopt. Inst. Eng. Conference on Medical Imaging, in press.
27. Perrier, P.A., Prucnal, P.R. and Chbat, M.W. (1989), "Demonstration of a self-clocked optical time-slot interchanger," Topical Meeting on Photonic Switching, Tech. Digest Series, (Optical Society of America, Washington, DC), FC3, pp. 139-141.

28. Prucnal, P.R. (1989), "A new direction in photonic switching, Topical Meeting on Photonic Switching, Tech. Digest Series, (Optical Society of America, Washington, DC), p. 7.
29. Prucnal, P.R., Perrier, P.A., and Chbat, M.W. (1989), "Self-clocked optical time-division switch," Proceeding Conference Lasers and Electro-opt., 11, (Optical Society of America, Washington, DC), p. FG3, pp.398-399.
30. Cho, H. and Prucnal, P.R. (1989), "Parameter optimization of GaAsAlGaA multiple-quantum-well electro absorption modulators," Proceeding Conference Lasers and Electro-opt., 11, (Optical Society of America, Washington, DC), p. TuJ38.
31. Prucnal, P.R. and Perrier, P.A. (1989), "Optical interconnect switch," Proceeding Soc. Photoopt. Inst. Eng. 1178, (SPIE, Bellingham, WA), 162-170.
32. Kwong, W.C., Prucnal, P.R. and Perrier, P.A. (1989), "Synchronous versus asynchronous CDMA for fiber-optic LANs using optical signal processing," Proceeding Globecom, 28, pp. 1012-1016.
33. Prucnal, P.R. and Perrier, P.A. (1989), "Demonstration of a high- dimensionality space-division photonic switch," Proceeding Electrochem. Soc.
34. Goel, K.K., Perrier, P.A., Prucnal, P.R., Milbrodt, M.A., Desurvire, E. (1989), "Optical self-routing through a tree-structured space-division photonic switch using pulse-interval binary encoding," Optical Society of America Tech. Digest Series, 12 (Optical Society of America, Washington, DC), p. 48.
35. Prucnal, P.R., Perrier, P.A. and Kwong, W.C. (1989), "Synchronous CDMA for fiber-optic LANs using optical signal processing," Proceeding Inter. Conference on Integrated Opt. and Opt. Fiber Communic., poster.
36. Prucnal, P.R. (1989), "An optical interconnect switch," Proceeding Materials Res. Soc., 354.
37. Prucnal, P.R. (1990), "Passive shared-media systems," Proceeding IEEE International Conference on Communications, pp. 1135-1139.
38. Kwong, W.C. and Prucnal, P.R. (1990), "Continuous phase FSK direct detection FDMA lightwave network with laser phase noise immunity," Proceedings of 1990 CISS, Princeton University, Princeton, NJ, 883-888.
39. Perrier, P.A., Chbat, M.W. and Prucnal, P.R. (1990), "Optical clock recovery for high-speed optical networks," in Digest of LEOS Summer Topical on Optical Multiple Access Networks (IEEE, New York, NY), paper OMF12, pp. 73-74.
40. Kwong, W.C. and Prucnal, P.R. (1990), "Theory on multichannel CPFSK lightwave networks with laser phase noise immunity," Technical Digest on Optical Multiple Access Networks, LEOS, Summer Topical Meeting '90, IEEE 90TH0306-1, Library of Congress 90-82546, pp. 66-67.
41. Prucnal, P.R., Johns, S.T., Krol, M.F., and Stacy, J.L. (1990), "Time-division optical micro-area networks," SPIE Vol. 1389 Int. Conference On Advances in Interconnects and Packaging, pp. 462-476.
42. Chbat, M.W., Ianonne, P.P., Perrier, P.A., and Prucnal, P.R. (1990), "Optical Clock recovery circuit using periodic oscillations of a Mach-Zehnder interferometer with delayed feedback," in Technical Digest of the Optical Society of America 1990 Annual Meeting, Boston, MA, November 4-9, paper ThO3.

43. Kwong, W.C. and Prucnal, P.R. (1991), "A continuous phase FSK direct detection lightwave network using subcarrier multiplexing techniques," (Invited Paper), Technical Digest OCTIMA '91, Rome, Italy, Session 1, paper #3.
44. Kwong, W.C. and Prucnal, P.R. (1991), "Analysis of a sideband-difference multiple access (SDMA) coherent lightwave network," Proceedings of 1991 CISS, Johns Hopkins University, Baltimore, MD.
45. Sturm, J.C., Prucnal, P.R., Liu, Y.M., Manoharan, H., Mi, Q., Schwartz, P.V. and Xiao, X. (1991), "Applications of strained layer alloys for silicon-based optical interconnects," Proceeding Sarnoff Symposium, Princeton, NJ.
46. Liu, Y.M., Grove, M. and Prucnal, P.R. (1991), "MQW waveguide modulator for fiber-optic interconnects," Optical Society of America Tech. Digest Series, vol. 17, (Optical Society of America, Washington, DC), paper WD4, p. 108.
47. Liu, Y.M., Sun, K.W., Prucnal, P.R. and Lyon, S.A. (1991), "A simple method to start and maintain self mode-locking of a Ti: sapphire laser," Optical Society of America Tech. Digest Series, vol. 17, (Optical Society of America, Washington, DC), paper Tu14, p. 61.
48. Boncek, R.K., Krol, M.F., Johns, S.T., Stacy, J.L. and Prucnal, P.R. (1992), "Demonstration of a 5 Gbits optical time-division multiple access network," Proceeding IEEE OFC Conference
49. Chbat, M.W., Hong, B., Islam, M.N., Soccolich, C.E., and Prucnal, P.R. (1992), "Demonstration of a high-contrast ultrafast soliton-trapping AND gate," Proceeding IEEE OFC Conference, (Opt. Soc. Amer., Washington, D. C.), Vol. 5, paper TuC4, 13-14.
50. Islam, M.N., Soccolich, C.E., Chbat, M.W. and Prucnal, P.R. (1992), "Cascade of ultrafast soliton dragging and trapping logic gates," Conference on Lasers and Electroopt. Tech. Digest Series, (Opt. Soc. Am., Washington, DC).
51. Kwong, W.C., Liu, Y.M. and Prucnal, P.R. (1992), "Demonstration of a programmable ultrafast all-optical code-division multiple access network," Conference on Lasers and Electroopt. Tech. Digest Series, (Optical Society of America, Washington, DC), 12, 44-46.
52. Liu, Y.M. and Prucnal, P.R. (1992), "Noise measurement of a self-mode-locked Ti: sapphire laser stabilized by a shaker," Conference on Lasers and Electroopt. Tech. Digest Series (Optical Society of America, Washington, DC) Vol. 12, 148-149.
53. Kwong, W.C. and Prucnal, P.R., (1992), "Programmable ultrafast all-optical code-division multiple access networks," Proceeding IEEE Opt. Fiber Communic. Conference, vol. 5, paper WH 7, pp34.
54. Kwong, W.C. and Prucnal, P.R., (1992), "Frequency-pair encoding demonstration for a phase-noise-free coherent fiber-optic network," Proceeding of 1992 CISS, Princeton University, Princeton, NJ, 106.
55. Soccolich, C.E., Islam, M.N., Chbat, M.W. and Prucnal, P.R., (1992), "Energy contrast from cascaded soliton logic gates," Proceeding Integrated Photonics Research Conference.
56. Boncek, R.K., Krol, M.F., Johns, S.T. and Stacy, J.L., (1992), "Gigabit optical time-division multiple access network," Proceeding DOD Fiber Optics '92.

57. Prucnal, P.R. and Sokoloff, J.R., (1992), "Multiple quantum well modulators and switches for optical interconnect systems," Proceeding DOD Fiber Optics '92.
58. Soccolich, C.E., Chbat, M.W., Islam, M.N., and Prucnal, P.R. (1992) "Cascade of ultrafast soliton dragging and trapping logic gates," in Digest of Conference on Lasers and Electro-Optics (CLEO'92), 1992 Technical Digest Series, Vol. 12 (Optical Society of America, Washington, DC), CMH3.
59. Soccolich, C.E., Islam, M.N., Chbat, M.W., and Prucnal, P.R. (1992), "Energy contrast from cascaded soliton logic gates," in Digest of Integrated Photonics Research Topical Meeting , 1992 Technical Digest Series, Vol. 10 (Optical Society of America, Washington, DC), paper WA-1.
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61. Islam, M.N., Soccolich, C.E., Chbat, M.W., Prucnal, P.R., and Sauer, J.R. (1992), "Ultrafast logic gates in a soliton ring network," in Digest of LEOS Summer Topical Meeting on Multiple Access Networks, (IEEE, New York, NY), Invited paper WA-1.
62. Kwong, W.C., Liu, Y.M., and Prucnal, P.R. (1992), "Ultrafast all-optical code-division multiple-access networks," Proceeding of the SPIE International Symposium: OEFIBERS'92, paper 1787-10.
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65. Prucnal, P.R. (1992), "Optically-processed self-routing, synchronization and contention resolution for 1D and 2D photonic switching architectures," LEOS Summer Topical Meeting Digest on Optical Multiple Access Networks, post-deadline paper, PD2.
66. Yu, S., Forrest, S.R. and Prucnal, P.R. (1992), "A simple two-stage 2D optoelectronic process printer connection using smart pixels," LEOS Summer Topical Meeting Digest on Smart Pixels, paper MA2, 5-8.
67. Kwong, W.C. and Prucnal, P.R. (1992), "An integrable ultrafast all-optical CDMA network," Tech. Digest SPIE International Symposium OEFIBERS '92, Boston, MA, September, paper 1787-10.
68. Kwong, W.C., and Prucnal, P.R. (1992), "Demonstration of a phase-noise cancelled coherent subcarrier fiber-optic communication system," Proceeding IEEE LEOS Annual Meeting, Boston, MA, November, 90-91, paper # OCTS 2.3.
69. Bononi, A., Forghieri, F., and Prucnal, P.R. (1992), "Analysis of one-buffer deflection routing in ultra-fast optical mesh networks," INFOCOM '93, San Francisco, CA, July, pp. 303-311.

70. Glesk, I., Sokoloff, J.P., and Prucnal, P.R., "Optical amplitude encoding using a loop modulator," SPIE Conference on Analog Photonics, vol. 1790, p. 18, Boston, MA, Sept 10-11, 1992.
71. Forghieri, F., Bononi, A., and Prucnal, P.R. (1993), "Novel packet architecture for ultra-fast all-optical networks," in Proceeding OFC '93, San Jose, CA, paper TH13, February, pp. 198-199.
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73. Prucnal, P.R. (1993), "Photonic packet switching with optically-processed control," Topical Meeting on Photonics in Switching, Technical Digest Series (OSA, Washington, DC) (invited).
74. Sawchuck, A.A., Cheng, L., Forrest, S.R. and Prucnal, P.R. (1993), "Smart pixel optical computing architectures," Topical Meeting on Optical Computing, Technical Digest Series (OSA, Washington, DC) (invited).
75. Kwong, W.C. and Prucnal, P.R. (1993), "All-serial coding architecture for ultrafast optical DMA," Proceeding of ICC'93, paper 297, session 208 Geneva, Switzerland, May.
76. Sokoloff, J. P., Glesk, I., and Prucnal, P. R., (1993), "A Terahertz optical asymmetric demultiplexer," Switching in Photonics, Palm Springs, CA.
77. Sokoloff, J.P., Glesk, I., Prucnal, P.R., and Boncek, R.K., (1993), "Performance of a Terahertz optical asymmetric demultiplexer in a 50 Gbps OTDM System," Tech. Digest , SPIE Meeting on Multigigabit Fiber Communications Systems, San Diego, July, Vol. 2024, pp 145-148.
78. Kwong, W.C., Prucnal, P.R., Sokoloff, J.P., and Glesk, I., (1993), "Ultrafast all-optical photonic packet switching," (Invited paper), Technical Digest , SPIE Meeting on Multigigabit Fiber Communication Systems, San Diego, CA, July, Vol. 2024, pp 150-170.
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81. Sokoloff, J.P., Prucnal, P.R., Glesk, I., and Kane, M. "A terahertz optical asymmetric demultiplexer (TOAD),"OSA Conference on Switching in Photonics, post deadline paper #4, (PD-4), Palm Springs, CA March 6-9, 1993.
82. Bononi, A. and Prucnal, P.R., (1994) "Minimum-loss node structures for deflection routing transparent optical networks," in Proceeding OFC '94 , San Jose, CA, paper W15, February 1994.
83. Bononi, A. and Prucnal, P.R.,(1994) "New structures of the optical node in transparent optical multihop networks using deflection routing," IEEE INFOCOM '94, paper 3d4.
84. Prucnal, P.R., Glesk, I. and Sokoloff, J.P. (1994), "Demonstration of all-optical self-clocked demultiplexing of TDM data at 250 GBs," Proceeding IEEE

