UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC,
Petitioner

v.

KOVE IO, INC.,
Patent Owner

Case IPR2024-01017
U.S. Patent No. 7,103,640

DECLARATION OF DR. MICHAEL T. GOODRICH
IN SUPPORT OF PATENT OWNER'S PRELIMINARY RESPONSE

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I, Dr. Michael T. Goodrich, hereby declare as follows:

I. INTRODUCTION

1. I have been retained as an independent technical expert by Patent Owner Kove IO, Inc. ("Patent Owner" or "Kove") in this proceeding. Kove has asked me to provide my expert opinions concerning certain technical issues relating to Petitioner Google LLC.'s ("Petitioner" or "Google") petition for *inter partes* review of U.S. Patent 7,103,640 ("'640 patent") in Case No. IPR2018-01017 ("Petition") and the accompanying Declaration of Dr. Sandeep Chatterjee (Ex. 1002). I am being compensated for my work in this matter at my customary hourly rate. I am also reimbursed for any reasonable expenses associated with my work on this matter. My compensation is not contingent on the results of my study, the substance of my opinions, or the outcome of this matter.

II. MATERIALS CONSIDERED

2. In providing my expert opinions in this matter, I have reviewed:

- Ex. 1001: U.S. Patent No. 7,103,640 to Overton et al. ("the '640 patent")
- Ex. 1002: Declaration of