- Workshop on Massively Parallel Processing using Optical Interconnects, (IEEE Comm. Soc. Press), Cancun, Mexico, pp. 106-117.
85. Iannone, P., Gnauck, A.H. and Prucnal, P.R. (1994), "1.5 μ 10-Gbs dispersion-compensated transmission over 333km of conventional fiber using mid-span spectral inversion in an injection-locked semiconductor laser," in Proceeding OFC'94, San Jose, CA, post deadline paper, February 1994.
 86. Iannone, P. and Prucnal, P.R. (1994), "Wavelength conversion of psec optical pulses," in Proceeding OFC'94, San Jose, CA, February 1994.
 87. Bononi, A. and Prucnal, P.R. (1994), "Analytical evaluation of improved transmission techniques in deflection routing networks," Proceeding Conference on CISS94, Session WP-1, Princeton, NJ, pp. 255-260, March 16-18.
 88. Boncek, R.K., Prucnal, P.R., Bononi, A., Sokoloff, J.P., Stacy, J.L. and Bare, H.F., (1994), "Optically transparent ATM packet switch node," Proceeding DOD Fiber Optics '94.
 89. Kwong, W.C., Prucnal, P.R., and Teich, M.C., (1994), "Optical wireless: Coherent detection of very narrow linewidth millimeter-wave and microwave signals," Proceeding IEEE Princeton Central Jersey Sarnoff Symposium, paper # Ia3, Princeton, NJ, April.
 90. Kwong, W.C., Prucnal, P.R., and Teich, M.C., (1994), "Coherent detection of very narrow linewidth millimeter-wave and microwave subcarrier signals for optical wireless," Proceeding The Sixth International Conference on Wireless Communications, Calgary, Alberta, Canada, July.
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384. T. Ferreira de Lima, H.-T. Peng, M. A. Nahmias, S. Abbaslou, C. Huang, A. N. Tait, B. J. Shastri, P. R. Prucnal, "Enhancing SOI waveguide nonlinearities via microring resonators," in Proc. Conf. on Lasers and Electro-Optics (CLEO), San Jose, CA, USA, May 2019
385. P. R. Prucnal, A. N. Tait, M. A. Nahmias, T. Ferreira de Lima, H.-T. Peng, and B. J. Shastri, "Multiwavelength neuromorphic photonics," in Proc. Conf. on Lasers and Electro-Optics (CLEO), San Jose, CA, USA, May 2019
386. H.-T. Peng, T. Ferreira de Lima, M. A. Nahmias, A. N. Tait, B. J. Shastri, P. R. Prucnal, "Autaptic circuits of integrated laser neurons," in Proc. Conf. on Lasers and Electro-Optics (CLEO), San Jose, CA, USA, May 2019
387. B. J. Shastri, A. N. Tait, M. A. Nahmias, T. Ferreira de Lima, H.-T. Peng, and P. R. Prucnal, "Multiwavelength neuromorphic silicon photonics," in Proc. Conf. on Lasers and Electro-Optics Europe & Quantum Electron. Conf. (CLEO/Europe-EQEC), Munich, Germany, June 2019
388. B. J. Shastri, A. N. Tait, M. A. Nahmias, T. Ferreira de Lima, H.-T. Peng, and P. R. Prucnal, "Neuromorphic photonic processor applications," Proc. IEEE Photon. Soc. Summer Topical Meeting Series (SUM), Fort Lauderdale, FL, USA, July 2019
389. A. N. Tait, T. Ferreira de Lima, J. Shainline, S. Buckley, A. McCaughan, M. A. Nahmias, H.-T. Peng, H. Miller, S. Nam, R. Mirin, B. J. Shastri, and P. R. Prucnal, "Neuromorphic silicon photonics on foundry and cryogenic platforms," Proc. IEEE Photon. Soc. Summer Topical Meeting Series (SUM), Fort Lauderdale, FL, USA, July 2019

390. P. R. Prucnal, A. N. Tait, M. A. Nahmias, T. Ferreira de Lima, H.-T. Peng, and B. J. Shastri, "Advances in neuromorphic silicon photonics," Proc. IEEE Photon. Soc. Summer Topical Meeting Series (SUM), Fort Lauderdale, FL, USA, July 2019.
391. V. Bangari, B. A. Marquez, A. N. Tait, M. A. Nahmias, T. Ferreira de Lima, H.-T. Peng, P. R. Prucnal, and B. J. Shastri "Neuromorphic photonics for deep learning," in Proc. IEEE Photon. Conf. (IPC), San Antonio, TX, USA, Sept.- Oct. 2019
392. R. Amin, M. Miscuglio, B. J. Shastri, P. Prucnal, and V. J. Sorger, "Electro- optic perceptron towards 10^{18} mac/j-efficient photonic neural networks (conference presentation)," in AI and Optical Data Sciences, vol. 11299. International Society for Optics and Photonics, 2020, p. 112990D.
393. B. Shastri, T. F. de Lima, A. Tait, B. Marquez, H. Peng, C. Huang, V. Sorger, and P. Prucnal, "Advances in neuromorphic photonics (conference presentation)," in Integrated Optics: Devices, Materials, and Technologies XXIV, vol. 11283. International Society for Optics and Photonics, 2020, p. 1128314.
394. [Post Deadline] C. Huang, S. Fujisawa, T. Ferreira de Lima, A. N. Tait, E. C. Blow, Y. Tian, S. Bilodeau, A. Jha, F. Yaman, H. Batshon, H.-T. Peng, B. J. Shastri, T. Wang, and P. R. Prucnal, "Demonstration of photonic neural network for fiber nonlinearity compensation in long-haul transmission systems," in Proc. Opt. Fiber Commun. (OFC), San Diego, CA, USA, Mar. 2020, paper Th4C.6.
395. C. Huang, S. Bilodeau, T. Ferreira de Lima, A. N. Tait, P. Y. Ma, E. C. Blow, A. Jha, H.-T. Peng, B. J. Shastri, and P. R. Prucnal, "Demonstration of multi-channel feedback control for on-chip microring weight banks," in Proc. Opt. Fiber Commun. (OFC), San Diego, CA, USA, Mar. 2020, paper W3A.7.
396. T. Ferreira de Lima, C. Huang, S. Bilodeau, A. N. Tait, H.-T. Peng, P. Y. Ma, E. C. Blow, B. J. Shastri, and P. R. Prucnal, "Real-time operation of silicon photonic neurons," in Proc. Opt. Fiber Commun. (OFC), San Diego, CA, USA, Mar. 2020, paper M2K.4.
397. [Invited] B. J. Shastri, T. Ferreira de Lima, A. N. Tait, B. A. Marquez, H. T. Peng, C. Huang, V. J. Sorger, and P. R. Prucnal, "Advances in neuromorphic photonics," in Proc. SPIE, vol. 11283, Integrated Optics: Devices, Materials, and Technologies XXIV, SPIE OPTO, San Francisco, CA, USA, Mar. 2020, paper 1128314.
398. [Invited] R. Amin, M. Miscuglio, B. J. Shastri, P. R. Prucnal, and V. J. Sorger, "Electro-optic perceptron towards 10^{18} MAC/J-efficient photonic neural networks," in Proc. SPIE, vol. 11299, AI and Optical Data Sciences, SPIE OPTO, San Francisco, CA, USA, Mar. 2020, paper 112990D.
399. E. C. Blow, C. Huang, Z. Liu, S. J. Markoff, and P. R. Prucnal, "Silicon photonic weights for microwave photonic canceller," in 2020 Conference on Lasers and Electro-Optics (CLEO). IEEE, May, 2020, pp. 1–2.
400. A. Jha, C. Huang, T. F. de Lima, and P. R. Prucnal, "Programmable fast all- optical thresholder," in CLEO: Science and Innovations. Optical Society of America, May, 2020, pp. JTu2F–17.

401. [Invited] B. J. Shastri, B. A. Marquez, A. N. Tait, T. Ferreira de Lima, H.-T. Peng, C. Huang, and P. R. Prucnal, "Silicon photonic neural networks and applications," in Proc. Photon. North (PN), May 2020, doi: 10.1109/PN50013.2020.9167001.
402. [Invited] B. J. Shastri, B. A. Marquez, M. Filipovich, Z. Guo, E. R. Howard, H. Morison, A. N. Tait, T. Ferreira de Lima, C. Huang, and P. R. Prucnal, "Silicon photonics for AI hardware," in Proc. Adv. Photon. Congress (APC), July 2020, paper IM2A.2.
403. A Jha, C Huang, PR Prucnal, "Reconfigurable all-optical nonlinear activation functions", IEEE Photonics Conference, Sept 2020
404. [Tutorial] P. R. Prucnal, T. Ferreira de Lima, C. Huang, B. A. Marquez, and B. J. Shastri, "Neuromorphic photonics: current status and challenges," in Proc. European Conf. Opt. Commun. (ECOC), Brussels, Belgium, paper Tu4C-1, Dec. 2020.
405. H.-T. Peng, J. C. Lederman, L. Xu, T. Ferreira de Lima, C. Huang, B. J. Shastri, D. Rosenbluth, and P. R. Prucnal, "A Silicon Photonic Recurrent Neural Network for RF Fingerprinting," (GOMAC) 2021.
406. B. A. Marquez, Z. Guo, H. D. Morison, S. Shekhar, L. Chrostowski, P. R. Prucnal, and B. J. Shastri, "On-chip online learning and inference for photonic pattern recognition" Proc. Conf. on Lasers and Electro-Optics (CLEO), paper SM1B.5, May 2021.
407. [Invited] B. J. Shastri, C. Huang, A. N. Tait, T. Ferreira de Lima, and P. R. Prucnal, "Photonic neural networks applications," Proc. Photon. North (PN), June 2021.
408. S. Fujisawa, F. Yaman, H. G. Batshon, M. Tanio, N. Ishii, C. Huang, T. Ferreira de Lima, Y. Inada, P. R. Prucnal, N. Kamiya, and T. Wang, "Nonlinear impairment compensation using neural networks," in Optical Fiber Communication Conference (OFC) 2021, p. M5F.1., 2021
409. A. Jha, C Huang, and P.R.Prucnal, "Programmable, high-speed all-optical nonlinear activation functions for neuromorphic photonics," Optical Fiber Communication (OFC) Conference. June, 2021.
410. [Invited] B.J. Shastri, S. Bilodeau, B.A. Marquez, A.N. Tait, T. Ferreira de Lima, C. Huang, L. Chrostowski, S. Shekhar, P.R. Prucnal, "Neuromorphic Photonic Networks," Optical Fiber Communication Conference (OFC) 2021, Th5A.2, June 2021.
411. C. Huang, T. Ferreira de Lima, S. Fujisawa, A.N. Tait, H.-T. Peng, B.J. Shastri, T. Wang, and P.R. Prucnal, "Neuromorphic photonics for optical communication systems," in Optical Fiber Communication Conference (OFC) 2021, p. M5B.1, June 2021.
412. [Tutorial] B.J. Shastri, T. Ferreira de Lima, C. Huang, B.A. Marquez, S. Shekhar, L. Chrostowski, and P.R. Prucnal, "Silicon photonics for artificial intelligence and neuromorphic computing," in Proc. IEEE Photon. Soc. Summer Topical Meeting Series (SUM), paper TuB1.1, July 2021.
413. C. Huang, A. Jha, T. Ferreira de Lima, B.J. Shastri, P.R. Prucnal, "Programmable Optical Nonlinearity for Photonic Neural Networks," Photonics in Switching and Computing (PSC), paper W1B.2., Sep. 2021

414. [Keynote] B.J. Shastri, C. Huang, A. N. Tait, and P.R. Prucnal, "Photonics for neuromorphic computing and artificial intelligence," in Proc. OSA Photonics in Switching and Computing Conference (PSC), paper W3B.3, Sep. 2021.
415. C. Huang, T. Ferreira de Lima, A.N. Tait, B.J. Shastri, P.R. Prucnal, "Intelligent Optical Signal Processing for Optical Communications," Asia Communications and Photonics Conference (ACP), paper T1E, Oct. 2021.
416. [Invited] C. Huang, T. Ferreira de Lima, A.N. Tait, B. Marquez, B.J. Shastri, P.R. Prucnal, "Neuromorphic Photonics for Intelligent Signal Processing," IEEE Photonic Conference (IPC), paper WD4.1, Oct. 2021.
417. [Postdeadline] W. Zhang, C. Huang, B.J. Shastri, P.R. Prucnal, "Broadband blind source separation by Integrated photonics", IEEE Photonics Conference (IPC), Oct. 2021.
418. [Invited] T. Ferreira de Lima, C. Huang, B.J. Shastri, P.R. Prucnal, "Real-time Processing with Neuromorphic Silicon Photonics," IEEE Photonic Conference (IPC), MA3.2., Oct. 2021.
419. [Invited] E.C. Blow, B Shastri, and P.R. Prucnal, "Broadband RF Signal Processing with Neuromorphic Photonics," SPIE Photonics West, Jan. 2022.
420. [Invited] E. C. Blow, T. Ferreira de Lima, H.-T. Peng, W. Zhang, C. Huang, B. J. Shastri, P. R. Prucnal, "Broadband radio-frequency signal processing with neuromorphic photonics", Proc. SPIE 12019, AI and Optical Data Sciences III, SPIE OPTO, paper 120190N, Jan 2022.
421. [Invited] B. J. Shastri, C. Huang, A. N. Tait, T. Ferreira de Lima, P. R. Prucnal, "Silicon photonic neural network applications and prospects", Proc. SPIE 12019, AI and Optical Data Sciences III, SPIE OPTO, paper 120190K, Jan. 2022.
422. A. Jha, C. Huang, H.-T. Peng, W. Zhang, B. J. Shastri, P. R. Prucnal, "High- speed time series prediction and classification on an all-optical neural network", Proc. Opt. Fiber Commun. (OFC), paper Tu3G.3., Mar. 2022
423. [Invited] C. Huang, T. Ferreira de Lima, S. Bilodeau, W. Zhang, H.-T. Peng, B. J. Shastri, P. R. Prucnal, "Intelligent signal processing by neuromorphic silicon photonics", Proc. Photon. Electromagn. Res. Symp. (PIERS), April, 2022.
424. [Invited] B. J. Shastri, C. Huang, A. N. Tait, T. Ferreira de Lima, and P. R. Prucnal, "Silicon photonics for neuromorphic computing and artificial intelligence: applications and roadmap", Proc. Photon. Electromagn. Res. Symp. (PIERS), pp. 18–26. April, 2022.
425. H.-T. Peng, T. Ferreira de Lima, E. C. Blow, S. Bilodeau, A. Jha, C. Huang, B. J. Shastri, P. R. Prucnal, "Time series prediction and classification using silicon photonic neuron with a self-connection", Proc. Conf. on Lasers and Electro-Optics (CLEO), paper STh4N.4, May 2022.
426. D. Wang, B. Wang, W. Zhang, T. Ferreira de Lima, B. J. Shastri, P. R. Prucnal, C. Huang, "Photonic blind source separation for multimode optical fiber interconnects", Proc. Conf. on Lasers and Electro-Optics (CLEO), paper SS2B.2, May 2022.
427. [Invited] B. J. Shastri, M. J. Filipovich¹, Z. Guo, P. R. Prucnal, S. Shekhar, V. J. Sorger, "In situ training with silicon photonics neural networks", Proc. Photon. North (PN), May 2022.

428. S. Bilodeau, T. F. de Lima, E. A. Doris, M. Hack and P. R. Prucnal, "Thin film photonic resonator weight stacks," 2022 IEEE Photonics Society Summer Topicals Meeting Series (SUM), pp. 1-2, doi: 10.1109/SUM53465.2022.9858291, July 2022.
429. [Invited] B. J. Shastri, M. J. Filipovich¹, Z. Guo, P. R. Prucnal, S. Shekhar, V. J. Sorger, "Silicon photonics neural networks for training and inference", Proc. Adv. Photon. Congress (APC), paper NeW2D.2, Jul. 2022.
430. [Invited] B. J. Shastri, M. J. Filipovich¹, Z. Guo, P. R. Prucnal, S. Shekhar, and V. J. Sorger, "Silicon photonics for training deep neural networks", Proc. Conf. on Lasers and Electro-Optics (CLEO) Pacific Rim, paper CThA13B-02, Aug. 2022.
431. [Invited] B. J. Shastri, M. J. Filipovich¹, Z. Guo, P. R. Prucnal, S. Shekhar, V. J. Sorger, "Silicon photonics for machine learning: training and inference", Proc. European Conf. Opt. Commun. (ECOC), paper Tu4G.1., Sep. 2022.
432. [Invited] W. Zhang, J. Lederman, T.F. de Lima, E. Blow, B.J. Shastri, P.R. Prucnal, "FPGA-Silicon Photonics Hybrid Processor Solves Broadband Radio Interference in Real-Time", Frontier in Optics/Laser Science (FiO/LS), paper FW1E.1, Oct. 2022.
433. Lei Xu, Simon Bilodeau, Eli Doris, Weipeng Zhang, Josh Lederman, Yusuf Jimoh, Jiawei Zhang, Eric Blow, Thomas de Lima, Paul Prucnal, "Integrated Neuromorphic Photonic Computing", Poster, Photonics NJ Feb 2023
434. Thomas Ferreira de Lima, Joshua Lederman, Weipeng Zhang, Junqiang Hu, Eric Blow, Koji Asahi, Yoshiaki Aono, Ting Wang, and Paul Prucnal. "Real-Time Blind Source Separation with Integrated Photonics for Wireless Signals," CLEO, May 2023
435. [Invited] Paul Prucnal, Bhavin Shastri, "Photonics for Neuromorphic Computing", AI Photonics, Sept. 2023
436. James Garofolo, Taichu Shi, Thomas Ferreira de Lima, Paul Prucnal, Ben Wu, "Digital Electronic and Analog Photonic Acceleration for Point Cloud Classifiers", Laser Science, Oct. 2023
437. Joshua Lederman, Yusuf Jimoh, Simon Bilodeau, Weipeng Zhang, Eric Blow, Thomas Ferreira de Lima, Bhavin Shastri, Paul Prucnal. "A Multi-Layer Topologically Reconfigurable Broadcast-and-Weight Photonic Neural Network" In IEEE Photonics Conference (IPC), Nov 2023
438. Weipeng Zhang, Tengji Xu, Jiawei Zhang, Bhavin Shastri, Chaoran Huang, and Paul Prucnal. "Online training and pruning of photonic neural networks" In IEEE Photonics Conference (IPC), Nov 2023
439. Jannes Gladrow, Benjamin Scellier, Eric Xing, Babak Rahmani, Francesca Parmigiani, Paul Prucnal, Cheng Zhang, "Machine Learning with New Compute Paradigms", Workshop, Nurips, Dec 2023

Contributions to Conferences, Symposia and Workshops

Optical Society of America, Annual Meeting, Toronto, CANADA (October 1977).

- "Photon counting and energy detection in vision," given by M.C. Teich. Society for Neuroscience, Seventh Annual Meeting, Anaheim, CA (November 1977).

- "Photon counting and energy detection: the experiment of Hecht, Shlaer and Pirenne revisited," given by M.C. Teich.

Association for Research in Vision and Ophthalmology Annual Meeting, Sarasota, FL (May 1978).

- "Quantum requirements at the absolute threshold with non-Poisson visual stimuli," given by M.C. Teich.

Optical Society of America, Annual Meeting, San Francisco, CA (October 1979).

- "Optimum detection in optical communications with a simple counting

- processor.”
- “Statistical properties of counting distributions for modulated radiation.”
- “Non-Poisson nature of the effective noise in the visual system near threshold.”

Optical Society of America, Annual Meeting, Rochester, NY (October 1979).

- “Increment threshold law for sources of arbitrary statistics.”
- “Role of quantum fluctuations and the Neyman type-A distribution in human vision,” given by M.C. Teich.

NSF Grantee-User Meeting on Optical Communication Systems, Cincinnati, OH (June 1980).

- “A new generalized performance parameter for single-threshold optical communications.”

Optical Society of America Annual Meeting, Chicago, IL (October 1980).

- “Receiver performance evaluation using photocounting cumulates.”
NSF Grantee-User Meeting on Optical Communication Systems, St. Louis, MO (May 1981).
- “Detection and estimation in signal-dependent noise.”
Optical Society of America Annual Meeting, Orlando, FL (October 1981).
- “Evaluation of fiber-optic error rates using a normalizing transform.” Joint
Services Electronics Program Review Meeting, Columbia University, NY (December
1981).
- “Wideband FSK and FM fiber-optic communication.” Conference on
Lasers and Electrooptics, Phoenix, AZ (April 1982).
- “Wideband FSK fiber-optic communication experiment.”
NSF Grantee-User Meeting on Optical Communication Systems, Berkeley, CA (June 1982).
- “Wideband FSK fiber-optic communication experiment.”
Optical Society of America Annual Meeting, Tucson, AZ (October 1982).
- “Wideband FSK optical fiber communication experiment.”
NSF Grantee-User Meeting on Optical Communications Systems, MIT, Cambridge, MA (May
1983).
- “Frequency-shift-key modulation for fiber-optic communications.” Optical Society
of America Annual Meeting, New Orleans, LA (October 1983).
- “Orthogonal modulation formats for fiber-optic communications.”
Joint Services Electronics Program Review Meeting, Columbia University, NY (October
1984).
- “Ultra high speed circular hollow waveguide modulator.”
Center for Telecommunications Research Opening, Columbia University, NY (December
1984).
- “Telecommunications research at Columbia: Fiber optics.” NSF
Site Visit, Columbia University, NY (January 1985).
- “Ultra high speed optical processing.”
NSF Industry-University Workshop, Columbia University, NY (June 1985).
- “Ultra high speed optical signal processing.”
International Workshop on Digital Communications, Tirrenia, Italy (September 1985).
- “Spread spectrum fiber optic local area network using optical processing.” Optical
Society of America Annual Meeting, Washington, DC (October 1985).
- “Local area network with spread spectrum processing.”
• “Integrated fiber optic coupler for VLSI interconnects.” DARPA
Optical Processing Review, McLean, VA (November 1985).
- “Vertical optical interconnects.”
NASA Review, Greenbelt, MD (November 1985).
- “Transmission codes for optical communications.”
Workshop on Optical Interconnects, MCC, Austin, TX (November 1985).
- “Integrated fiber optic coupler for VHSICVLSI interconnections.”
IBMCTR Workshop on Computer Networks, Arden House, Arden, NY (December 1985).
- “Optical interconnects for VLSI local area networks.”

Society of Photooptical Instrumentation Engineering, Los Angeles, CA (January 1986).

- “Integrated fiber optic coupler for VLSI interconnects.”

Optical Society of America, Topical Meeting on Quantum Limited Detection (April 1986).

- “Exact variance stabilizing transforms for image-signal-dependent-noise.” NSF

Industry - University Workshop, Columbia University, NY (May 1986).

- “All-optical fiber networks.”

International Optical Computing Conference, Jerusalem, Israel (July 1986).

- “VLSI fiber-optic local area network.”

SPIE FiberLASE 86, Cambridge, MA (September 1986).

- “VLSI optical interconnection networks.”
- “All-optical ultrafast networks.”

Fiber-optic communication local area networks 86, Orlando, FL (October 1986).

- “Spread spectrum fiber-optic local area network using optical processing.”

International Electronic Packaging Society, San Diego, CA (November 1986).

- “Direct connection of optical fibers to integrated circuits,” given by R. Aide. Optical

Processing Annual Review, DARPA, Leesburg, VA (February 1987).

- “VLSI optical micro-area networks.”

Topical Meeting on Photonic Switching, Lake Tahoe (March 1987).

- “Self-routing optical switch with optical processing.”

International Workshop on High-Speed Optical Processes, University of Michigan, Ann Arbor, MI (May 1987).

- Invited Paper: “A 12.5 Gbps all-optical network demonstration.”

95th ASEE Annual Conference, University of Nevada, Reno, NV (June 1987).

- “All-optical integrated circuit micro-area network.”

3rd International Conference on Data Communication Systems, Rio de Janeiro, Brazil (June 1987).

- “All-optical integrated circuit micro-area network.”

IEEE Communications Techniques Seminar on Metropolitan Area Networks, Princeton, NJ (November 1987).

- Invited Paper: “Self-routing photonic switching technology for metropolitan area networks.”

Optical Fiber Communication Conference, New Orleans, LA (January 1988).

- “Low-loss high-impedance integrated fiber-optic tap,” given by S. Elby.
- “Self-routing of 12.5 Gbps data through an 8x8 lithium niobate optical crossbar matrix with gigahertz switching speed.”

IEEE Communication Theory Workshop, Sedona, AR (April 1988).

- “Ultra-fast all-optical networks.”

Conference on Lasers and Electro-optics, Anaheim, CA (April 1988).

- “Optical self-routing of 12.5 Gbps time-division-multiplexed data.”

IEEE International Conference on Communications, Philadelphia, PA (June 1988).

- “Ultra fast fiber-optic networks using all-optical processing.”

Franco-American Workshop on New Research Directions in Integrated Networks, Sophia Antipolis, France (June 1988).

- Invited Paper: “Self-routing photonic switch with optical processing.”

- IEEE Workshop on Computer Communications, Harriman, NY (September 1988).
- “Optical self-routing in a self-clocked photonic switch using pulse-interval encoding.”
- Society of Photooptical Instrumentation Engineers, Boston, MA (September 1988).
- “Fiber-optic interconnect devices for VLSI micro-area networks.” European Conference on Optical Communication, Brighton, England (September 1988).
 - “Optical self-routing in a self-clocked photonic switch using pulse-interval encoding,” given by P. Perrier.
 - “Demonstration of a high-dimensionality local area network photonic switch,” given by P. Perrier.
- Optical Society of America, Santa Clara, CA (October 1988).
- “Self-synchronizing pulse-interval technique for optical routing control in a photonic switch,” given by P. Perrier.
 - “Demonstration of a high-dimensionality optical local area network switch,” given by P. Perrier.
- 9th International Conference on Computer Communications, Tel Aviv, Israel (October 1988).
- Invited Plenary Paper: “A new direction in photonic switching.”
 - Invited Panel Member: “Network architecture for optical communications.” Society of Photooptical Instrumentation Engineers Conference on Medical Imaging, Newport Beach, CA (January 1989).
 - “High-density optical storage using optical delay lines,” given by G. Maguire. IEEE OSA Topical Meeting on Photonic Switching, Salt Lake City, UT (March 1989).
 - Invited Plenary Paper: “A new direction in photonic switching.”
 - “Demonstration of a self-clocked optical time-slot interchanger.” Congreso de Informatica y Telecomunicaciones, Berisso, Argentina (April 1989).
 - Invited Plenary Paper: “Future trends in fiber-optic networks.” IEEE Communications Theory Workshop, Hawk's Cay (April 1989).
 - “A collapsed network photonic switching architecture.” Conference on Lasers and Electro-optics, Baltimore, MD (April 1989).
 - “Parameter optimization of GaAsAlGaAs multiple-quantum-well electroabsorption modulators,” given by H. Cho.
 - “Self-clocked optical time-division switch.”
- Gordon Research Conference on Holography and Optical Information Processing, Plymouth State College, NH (August 1989).
- Invited Paper, “Optical micro-area networks.”
- Society of Photooptical Instrumentation Engineers, Boston, MA (September 1989).
- “Optical interconnect switch” given by P. Perrier.
- International Workshop on Digital Communications, Tirrenia (September 1989).
- “Optical processing for self-routing photonic switching.”
- Electrochemical Society, Hollywood, FL (October 1989).
- “Demonstration of a high-dimensionality space-division photonic switch.” Optical Society of America, Orlando, FL (October 1989).
 - “Optical self-routing through a tree-structured space-division photonic switch using pulse-interval binary encoding.”

IEEE Global Telecommunications Conference, Dallas, TX (November 1989).

- “Synchronous versus asynchronous CDMA for fiber-optic LANs using optical signal processing,” given by W. Kwong.

Materials Research Society, Boston, MA (November 1989).

- “An optical interconnect switch.”

IEEE International Conference on Communications, Atlanta, GA (April 1990).

• Invited Plenary Paper: “Passive shared-media photonic switching.” Topical Meeting on Optical Multiple Access Networks, Monterey, CA (July 1990).

- “Theory of multichannel CPFSK lightwave network with laser phase noise immunity,” given by W. Kwong.
- “Optical clock recovery for high speed optical networks,” given by M. Chbat. Society of Photooptical Instrumentation Engineers, Boston, MA (November 1990).
- “Time-division optical microarea networks.”

Optical Society of America, Boston, MA (November 1990).

- “Optical clock recovery circuit using periodic oscillations of a Mach-Zehnder interferometer with delayed feedback,” given by M. Chbat.

LEOS, Boston, MA (November 1990).

- “Time-division optical cross connect.”

Optical Coherent Transmission in Multipoint Applications, Rome, Italy (January 1991).

- Invited paper: “A continuous phase FSK direct detection lightwave network using subcarrier multiplexing techniques,” (conference postponed).

Engineering Foundation Conference on High Speed High Frequency Optoelectronics, Palm Coast, FL (March, 1991).

- “Optical processing for multiaccess networks.”

Sarnoff Symposium, Princeton (March 1991).

- “Applications of Si_{1-x}Ge_x strained layer alloys for silicon-based optical interconnects,” presented by J.C. Sturm.

Society of Photooptical Instrumentation Engineers, OEAerospace Sensing, Orlando (April 1991).

- “Free-space optical TDM switch.”
- “Operating characteristics of a high-speed GaInAs:Fe photoconductive AND gate,” given by K. Goel.

IEEE Communication Theory Workshop, Rhodes, Greece (July, 1991).

- “Photonic fast packet switch with optically-processed control.” Optical

Society of America, San Jose, CA (November 1991).

- “MQW waveguide modulator for fiber-optic interconnects,” given by Y.M. Liu.
- “A simple method to start and maintain self-mode-locking of a Ti: sapphire laser,” given by Y.M. Liu.

IEEEOSA Optical Fiber Communications Conference, San Jose, CA (February 1992).

- “Demonstration of a 5 Gbits optical time-division multiple access network,” given by R. Boncek.
- “Demonstration of high-contrast ultrafast soliton-trapping AND gate.”
- “Programmable ultrafast all-optical CDMA networks,” given by W. Kwong. DOD

Fiber Optics '92, McLean, VA (March, 1992).

- "Multiple quantum well modulators and switches for optical interconnect systems," given by R. Boncek.
 - "Gigabit optical time division multiple access network," given by J. Sokoloff.
- Conference on Lasers and Electrooptics, Anaheim, CA (April 1992).
- "Noise measurement of a self-mode-locked Ti: sapphire laser stabilized by a shaker," (poster) given by Y.M. Liu.
 - "Demonstration of a programmable ultrafast all-optical CDMA network", given by W. Kwong.
 - "Cascade of ultrafast soliton trapping and dragging logic gates," given by M. Islam.
- IEEELEOSOSA Integrated Photonics Research Topical Meeting, New Orleans, LA (April 1992).
- "Energy contrast from cascaded soliton logic gates," given by C. Soccolich. LEOS Summer Topical Meeting, Santa Barbara, CA (August 1992).
 - "Optically processed self-routing, synchronization and contention-resolution for 1D and 2D photonic switching architectures" (post-deadline paper).
 - "Ultra fast logic gates in a soliton ring network," given by M. Islam.
 - "A simple 2-stage 2D optoelectronic processor interconnection using smart pixels," given by S. Forrest.
- SPIE International Symposium OEFibers, Boston, MA (September 1992).
- "Optical pulse train modulation using a fiber interferometer," given by J. Sokoloff.
 - "An integratable ultrafast all-optical CDMA multiple access network," by W. Kwong.
- IEEE Computer Communications Workshop, Hilton Head, NC (October 1992).
- "Photonic fast packet switching using optically processed control," (invited paper).
- IEEE LEOS Annual Meeting, Boston, MA (November 1992).
- "Demonstration of a phase-noise-cancelled coherent subcarrier fiber-optic communication system," given by W. Kwong.
- NSF Workshop on All-Optical Networks, Washington, DC (January 1993).
- "Architectures and technology for all-optical TDMA networks."
- OFCIOOC '93, San Jose, CA (February 1993).
- "High-speed optical TDMA networks," (Invited paper), unable to attend: given by J. Sokoloff.
 - "Throughput limitations in ultrafast all-optical soliton mesh networks using deflection routing," given by A. Bononi.
 - "Novel packet architecture for ultrafast all-optical networks," given by F. Forghieri.
- OSA Optical Computing Topical Meeting, Palm Springs, CA (March 1993).
- "Smart pixel optical computing architectures," given by S. Sawchuck (Invited paper).
- OSA Photonics in Switching Topical Meeting, Palm Springs, CA (March 1993).
- "Photonic packet switching with optically-processed control" given by D. Blumenthal (invited paper).

- "Terahertz optical asymmetric demultiplexer," (post-deadline) given by J. Sokoloff.
- IEEE Communications Theory Workshop, Hawk's Cay, FL (April 1993).
- "TBA" (Invited paper).
- ICC '93, Geneva, Switzerland (May 1993).
- "All-serial coding architecture for ultrafast optical CDMA," given by W. Kwong. SPIE Multigigabit Fiber Communications System, San Diego, CA (July 1993).
 - "Ultrafast all-optical photonic packet switching," (Invited paper).
 - "Performance of a terahertz optical asymmetric demultiplexer in a 50Gbps optical time-multiplexed system", given by J. Sokoloff.
- LEOS '93, San Jose, CA (November 1993).
- "Photonic fast packet switching" (Invited paper). IEEE Workshop on LANsMANs, San Diego (October 1993).
 - "Photonic packet switching with optically processed control," (Invited). 27th HICSS Conference, Maui (January 1994).
 - "Time-division optical micro-area networks," (Invited).
- OFC'94, San Jose (February 1994).
- "Minimum loss node structures for deflection routing transparent optical networks," given by A. Bononi.
 - "Wavelength conversion of psec optical pulses," given by P. Iannone.
 - "1.5 μ Gbs dispersion-compensated transmission over 333km of conventional fiber using mid-span spectral inversion in an injection-locked semiconductor laser," given by P. Iannone (post deadline).
- NSF Workshop on Optical Communications and Network Systems, Arlington, VA (March 1994).
- "Education in Optical Communications." (Invited presentation). DOD Fiber Optics '94, McLean, VA (March 1994).
 - "Optically transparent ATM packet switch node," given by R. Boncek. Rank Prize Symposium, Grasmere, England (April 1994).
 - "High-speed optical time-division multiple access networks," (Invited).
- Bowdoin Science Symposium, Brunswick, ME (March 1994).
- "Transparent optical networks," (Invited).
- Workshop on Massively Parallel Processing using Optical Interconnects, Cancun, Mexico, (April 1994).
- "Optically-processed self-routing for 1-D and 2-D photonic switching architectures," (Invited).
- Infocomm '94, (1994).
- "New structures of the optical node in multihop transparent optical networks with deflection routing," given by A. Bononi.
- ARPA Networking'94, Santa Fe, NM (September 1994).
- "100 Gbps packet-switched multihop transparent optical networks."
- IEEE Workshop on Computer Communications, Duck Key, Marathon, FL (October 1994).
- "250 Gbps packet-switched transparent optical networks," (Invited).

Viva A Ci^encia, Cultural Program of the Portuguese Secretariat of State for Industry and Technology, Commemoration of the 25th Anniversary of Submarine Cables, Lisbon, Portugal, (October 1994).

- “Undersea lightwave communication systems,” (Keynote address, Invited by the Board of Directors of Companhia Portuguesa Rádio Marconi.)

ARPA Workshop on Solitons for Switched Optical Networks, Weston, MA (December 1994).

- “100 Gbps packet-switched multihop transparent optical networks,” (Invited). OFC'95 Workshop on Ultra-High Bit Rate Networks, San Diego, CA, (February 1995).

- “Ultrafast packet networks,” (Invited Keynote Paper).

NCIPT Annual Review, Los Angeles, CA (February 1995).

- “Systems and devices for broadband networks.”

OSA Photonics in Switching Topical Meeting, Salt Lake City, UT (March 1995)

- “Ultrafast photonic switching with optically processed control.” IEEE

Sarnoff Symposium, Princeton, NJ (April 1995).

- “Ultrafast All-Optical Wavelength and Polarization Independent Demultiplexer,” (Invited Paper), given by K. Kang.

Conference on Lasers and Electrooptics, Baltimore, MD (May 1995).

- “Demonstration of ultrafast, all-optical, low control energy, single wavelength, polarization independent, cascadable, and integratable switch,” post-deadline paper given by K. Kang.

European FOC & Networking, Brighton, England (June 1995).

- “Transparent optical networks with time division multiplexing,” (Invited Paper). Int. Symposium on Computer Architecture, Santa Margherita Ligure, (June 1995).

- “Are crossbars really dead?”

ARPA 1995 CSTO Program Review, Ft. Lauderdale, FL (June 1995).

- “100 Gbps packet switched multihop transparent optical networks.” ARPA 1995 MTO Program Review, Big Sky, MT (July 1995).

- “100 Gbps packet switched multihop transparent optical networks.” IEEE

LEOS, San Francisco, CA (October 1995).

- “TDM optical networks,” (Invited paper).

Experimental mechanics and applied optics, Kovoce, Slovakia (October 1995)

- “Undersea lightwave communications,” Keynote address.

AFOSRBMDO Focused Research Initiative kickoff, College Park, MD (December 1995).

- “Terabit networks and devices for data fusion.”

HICSS '96 Maui, HI (January 1996).

- “Time division optical networks.”

NCIPT Annual Meeting, Los Angeles, CA (February 1996).

- “Packaging issues for broadband optical networks.” ARPA

Networking PI Meeting, Charleston, SC (February 1996).

- “Architectural and performance issues in transparent optical networks,” given by H. Kobayashi.

IEEE Santa Fe Workshop on Interconnections in High Speed Digital Systems, Santa Fe, NM (May 1996).

- "100Gbps packet-switched multihop transparent optical networks," (Invited paper).
- IEEE LEOS Annual Meeting, Boston, MA (November 1996).
- "Packaging issues in optical TDM networks," (Invited paper).
 - "Optical packet compressor operating at 100 Gbs,"
 - "Ultrafast all-optically controlled 2x2 crossbar switch." DARPA 1996 ETO Program Review, Orlando, FL (October 1996)
 - "100 Gbps packet switched multihop transparent optical networks"
- IEEE Massively Parallel Processing using Optical Interconnects, Maui, HI (October 1996)
- "High throughput optical algorithms for the FFT and sorting via data packing"
- OSA/IEEE Photonics in Switching, Stockholm, Sweden (April 1997).
- "TDM 100 Gbps packet switching in an optical ShuffleNet"
 - "Demonstration of ultrafast all-optical packet routing"
- European Conference on Optical Communications, Edinburgh, Scotland, (September, 1997)
- "Towards Terabit/sec TDM Photonic Systems" (invited paper)
- Photonic A/D Converter Technology Workshop, Arlington, VA (October, 1997)
- "Real time ultrafast optical sampling using the TOAD"
- IEEE LEOS Annual Meeting, San Francisco, CA (November, 1997)
- "Transparent optical networks with time division multiplexing" (invited paper) DARPA /ETO, PI Meeting, Reston, VA (February, 1998)
 - "100 Gb/s packet-switched multihop optical networks"
 - "Demonstration of a 100 Gbps scalable optical multiprocessing system using OTDM"
- Sarnoff Symposium, Princeton, NJ (March, 1998)
- "Ultrafast optical networks," (invited). DARPA/ITO
- PI Meeting, Tucson, AZ (March, 1998)
- "Demonstration of a 100 Gbps Scalable Optical Multiprocessing System Using OTDM"
- Rank Pize Symposium on Ultrafast Photonic Processing, Grasmere, England (April, 1998)
- "Ultrafast Photonic Processing in Networks," (invited paper) ICC, Atlanta, GA, (April, 1998)
 - "Performance and fault-tolerance of ultrafast optical shuffle networks with optimal node structure"
- Conference on Lasers and Electrooptics, San Francisco, CA (May 1998)
- "Experimental and Theoretical Evaluation of an Ultrafast Multihop Packet Switched Optical TDM Network Testbed"
 - "Influence of Crosstalk on the Scalability of Large OTDM Interconnects Using a Novel Fast Time-Slot Tuner",
 - "Single-shot Optical Sampling Oscilloscope for Ultrafast Optical Waveforms"
 - "A Widely Tunable Laser Based on Semiconductor Optical Amplifier in a Highly Birefringent Fiber Ring Cavity"
- XIth Slovak-Czech-Polish Optical Conference on Wave and Quantum Aspects of Contemporary Optics, Stara Lesna, Slovakia (September, 1998)

- "Novel all-optical devices for terabit optical networks" (invited paper)
 - "High Speed Optical Networks" (invited paper)
- European Conference on Optical Communications, Madrid, Spain (September, 1998)
- "Photonic signal processing in high speed optical TDM networks," (invited paper)
- IEEE/LEOS Topical Meeting on Microwave Photonics, Princeton, NJ (October 1998)
- "Generation, Routing, and Detection of 100 GSa/s Arbitrary Analog Optical Waveform Packets Using Analog Optical TDM"
- DARPA Next Generation Internet Conference, Arlington, VA (October, 1998)
- "Demonstration of a 100 Gbps Scalable Optical Multiprocessing System Using OTDM"
- LEOS Annual Meeting, Orlando, FL (December 1998)
- "Saturation Effects in a Terahertz Optical Asymmetric Demultiplexer,"
 - "A Simple Method to Characterize Dynamic Parameters of Semiconductor Waveguide Amplifier,"
 - "Demonstration of 100 GSa/s Analog Photonic Packet Service Using Analog Optical TDM,"
- 10th Annual Workshop on Interconnections Within High Speed Digital Systems, Santa Fe, NM (May 1999)
- "Latency & Scaling Issues in High-speed Optical TDM Networks" (Invited Paper)
- Optical Fiber Communications Meeting, Baltimore, MD (March 2000)
- "Ultrafast Optical Signal Processing"
- American Physical Society Annual Meeting, Minneapolis, MN (March 2000)
- "The Physics of Optical Switching Technology", invited tutorial
- CLEO/PR-2001, Makuhari Messe, Chiba, Japan (June 2001)
- "TOAD an All-Optical Switch for Ultrashort Pulse Signal Processing and Networks"
- CISS Conference, Princeton, NJ, USA. (March 2002)
- "A fast optical switch based on two cascaded Terahertz Optical Asymmetric Demultiplexers (TOAD)"
 - "Performance-improved all-optical RZ to NRZ format conversion for hybrid optical networking interface"
- LEOS Summer Topical Meeting Chateau Mont Tremblant, QC Canada (July 2002)
- "Systems Perspective on Optical Processing/Packet Networks"
 - "173 picosecond wavelength switching of four WDM channels using an OTDM channel selector"
- OSA Topical Meeting-Integrated Photonics Research, Vancouver, Canada July 2002
- "Wavelength Converters using SOAs: Simulations and Experiments" Invited Talk
- IEEE Laders and Electro-Optics Society, Glasgow Scotland (November 2002)
- "All-optical data format conversion between RZ and NRZ based on wavelength converter"
 - "Monolithically integrated Sagnac interferometer for all-optical wavelength conversion"

WOCC 2002, Newark, NJ (April 2002)

- "New Generation of All-Optical Devices for Optical Networks"

Photonics Prague 2002, Prague, Czech Republic, (May 2002)

- "New Generation of All-Optical Devices for Future Communication Networks"

CLEO 2003, Baltimore, MD (June 2003)

- "Suppression of beating noise of narrow linewidth Erbium doped fiber ring laser using SOA"
- "Highly scalable serial-parallel optical delay line"
- "Wavelength tunable semiconductor fiber ring laser"

Europe-U.S.-Japan Symposium on Ultrafast Photonic Technology, Chiba, Japan, (July 2003)

- "An Optical Platform for Ultra-fast Signal Processing and Networks" **Invited**
- Workshop on University-Industry Collaboration, Princeton, NJ, (September 17, 2003)
- "NJ Center for Ultra-Fast Broadband Communication Networks" **Invited**

4th Electronic Circuits and Systems Conference, Bratislava, Slovakia (September 2003)

- "Fiber Ring Laser with Computer Controlled Wavelength Tunability"

Photonics in Switching 2003. Versailles, Paris, France (September 2003)

- "All-optical wavelength conversion using SOA at nearly symmetric position in a fiber-based Sagnac interferometric loop"

LEOS Tucson, AZ, (October 2003)

- "Scalable OTDM Transmitter with full Multicast Capability"
- "A Scalable Wavelength-hopping, Time-spreading Optical-CDMA system"

Nonlinear Guided Waves and Their Applications. Optical Society of America, 2004

- "Noise-immune universal computation using Manakov soliton collision cycles."

ThP4, Avionics, Fiber-Optics and Photonics Workshop, St. Louis, MO, April 2004

- "Incoherent 2D Optical Code Division Multiple Access"

IEEE Sarnoff Symposium on Advances in Wired and Wireless Communications, Princeton, NJ, April 26-27, 2004

- "Pulse width and wavelength tunable injection modelocking lasers employing TOAD technologies"
- "Fully automated narrow-linewidth wavelength tunable semiconductor fiber ring laser with fast wavelength selection"

CLEO 2004, San Francisco, CA, May 2004

- "Wavelength aware receiver for enhanced 2D OCDMA system performance"
- "Noise reduction in fiber ring lasers by use of a semiconductor optical amplifier"
- "Novel all-optical NRZ wavelength conversion employing SOA-based Sagnac interferometer"
- "Scalability of Frequency-Hopping Time Spreading OCDMA code matrix"

IASTED WOC (OCSN), Banff, Canada, July 2004

- "Demonstration of 4-node 253Gchip/s fast frequency-hopping time-spreading optical CDMA with differentiated service provisioning"

14th Czech-Slovak-Polish Optical Conference on Wave and Quantum Aspects of Contemporary Optics, Nitra, Slovakia, Sept. 13-17, 2004.

- “New Approach to High Speed Optical Code Division Multiple Access Networks with Multidimensional Codes and Use of Novel All-Optical Technology,”

Optics East, Philadelphia, PA, October 25-28, 2004

- “Ultrafast Technologies for Photonic Networks”

LEOS 2004, Puerto Rico, November 2004

- “Experimental Demonstration and Scalability Analysis of a 4-Node 102Gchip/s Fast Frequency-Hopping Time-Spreading Optical CDMA Network”
- “Multiple access interference (MAI) noise reduction in a 2D optical CDMA system using ultrafast optical thresholding”
- “Optical frequency-shift-keying (FSK) encoded pulses for high-capacity label switching applications”
- “Integrated Holographic Encoder/Decoder for 2D Optical CDMA”
- “All-Optical OCDMA Code Drop Unit for Transparent Ring Networks”
- “Vacuum-induced fluctuations of Manakov solitons based on a linearization approximation.”

Globecom 2005 Conference

- Increasing the Spectral Efficiency of Asynchronous O-CDMA: Performance Analysis

OFC 2005

- Compensation of chromatic dispersion by chirp control in all-optical regenerator based on asymmetric Sagnac loop

11th International Symposium on High-Performance Computer Architecture, 2005.

HPCA-11, February 12-16, 2005

- Exploring the design space of power-aware opto-electronic networked systems

5th Int’l Conference Photonics, Devices and Systems (Photonics Prague 2005), Prague, Czech Republic, June 8-11, 2005

- Is optical CDMA a viable technique for broadband networks?

2005 LEOS Summer Topical Meetings, July 25-27, 2005

- A rapidly reconfigurable multicast capable photonic switched interconnect - design and operating principles
- Demonstration of an all-optical interface between wavelength-hopping time-spreading optical CDMA and WDM networks
- Experimental demonstration of a 2D incoherent transparent OCDMA path router

5th Electronic Circuits and Systems Conference (ECS’05), Bratislava, Slovakia, September 8-9, 2005

- Design and demonstration of a novel incoherent optical CDMA system

IEEE MILCOM 2005, Atlantic City, NJ, Sept. 17-20, 2005

- Design and demonstration of a novel incoherent optical CDMA system

OK 2005, Prague, Czech Republic, September 20-21, 2005

- OCDMA-an alternative for optical communications

IEEE Conference Avionics Fiber-Optics and Photonics, 2005, September 20-22, 2005

- Integrated holographic encoder/decoder for avionic optical CDMA platforms
 - Performance enhancement of optical CDMA systems using ultrafast all-optical sampling
- LEOS 2005, Sydney, Australia, October 23-27, 2005
- Novel M-ary Architecture for Optical CDMA using Pulse Position Modulation
 - Quantum phase noise reduction in soliton collisions
 - Simultaneous All-Optical 3R Regeneration of Multiple WDM Channels
- Workshop on Optical and Wireless Communications Technologies, Princeton University, Princeton, NJ, February 3, 2006
- "Princeton testbed for optical and wireless communications", PRISM – University-Industry Research Symposium
- Seminar, McGraw Center, Princeton University, Princeton, NJ, March 15, 2006
- "Effective Teaching Methods"
- Sarnoff Symposium, Princeton, NJ, March 27-28, 2006
- "Design of an avionics platform for Lockheed-Martin based on incoherent optical CDMA,"
- Universita Komenskeho, Bratislava, May 31, 2006
- "All-Optical Signal Processing: Challenges and Applications"
- PI annual meeting, Chicago, IL, August 2006
- "Reconfigurable asynchronous incoherent OCDMA"
- 15th Czech-Slovak-Polish Optical Conference on Wave and Quantum Aspects of Contemporary Optics, Liberec, Czech Republic, September 11-15, 2006
- "How optics has changed data communications"
 - "The roll of optics in optical communications"
- Globecom Access '06 Business Forum, San Francisco, November 29, 2006
- All-Optical Signal Processing: Technologies for network Applications
- Polytechnic University, New York, NY, November 30, 2006
- All-Optical Signal Processing: Technologies for network Applications
- 2007 Optical Fiber Communication and National Fiber Optic Engineers Conference (OFC/NFOEC), Anaheim, CA, USA, March 25-29, 2007
- "Integration of dual-code optical CDMA encoder and decoder by holographic bragg reflectors"
 - "Optical approach to avionic platforms based on OCDMA"
 - "Towards a cryptanalysis of spectral-phase encoded optical CDMA with phase-scrambling"
- US Army Command Laboratory, Ft. Monmouth, April 12, 2007
- "Optical Analog to Digital Conversion" Webcast: April 13, 2007
- Advances in Metropolitan Optical Networking and Wireless/Optical Integration I
- 2007 Nonlinear Optics and Applications II, Prague, Czech Republic
- "Novel optical CDMA platform for avionics applications"
- 2007 IEEE Sarnoff Symposium, Princeton, NJ, USA, April 30 - May 2, 2007
- "Timing jitter analysis of a multi-wavelength all-optical regenerator"
- 2007 Conference on Lasers and Electro-Optics (CLEO), Baltimore, MD, May 6-11, 2007

- "Improving transmission privacy using optical layer XOR"
- "Security analysis of stealth transmission over a public fiber-optical network"
Boston University, Seminar, May 16, 2007
- "All-optical Signal Processing Technologies for Network Applications"
Webcast: May 18, 2007
- Advances in Metropolitan Optical Networking and Wireless/Optical Integration II
18th Annual Workshop Interconnections within High-Speed Digital Systems, Santa Fe, New Mexico, May 20-23, 2007
- Poster "Interferometric noise characterization in OCDMA networks with FBG encoders/decoders and 2-D time-spreading wavelength-hopping codes"
International Symposium on Next-Generation Lightwave Communications, Hong Kong, June 11-13, 2007
- "Ultrafast Optical Technologies for Optical CDMA and Network Security"
[Invited]
9th International Conference on Transparent Optical Networks (ICTON 2007), Rome, Italy, July 1-5, 2007
- "Interferometric noise characterisation of a 2-D time spreading wavelength hopping OCDMA networks using FBG encoding/decoding"
Research seminar, Holmdel, NJ, July 12, 2007
- "Ultrafast Optical Technologies for Optical CDMA and Network Security"
- Technical meetings
2007 International Conference on Photonics in Switching (PS), San Francisco, CA, USA, August 19-22, 2007
- "Increasing optical security with OCDMA using optical XOR"
3rd International Symposium on Ultrafast Photonic Technologies (ISUPT 2007), Boston, MA, August 20-21, 2007
- "Ultrafast Optical Technologies for Optical CDMA and Network Security"
- Research and development discussion with professors from Boston University.
33rd European Conference on Optical Communication (ECOC), Berlin, Germany, September 16-20, 2007
- Achieving physical layer security / privacy with self-wrapped OCDM transmission"
2007 IEEE Avionics Fiber Optics and Photonics Conference (AVFOP), Victoria, BC, Canada, October 2-5, 2007
- "Novel secure platform for avionic applications based on optical CDMA" 20th IEEE Lasers and Electro-Optics Society (LEOS 2007), Lake Buena Vista, FL, USA, October 21-25, 2007
- "Experimental evaluation of near-far effect in optically-thresholded OCDMA network transporting gigabit ethernet traffic"
- "Stealth transmission over a WDM network with detection based on an all-optical thresholder"
2007 Military Communications Conference (MILCOM), Orlando, FL, USA, October 29-31, 2007

- "Achieving physical layer security / privacy with self-wrapped OCDM transmission"
- 2008 Optical Fiber Communication and National Fiber Optic Engineers Conference (OFC/NFOEC), San Diego, CA, USA, February 24-28, 2008
- Virtual I/Q multiplexing in optical code division for secure local area OFDM transport"
- 42nd Annual Conference on Information Sciences and Systems (CISS 2008) Princeton, NJ, USA, March 19-21, 2008
- Demonstration of 2-D wavelength-hopping time-spreading incoherent optical CDMA network by pulse carving of CW laser source"
- 2008 IEEE Sarnoff Symposium, Princeton, NJ, USA, April 28-30, 2008
- Miniaturization of 2-D wavelength-hopping time-spreading incoherent optical CDMA network by pulse carving of CW laser source"
- 2008 Conference on Lasers and Electro-Optics and Quantum Electronics and Laser Science Conference (CLEO/QELS), San Jose, CA, USA, May 4-9, 2008
- Steganographic fiber-optic transmission using coherent spectral-phase-encoded optical CDMA"
- 5th Workshop on Optimization of Optical Networks (OON 2008), Montréal, Canada, May 7-8, 2008
- "Data Availability and Confidentiality in OCDMA Networks"
- Workshop on Modeling And Analysis Of Computer And Communication Systems, Princeton, NJ, May 9, 2008
- "Securing the optical-wireless interface in access networks"
- 19th Annual Workshop on Interconnections within High Speed Digital Systems (HSD 2008), Santa Fe, New Mexico, May 18-21, 2008
- "All-Optical Processing for Optical CDMA and Network Security" [Invited]
 - Poster "Self-Clocked All-Optical Add/Drop Multiplexer for Asynchronous Optical CDMA Networks"
 - Poster "Incoherent Method of Optical Interference Cancellation for Radio-Frequency Communications"
- Lockheed Martin, Cherry Hill, NJ, July 11, 2008
- Seminar and research presentation
- 17th International Conference on Computer Communications and Networks (ICCCN 2008), St. Thomas, USA Virgin Islands, August 3-7, 2008
- "Using optical signal processing to provide information security in data networks"
- 2008 International Conference on Photonics in Switching (PS), Sapporo, Hokkaido, Japan, August 4-7, 2008
- "Securing data networks using optical signal processing"
- MIRTHE Summer Workshop, Baltimore, MD August 5, 2008
- Workshop
- 2008 Photonics, Devices, and Systems IV, Prague, Czech Republic, August 27-29, 2008
- "Design and demonstration of OCDMA system with superior scalability"
- Laboratory for Physical Sciences, College Park, MD, October 1, 2008
- Research seminar

21st IEEE Lasers and Electro-Optics Society (LEOS 2008), Newport Beach, CA, USA, November 9-13, 2008

- "Low-latency nonlinear fiber-based approach for data encryption and anti-jamming in optical network"

2008 IEEE Photonics Global at Singapore (IPGC), Singapore, December 8-11, 2008

- "Improving performance of FBG-based OCDMA system employing all-optical signal processing"
- "Providing network security with optical signal processing"

2009 Optical Fiber Communication and National Fiber Optic Engineers Conference (OFC/NFOEC), San Diego, CA, USA, March 22-26, 2009

- "All-optical encryption for optical network with interleaved waveband switching modulation"
- "Multiple access interference and interferometric noise suppression using dispersion imbalanced loop mirror in optical CDMA networks"
- "Optical steganography using chirped fiber bragg grating"

2009 Conference on Lasers and Electro-Optics and Quantum Electronics and Laser Science Conference (CLEO/QELS), Baltimore, MD, USA, June 2-4, 2009

- "Optical auto-correlation peak discriminator for optical CDMA signal detection"

16th International Conference on Digital Signal Processing (DSP), Santorini, Greece, July 5-7, 2009

- "Optical steganography for data hiding in optical networks"

14th OptoElectronics and Communications Conference (OECC 2009), Hong Kong, China, July 13-17, 2009

- "Physical layer network security based on optical processing using compact passive devices" [Invited]

2009 IEEE Lasers and Electro-Optics Society Summer Topical Meeting (LEOS), Newport Beach, CA, USA, July 20-22, 2009

- "Asynchronous detection with clock and data recovery in optical CDMA networks using a dispersion-imbalanced loop mirror"
- "Secure sensor data transmission channel overlay on passive optical networks"
- "Truly-asynchronous, scalable and survivable optical CDMA networks with heterogeneous QoS" [Invited]

2009 Asia Communications and Photonics Conference and Exhibition (ACP), Shanghai, China, November 2-6, 2009

- "Physical layer security in data networks using optical signal processing" [Invited]

2010 Optoelectronic Interconnects and Component Integration IX, San Francisco, CA, USA, January 25-27, 2010

- "Electro optic cosite interference mitigation"

2010 Optical Fiber Communication and National Fiber Optic Engineers Conference (OFC/NFOEC), San Diego, CA, USA, March 21-25, 2010

- "All-optical XOR gate with feedback using highly Ge-doped nonlinear fiber"
- "Asynchronous and packetized transmission in optical CDMA distributed sensor network"

- "Four-wave mixing in highly Ge-doped nonlinear fiber"
 - "Improving optical steganography transmission privacy by imposing phase masks on stealth signals"
- 2010 Conference on Lasers and Electro-Optics and Quantum Electronics and Laser Science Conference (CLEO/QELS), San Jose, CA, USA, May 16-21, 2010
- "Secure Optical Transmission in Single-User Channel Using Encrypted Wireless CDMA Codes"
- 2010 IEEE Photonics Society Summer Topical Meeting, Playa del Carmen, Mexico July 19-21, 2010
- "Heterogeneous optical CDMA with near-far mitigation"
- 2010 IEEE Avionics Fiber Optics and Photonics Conference (AVFOP), September 21-23, 2010
- "A Photonic Neuromorphic Computational Primitive for Complex High Bandwidth Signal Processing"
- 9th International Conference on Optical Communications and Networks (ICOON 2010), Nanjing, China, October 24-27, 2010
- "Photonic Neurons for Terahertz Pulse Processing" [Invited]
- 23rd Annual Meeting of the IEEE Photonics Society, Denver, CO, November 7-11, 2010
- "Optical Steganography over a Public DPSK Channel"
- 2011 Optical Fiber Communication and National Fiber Optic Engineers Conference (OFC/NFOEC), Los Angeles, CA, March 6-10, 2011
- "Polarization Insensitive Cross-Phase Modulation in 10.5-M Highly Ge-Doped Nonlinear Fiber"
 - "Performance Investigation of Polarization-Multiplexed 16-QAM Using All-Optical OFDM Transmission and Digital Coherent Detection"
- 2011 Progress in Electromagnetics Research Symposium, Marrakesh, Morocco, March 20-23, 2011
- "Lightwave Neuromorphic Based Terahertz Pulse Processor"
- 2011 Conference on Lasers and Electro-Optics (CLEO), Baltimore, MD, May 1-6, 2011
- "Experimental Characterization of Simultaneous Gain Pumping and Depletion in a Semiconductor Optical Amplifier"
- 22nd Annual Workshop on Interconnections within High Speed Digital Systems, Santa Fe, NM, May 8-11, 2011
- "Analysis of Hybrid Spike Coding for High-Speed Networking"
 - "Constructing Terahertz Spike Processors -- Improving the Photonic Neuron"
 - "High Performance All-Optical Thresholding for High-Speed Interconnects".
 - "Intelligent Sensor Interconnection Networks Performing Signal Classification"
- 2011 International Conference on Information Photonics, Ottawa, Canada, May 18- 20, 2011
- "Lightwave Neuromorphic Signal Processing"
- 2011 International Conference on Business and Information (BAI), Bangkok, Thailand, July 4-6, 2011
- "Experimental Demonstration of Survivable Optical CDMA Ring Networks"

2011 IEEE Photonics Society Summer Topical Meeting Series, Montreal, Canada, July 18-20, 2011

- "Experimental Demonstration of Bandwidth Provisioning in a Heterogeneous Optical CDMA System Transporting Gigabit Ethernet Traffic"

SPIE Optics and Photonics for Information Processing V Conference, San Diego, California, USA, August 24, 2011

- "Optical Hybrid Analog-Digital Signal Processing Based on Spike Processing in Neurons"

2011 Eastern Analytical Symposium and Exposition in Somerset, NJ, November 14- 17, 2011

- "Co-Site RF Interference Cancellation for Power Savings in a Wireless Sensor Network"

Optical Fiber Communication Conference and Exposition and the National Fiber Optic Engineers Conference (OFC/NFOEC), paper OTh3H.1, Los Angeles, CA, USA, March 2012

- "Asynchronous Spiking Neuron Based on Four-Wave Mixing and Cross Absorption Modulation"

SPIE Defense, Security, and Sensing 2012, paper 8397-4, Baltimore, MD, April 2012

- "Co-Site Interference Mitigation using Optical Signal Processing"

2012 International Conference on Optical MEMS and Nanophotonics (OMN), August 6-9, 2012

- "A Dual Resonator Enhanced Asymmetric Mach-Zehnder: Ultrafast Passive Threshold for Silicon-on-Insulator"

2012 International Workshop on Information Physics and Computing in Nano-scale Photonics and Materials (IPCN), Orleans, France, September 7, 2012

- "Photonic Neuromorphic Signal Processing and Computing"

2012 IEEE Photonics Conference (IPC), Burlingame, CA, September 23-27, 2012

- "A 20-Gsample/S (10 GHz × 2 Clocks) Burst-Mode CDR Based on Injection-Locking and Space Sampling for Access Networks"

Bell Labs/Alcatel-Lucent Green ICT Summit, Murray Hill, NJ, USA, Jan. 2013

- "Photonic neuromorphic spike processor for ultrafast and low energy cognitive computing"

2013 Optical Fiber Communication and National Fiber Optic Engineers Conference (OFC/NFOEC), Anaheim, CA, March 17-21, 2013

- "112-Gb/S Dp-Qpsk Transmission over 7,860-Km Dmf Using Phase Conjugated Copy and Digital Phase-Sensitive Boosting with Enhanced Noise and Nonlinearity Tolerance"
- "A Timing Jitter Insensitive Logic Gate Using Tunable Gain Dynamics in an SOA and Optical Thresholding"

2013 IEEE Optical Interconnects Conference, Santa Fe, NM, May 5-8, 2013

- "Intelligent THz Photonic Processor for Interconnection Networks Based on Spike Timing Dependent Plasticity"

2013 Conference on Lasers and Electro-Optics (CLEO), San Jose, CA, June 9-14, 2013

- "Room Temperature and High Responsivity Short Wavelength II-VI Quantum

- Well Infrared Photodetector”
 - “Two dimensional encrypted optical steganography based on amplified spontaneous emission noise”
 - “Amplitude-invariant fast q12 light in a semiconductor optical amplifier for microwave photonics”
 - “Coupled waveguides for optical multiplexing in high-performance interconnects”
 - “Two Dimensional Encrypted Optical Steganography Based on Amplified Spontaneous Emission Noise”
- 13th International Conference on Numerical Simulation of Optoelectronic Devices (NUSOD), Vancouver, Canada, August 19-22, 2013
- “Exploring Excitability in Graphene for Spike Processing Networks” IEEE North Jersey Section Computer Chapter and Signal Processing Chapter, Teaneck, NJ, USA, September 2013
 - “Photonic neuromorphic spike processing for ultrafast cognitive computing” 2013 IEEE Photonics Conference (IPC), Seattle, WA, USA, September 2013
 - “Phase mask encrypted optical steganography based on amplified spontaneous emission noise”
 - “An evanescent hybrid silicon laser neuron”
 - “Graphene excitable laser for photonic spike processing”
- Sandia Labs Beyond Moore Device Physics Workshop, Albuquerque, NM, USA, January 2014
- “Integrated photonic spike processing”
- Professor Dinner Series at the Colonial Club, February 2014
- “Using Technology to Protect our Information Infrastructure,” invited talk.
- Neuro-Inspired Computational Elements Workshop, Albuquerque, NM, USA, February 2014
- “Photonic spike processing”
- 2014 Wireless Optical Communications Conference (WOCC), Newark, NJ, USA, May 2014
- “An integrated optical interference cancellation system”
- 2014 IEEE Optical Interconnects Conference, Coronado Bay, CA, USA, May 2014
- “O-BAR: A scalable, optical neuromorphic communication protocol”
 - “Broadcast-and-weight interconnects for integrated distributed processing systems”
- 2014 Conference on Lasers and Electro-Optics (CLEO), San Jose, CA, USA, June 2014
- “Coincidence detection with graphene excitable laser”
 - “Optical encryption based on cancellation of analog noise”
- AFCEA C4I Technology Review Days, Utica, NY, USA, June 2014
- “Lightwave neuromorphic processing”
- 2014 IEEE/ACM Int. Symposium on Nanoscale Architectures (NANOARCH 2014), Paris, France, July 2014
- “Applications of wavelength-fan-in for high-performance distributed processing systems”
- 2014 IEEE Summer Topicals Meeting Series, Montreal, QC, Canada, July 2014

- “Bistable spiking circuit with 67rapheme excitable laser for cascable photonic logic”
- 2014 Symposium on Nonlinear Theory and its Applications (NOLTA), Luzern, Switzerland, September 2014
- “Recent progress towards a fully-integrated hybrid silicon laser neuron platform”
- 2014 IEEE Photonics Conference (IPC), San Diego, CA, USA, October 2014
- “Spatiotemporal pattern recognition with cascable graphene excitable lasers”
 - “Resonant excitable switching with graphene”
 - “Microwave photonic self-interference cancellation system using a slow and fast light delay line”
- 2015 IEEE Environment and Electrical Engineering Conference (EEEIC), Rome, Italy, June 2015
- “Optical self-interference cancellation system for improved spectrum sensing in cognitive radios”
- 2015 IEEE Photonics Society Summer Topical Meeting Series, Nassau, Bahamas, July 2015
- “A photonic integrated circuit for full duplex spectrum monitoring in cognitive radio”
 - “A receiver-less link for excitable laser neurons: design and simulation”
 - “Proposal for CMOS- compatible optoelectronic integrated circuit for online wideband PCA”
 - “Balanced WDM weight banks for analog optical processing and networking in silico,” invited paper
- 2015 IEEE Photonics Conference (IPC), Reston, VA, October 2015.
- “Continuous control of microring weight banks”
 - “Compact optical steganography based on amplified spontaneous emission noise”
- 2016 IEEE Optical Interconnects Conference (OI), San Diego, CA, USA, May 2016
- “Coherent interactions in microring weight banks and impact on channel density”
 - “Silicon photonic weight bank control of integrated analog network dynamics”
 - “Multi-channel microring weight bank control for reconfigurable analog photonic networks”
- 2016 Conference on Lasers and Electro- Optics (CLEO), San Jose, CA, USA, June 2016
- “Long range secure key distribution over multiple amplified fiber spans based on environmental instabilities”
 - “Demonstration of an O/E/O receiverless link in an integrated multi-channel laser neuron”
- 2016 IEEE Photonics Society Summer Topicals Meeting Series (SUM), Newport Beach, CA, USA, July 2016
- “Demonstration of a silicon photonic neural network”
 - “Brain-inspired photonic hardware platforms”
 - “Physical modeling of photonic neural networks”

- 2016 Advanced Photonics Congress (APC), Vancouver, BC, Canada, July 2016
- “Passively synchronized Q-switched and simultaneous mode-locked dual- band Tm³⁺:ZBLAN fiber laser at 1.48- and 1.85- μ m using common graphene saturable absorber”
 - “Emerging photonic hardware platforms”
- 2016 International Topical Meeting on Microwave Photonics (MWP), Long Beach, CA, USA, October 2016
- “Microwave photonic interference canceller: noise reduction via balanced architecture”
- 2016 IEEE Photonics Conference (IPC), Waikoloa, Hawaii, USA, October 2016
- “A microwave photonic canceller for improved interference rejection in full duplex radio”
 - “Optical steganography communication using signal-carrying noise dispersion”
 - “Spike coded bit sequence generation using photonic excitable laser”
- 2017 Optical Fiber Communications Conference and Exhibition (OFC), Los Angeles, CA, March 2017
- “Microwave photonic chaos based device fingerprinting”
- 2017 Advanced Photonics Congress (APC), New Orleans, LA, USA, July 2017
- [Invited] “Emergence of neuromorphic photonics”
- 2017 Optical Interconnects Conference (OI), Santa Fe, NM, USA, June 2017
- “Application regime and distortion metric for multivariate RF photonics” 2017
- Conference on Lasers and Electro- Optics (CLEO), San Jose, CA, USA, May 2017
- “Simultaneous excitatory and inhibitory dynamics in a graphene excitable laser”
 - “Silicon microring weight banks for multivariate RF photonics”
- 2017 IEEE Photonics Conference (IPC), Lake Buena Vista, FL, USA, October 2017
- “Microring weight bank designs with improved channel density and tolerance”
 - “Reconfigurable analog photonic networks,”
- 2018 Conference Inf. Sci. Syst. (CISS), Princeton, NJ, USA, Mar. 2018
- “Blind Source Separation in the Physical Layer”
- 2018 Conference on Lasers and Electro-Optics (CLEO), San Jose, CA, USA, May 2018
- “Attojoule Modulators for Photonic Neuromorphic Computing”
 - “Microring Weight Banks for Neuromorphic Silicon Photonics”
- 2018 OSA Advanced Photonics, Zurich, Switzerland, July 2018
- “Electrooptic Nonlinear Activation Functions for Vector Matrix Multiplications in Optical Neural Networks”
- 2018 SPIE Optics and Photonics Congress, San Diego, CA, USA, Aug. 2018
- “Integrated Neuromorphic Photonics”
- 2018 Active Photonic Platforms, San Diego, CA, USA, Sep. 2018
- “Attojoule modulators for photonic neuromorphic algorithms” 2018
- European Conf. Opt. Commun. (ECOC), Rome, Italy, Sept. 2018.
- “Photonics for Neuromorphic Computing”
- 2018 IEEE Photonics Conference (IPC), Arlington, VA, USA, Sept.-Oct. 2018

- “A TeraMAC Neuromorphic Photonic Processor”
 - “Integrated Balanced Microwave Photonic Canceller”
 - “Temporal Dynamics of An Integrated Photonic Neuron”
- 2019 OFC, San Diego, CA, USA, March 2019
- “Giant enhancement in signal contrast using integrated all-optical nonlinear thresholder”
- 2019 SPIE OPTO, San Francisco, CA, USA, Mar. 2019
- “Advances in photonic neuromorphic computing”
- 2019 CLEO, San Jose, CA, USA, May 2019
- “Autaptic circuits of integrated laser neurons”
 - “Enhancing SOI waveguide nonlinearities via microring resonators”
 - “Multiwavelength neuromorphic silicon photonics”
- 2019 EIPBPN, Minneapolis, IN, USA, May 2019
- “Neuromorphic Computing Hardware with Silicon Photonics”
- 2019 PIERS, Rome, Italy, June 2019
- “Progress on Neuromorphic Silicon Photonics”
- 2019 CLEO/Europe, Munich, Germany, June 2019
- “Multiwavelength neuromorphic silicon photonics”
- 2019 IEEE SUM, Fort Lauderdale, FL, USA, July 2019
- “Advances in neuromorphic silicon photonics”
 - “Neuromorphic silicon photonics on foundry and cryogenic platforms”
 - “Neuromorphic photonic processor applications”
- 2020 International Society for Optics and Photonics, 2020
- “Electro-optic perceptron towards 10^{18} mac/j-efficient photonic neural networks”
 - “Advances in neuromorphic photonics”
- 2020 OFC, San Diego, CA, USA, March 2020
- “Real-time operation of silicon photonic neurons”
 - “Demonstration of multi-channel feedback control for on-chip microring weight banks”
 - “Demonstration of photonic neural network for fiber nonlinearity compensation in long-haul transmission systems”
- 2020 SPIE OPTO, San Francisco, CA, USA, Mar. 2020
- “Electro-optic perceptron towards 10^{18} MAC/J-efficient photonic neural networks”
 - “Advances in neuromorphic photonics”
- 2020 Proc. Photon. North PN, May 2020
- “Silicon photonic neural networks and applications”
- 2020 CLEO, San Jose, CA, USA, May 2020
- “Programmable fast all-optical thresholder Silicon photonic weights for microwave photonic canceller”
- 2020 APC, China, May 2020
- “Silicon photonics for AI hardware”
- 2020 IPC IEE Photonics Conference, Virtual, September 2020
- “Reconfigurable all-optical nonlinear activation functions”
- 2021 First Workshop on Neuromorphic photonics, Thessanoliiki, Greece, Dec. 2021

- “Prospects and applications of photonic neural networks”
2021 Conversations in Photonics Series, Oxford University, Virtual, Oct. 2021
2021 Emerging Topics in Artificial Intelligence, conference within the SPIE Optics and Photonics Congress, Virtual, Aug. 2021
2021 OSA Advanced Photonics Congress, Virtual, Aug. 2021
- “Neuromorphic and Computational Photonics”
2021 Winter School on Optoelectronics and Photonics: Neuromorphic Photonics, Virtual, June 2021
- “Spiking Photonic Neural Networks”
2021 Workshop on Neuromorphic Computing, OFC ’21, Virtual, June 2021
- “Neuromorphic silicon photonics”
2021 IEEE Conference on Lasers and Electrooptics (CLEO), Virtual, May 2021
- “Neuromorphic Silicon Photonics and Applications”
2021 SPIE Photonics West 2021, Virtual, Jan. 2021
- “Spiking neural networks and RF-intelligent Information Processing”
2022 IEEE Optical Fiber Communications Conference, San Jose, CA, March 2022
- “Neuromorphic Photonics”
2022 IEEE VLSI Symposium, Honolulu, HI, June 2022
- “Photonics for Neuromorphic Computing”
2022 Boston University Photonics Center Symposium, Boston, MA, Dec. 2022
- “Photonics and Artificial Intelligence”
2023 Rank Prize Symposium, Windermere, UK, Feb 2023
- “Photonics for Neuromorphic Computing”
2023 Photonics and Electromagnetics Research Symposium, Prague, CZE, July 2023
- “Photonics for Neuromorphic Computing”
2023 Artificial Intelligence Photonics Conference, San Sebastian, Spain, Sept. 2023
- “Photonics for Neuromorphic Computing”

Publications

Books

1. P. R. Prucnal, "Optical Code Division Multiple Access: Fundamentals and Applications," published by Taylor and Francis, New York, 2005, ISBN 084933683X.
2. P. R. Prucnal, B. J. Shastri, "Neuromorphic Photonics," CRC Press, Taylor & Francis Group (May 2017).

Book Chapters

1. “Spread spectrum fiber optic local area network using optical processing,” in Digital Communications, E. Biglieri and G. Prati, eds. (North Holland, NY, 1986), pp. 193-202.
2. “All-optical ultrafast networks,” L.F.M. deMoraes, E. de Souza e Silva, L.F.G. Soares, eds. (Editorial Campus Ltda., Rio de Janeiro, 1987), pp. 15-23.
3. “Self-routing optical switch with optical processing,” with D. Blumenthal and P. Perrier, in Photonic Switching, T.K. Gustafson and P.W. Smith, eds. (Springer-Verlag Series in Electronics and Photonics 25, NY, 1988), pp. 193- 195.
4. “All-optical ultrafast networks,” in Data Communication Systems and Their Performance, L.F.M. deMoraes, E. de Souza e Silva, L.F.G. Soares, eds. (North Holland, NY, 1988), pp. 3-13.

5. "Demonstration of a self-clocked optical time-slot interchanger," with P.A. Perrier and M. Chbat, in Photonic Switching, J.E. Midwinter and H.S. Hinton, eds. (Optical Society of America, Washington, DC, 1989), 3, pp. 219-225.
6. "A collapsed-network space-division switching architecture," with P.A. Perrier, in Photonic Switching, J.E. Midwinter and H.S. Hinton, eds. (Optical Society of America, Washington, DC, 1989), 3, pp. 200-207.
7. "A new direction in photonic switching," with P.A. Perrier, in Computer Communication Technologies for the 90's, J. Raviv, ed. (Elsevier Science Pub. B.V., Amsterdam, 1989), pp. 149-154.
8. "Demonstration of a high-dimensionality space-division photonic switch," with P.A. Perrier (Springer-Verlag, NY, 1989), in press.
9. "Optical processing for self-routing photonic switching," in Coherent Optical Communications and Photonic Switching, G. Prati, ed. (Elsevier, NY, 1990), 265-283.
10. "Ultrafast all-optical synchronous multiple access fiber networks," in Photonic Switching, H.S. Hinton and J.E. Midwinter, eds. (IEEE press, Progress in Lasers and Electrooptics series, NY, 1990) reprinted from: IEEE J. Select. Areas Commun. SAC-4 #9, 1484-1493.
11. "Spread spectrum fiber optic local area network using optical processing," in Photonic Switching, H.S. Hinton and J.E. Midwinter, eds. (IEEE press, Progress in Lasers and Electrooptics series, NY, 1990) reprinted from: IEEE J. Lightwave Tech., LT4 #5, 547-554.
12. "Time-division optical micro-area networks," with R.K. Boncek, S.T. Johns, M.F. Krol and J.S. Stacy, in Optical Interconnects, A. Marrakchi, ed., (Marcel Dekker, Inc., N.Y., 1993), pp 115-163.
13. "Photonic fast packet switching," in Photonics in Switching, J.E. Midwinter, ed. (Academic Press, NY, 1993), pp 267-314.
14. "Spread spectrum fiber-optic local area network using optical processing," in Fiber Optic Local Area Networks, E.G. Rawson, ed. (SPIE, Bellingham, WA), in press 71092.
15. I. Glesk and P. R. Prucnal, "*Demonstration of 250 Gbs all-optical routing control of a Photonic crossbar switch*," in Guided-Wave Optoelectronics: Devices, Characterization, Analysis and Design, T. Tamir, H. Bertoni, and G. Griffel, Eds., published by Plenum, NY, 1995, pp. 25-33.
16. I. Glesk, J.P. Sokoloff, and P.R. Prucnal, "*Demonstration of all-optical demultiplexing of TDM data at 250 Gbs*," in Selected Papers on Photonic Switching, SPIE Milestones Series Vol. SM 121, Abdellatif Marrakchi, Ed., 1996, p. 219.
17. K. Kang, I. Glesk, P.R. Prucnal, "*Ultrafast optical time demultiplexers using semiconductor optical amplifiers*," in Current Trends in Optical Amplifiers and Their Applications, T.P. Lee, Ed., published by World Scientific, Singapore, 1996, p. 125-151.
18. R. J. Runser, K.-L. Deng, P. Toliver, I. Glesk, and P. R. Prucnal, "*Highly Scalable Optical TDM Router Using a Computer Controlled Time Slot Selector with Picosecond Resolution*," OSA Trends in Optics and Photonics Vol. 32, Photonics in Switching, Paul R. Prucnal and Daniel J. Blumenthal, Eds published by Optical Society of America, Washington DC, 2000, pp. 83- 88.
19. P. Toliver, K.-L. Deng, I. Glesk, and P. R. Prucnal, "*Simultaneous Optical Compression and Decompression of 100 Gb/s OTDM Packets Using a Single*

- TOAD and a Bi-directional Optical Delay Line Lattice*," OSA Trends in Optics and Photonics Vol. 32, Photonics in Switching, Paul R. Prucnal and Daniel J. Blumenthal, Eds. published by Optical Society of America, Washington DC, 2000, pp. 38-40.
20. P. Toliver, R. J. Runser, I. Glesk, and P. R. Prucnal, "*Experimental Demonstration of a 1.5 ps Switching Window for High Speed Optical Networks Using an Active Mach-Zehnder Optical Switch*," OSA Trends in Optics and Photonics Vol. 32, Photonics in Switching, Paul R. Prucnal and Daniel J. Blumenthal, Eds., published by Optical Society of America, Washington DC, 2000, pp. 120-123.
 21. D. Zhou, I. Glesk, and P. R. Prucnal, "*Optical Impulse Response of Semiconductor Optical Amplifiers in a Counter-Propagation Mach-Zehnder Switch*," in OSA Trends in Optics and Photonics Vol. 32, Photonics in Switching, Paul R. Prucnal and Daniel J. Blumenthal, Eds., published by Optical Society of America, Washington DC, 2000, pp. 144-151.
 22. L. Xu, I. Glesk, D. Rand, V. Baby, and P. Prucnal, "*Suppression of Beating Noise of Narrow-Linewidth Erbium-Doped Fiber Ring Lasers by Use of a Semiconductor Optical Amplifier*," in Eliminating beat noise in ring lasers, Editor B. Hitz, pp. 104-106, 2003.
 23. V. Baby, L. Xu, B. C. Wang, I. Glesk, and P. Prucnal, "*Optical Spectral Bistability in a Widely Tuneable Fiber Ring Laser and Its Applications for Bit- Level Optical Memory*," in Recent Research Development in Electronics, Editor S. G. Pandalai, Publisher Transworld Research Network, Trivandrum, India, ISBN 81-7895-068-5, 2003.
 24. I. Glesk, D. Rand, and P. Prucnal, "*Toad: Ultrafast All-Optical Device for Packet Routing in Future Optical Networks*," in Recent Research Development in Optics, vol. 3, pp. 89-102, Publisher Research Signpost, Trivandrum, India, ISBN 81-271-0028-5, 2003. [Invited]
 25. I. Glesk, B. Wang, L. Xu, V. Baby, and P. Prucnal, "*Ultra-Fast All-Optical Switching in Optical Networks*," in Progress In Optics, vol. 45, Editor E. Wolf, pp. 53-117, Publisher Elsevier, ISBN 0444513345, 2003, [Invited].
 26. V. Baby, D. Rand, C.-S. Bres, L. Xu, I. Glesk, and P. R. Prucnal, "*Incoherent Optical CDMA Systems*," in Optical Code Division Multiple Access: Fundamentals and Applications, Editor P. R. Prucnal, pp. 199-240, Publisher Taylor and Francis, New York, ISBN 084933683X, 2006.
 27. P. R. Prucnal, I. Glesk, P. Toliver, and L. Xu, "*Photonic switching with SOAs*," in Optical switching, Editor T. S. El-Bawab, pp. 215-244, Publisher Springer, ISBN 978-0-387-26141-6, 2006. [Invited]
 28. Y.-K. Huang, P. Toliver, and P. R. Prucnal, "*Signal Processing Techniques for Data Confidentiality in OCDMA Access Networks*," in Broadband Access Networks: Technologies and Deployments, Editors A. Shami, M. Maier, and C. Assi, pp. 261-279, Publisher Springer, ISBN 978-0-387-92130-3, 2009.
 29. M. P. Fok and P. R. Prucnal, "*Switching based on optical nonlinear effects*," in Optical Switches Materials and Design, Editors B. Li and S. J. Chua, Publisher Woodhead Publishing Limited, ISBN 1 84569 579 8, 2010.
 30. B. Wu, B. J. Shastri, and P. R. Prucnal, "*Secure Communication in Fiber- Optic Networks*," in Emerging Trends in Information and Communication

- Technologies Security, B. Akhgar and H. R. Arabnia, Eds. Waltham, MA: Elsevier (Morgan Kaufmann), 2013, ch. 11, pp. 173–183.
31. A. N. Tait, M. A. Nahmias, Y. Tian, B. J. Shastri, and P. R. Prucnal, "*Photonic Neuromorphic Signal Processing and Computing*," in Nanophotonic Information Physics, ser. Nano-Optics and Nanophotonics, M. Naruse, Ed. Springer Berlin Heidelberg, 2014, ch. 8, pp. 183–222.
 32. B. J. Shastri*, J. Chang*, A. N. Tait, M. P. Chang, B. Wu, M. A. Nahmias, and P. R. Prucnal, "Ultrafast Optical Techniques for Communication Networks and Signal Processing," in *All-Optical Signal Processing: Data Communication and Storage Applications*, S. Wabnitz and B. J. Eggleton (Eds.) Springer Berlin Heidelberg, 2015, ch. 15, pp. 469–503. [*equal contribution].
 33. M.P. Chang, J. Sun, M. Lu, E. Blow, P.R. Prucnal, "Optical-Based Interference Cancellation in Wireless Sensor Networks," *Sensors for Everyday Life*. Springer International Publishing, 2017. pp. 273–301.
 34. B.J. Shastri, A. N. Tait, T. Ferreira de Lima, M. A. Nahmias, H.-T. Peng and P.R. Prucnal, "Principles of neuromorphic photonics," in *Encyclopedia of Complexity and System Science*, R. A. Meyers, Ed. Springer Berlin Heidelberg, 2018.
 35. S. Bilodeau, T. Ferreira de Lima, C. Huang, B.J. Shastri, and P.R. Prucnal, "Neuromorphic Silicon Photonics," *Silicon Photonics for High-Performance Computing and Beyond*, edited by CRC Press, pp. 307-326, 2021.
 36. B. A. Marquez, C. Huang, P.R. Prucnal, and B.J. Shastri, "Neuromorphic Silicon Photonics for Artificial Intelligence," *Silicon Photonics IV. Topics in Applied Physics*, vol 139. Springer, Cham, 2021. pp. 417-447.

Book Reviews

1. "*Multirate Digital Signal Processing*," by R. E. Crochiere and L. E. Rabiner, in *The American Scientist*, March 1984.
2. "*Fiber Optics: Technology and Applications*," by S. D. Personick, in *The American Scientist*, July 1986.

Archive Journal Papers (Publication based on peer review):

1. M. C. Teich, P. R. Prucnal, and G. Vannucci, "*Optimum photon detection with a simple counting processor*," *Optics Letters*, vol. 1, no. 6, pp. 208-210, December 1977.
2. P. R. Prucnal and M. C. Teich, "*Single-threshold detection of a random signal in noise with multiple independent observations. 1: Discrete case with application to optical communications*," *Applied Optics*, vol. 17, no. 22, pp. 3576-3583, November 1978.
3. P. R. Prucnal, "*Chain rule for finite differences*," *Proceedings of the IEEE*, vol. 67, no. 3, pp. 445-446, March 1979.
4. P. R. Prucnal and M. C. Teich, "*Single-Threshold Detection of a Random Signal in Noise with Multiple Independent Observations, Part 2: Continuous Case*," *IEEE Transactions on Information Theory*, vol. 25, no. 2, pp. 213-218, March 1979.

5. P. R. Prucnal and M. C. Teich, "Statistical properties of counting distributions for intensity-modulated sources," Journal of the Optical Society of America, vol. 69, no. 4, pp. 539-544, April 1979.
6. P. R. Prucnal, "Generalized performance parameter for single-threshold detection systems," Applied Optics, vol. 19, no. 21, pp. 3606-3610, November 1980.
7. P. R. Prucnal, "Receiver performance evaluation using photocounting cumulants with application to atmospheric turbulence," Applied Optics, vol. 19, no. 21, pp. 3611-3616, November 1980.
8. P. R. Prucnal, W. Hwang, and H. C. Card, "Statistical Fluctuations Of Dopant Impurities In Ion-Implanted Bipolar Transistor Structures And The Minimum Device Dimensions For VLSI System Reliability," Microelectronics and Reliability, vol. 20, no. 5, pp. 633-646, 1980.
9. P. R. Prucnal and M. C. Teich, "An increment threshold law for stimuli of arbitrary statistics," Journal of Mathematical Psychology, vol. 12, no. 2, pp. 168-177, 1980.
10. P. R. Prucnal, "Single-Threshold Processing For Orthogonal Likelihood-Ratio Detection With Application To FSK Fiber-Optic Communications," IEEE Transactions on Communications, vol. 29, no. 5, pp. 743-749, May 1981.
11. P. R. Prucnal and B. E. A. Saleh, "Transformation of image-signal dependent noise into image-signal-independent noise," Optics Letters, vol. 6, no. 7, pp. 316-318, July 1981.
12. M. C. Teich, P. R. Prucnal, G. Vannucci, M. E. Breton, and W. J. McGill, "Multiplication Noise In The Human Visual System At Threshold - 1. Quantum Fluctuations And Minimum Detectable Energy," Journal of the Optical Society of America, vol. 72, no. 4, pp. 419-431, April 1982.
13. P. R. Prucnal and H. C. Card, "Effects on VLSI Yield Of Doubly-Stochastic Impurity Distributions," IEEE Transactions on Reliability, vol. 31, no. 2, pp. 185-190, June 1982.
14. P. R. Prucnal, "Experiments In Digital Signal Processing," IEEE Transactions on Education, vol. 25, no. 3, pp. 91-95, August 1982.
15. P. R. Prucnal and M. C. Teich, "Multiplication noise in the human visual system at threshold 2. Probit estimation of parameters," Biological Cybernetics, vol. 43, no. 2, pp. 87-89, August 1982.
16. M. C. Teich, P. R. Prucnal, G. Vannucci, M. E. Breton, and W. J. McGill, "Multiplication noise in the human visual system at threshold 3. The role of non-Poisson quantum fluctuations," Biological Cybernetics, vol. 44, no. 3, pp. 157-165, August 1982.
17. P. R. Prucnal and B. E. A. Saleh, "Evaluation Of Fiber-Optic Error Rates Using A Normalizing Transform," Journal of the Optical Society of America, vol. 72, no. 9, pp. 1171-1178, September 1982.
18. P. R. Prucnal, "Wideband FSK Optical Fiber Communication Experiment," Journal of Optical Communications, vol. 4, no. 3, pp. 99-103, September 1983.
19. P. R. Prucnal and M. C. Teich, "Refractory Effects In Neural Counting Processes With Exponentially Decaying Rates," IEEE Transactions on

- Systems, Man and Cybernetics, vol. 13, no. 5, pp. 1028-1033, September 1983.
20. P. R. Prucnal, "Optical Interconnections for VLSI Local-Area-Networks," IEEE ElectroTechnology Review, vol. 2, pp. 97-98, 1986.
 21. P. R. Prucnal, M. A. Santoro, and T. R. Fan, "Orthogonal Modulation In Fiber Optic Communications," Proceedings of the IEEE, vol. 74, no. 1, pp. 225-227, January 1986.
 22. P. R. Prucnal, E. R. Fossum, and R. M. Osgood, "Integrated fiber-optic coupler for very large scale integration interconnects," Optics Letters, vol. 11, no. 2, pp. 109-111, February 1986.
 23. P. R. Prucnal, M. A. Santoro, and T. R. Fan, "Spread Spectrum Fiber-Optic Local Area Network Using Optical Processing," Journal of Lightwave Technology, vol. T-4, no. 5, pp. 547-554, May 1986.
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 25. P. R. Prucnal, M. A. Santoro, and S. K. Sehgal, "Ultrafast All-Optical Synchronous Multiple Access Fiber Networks," IEEE Journal on Selected Areas in Communications, vol. SAC-4, no. 9, pp. 1484-1493, December 1986.
 26. P. R. Prucnal, D. J. Blumenthal, and P. A. Perrier, "Self-routing photonic switching demonstration with optical control," Optical Engineering, vol. 26, no. 5, pp. 473-477, May 1987.
 27. P. R. Prucnal and E. L. Goldstein, "Exact variance-stabilizing transformations for image-signal-dependent Rayleigh and other Weibull noise sources," Applied Optics, vol. 26, no. 6, pp. 1038-1041, March 1987.
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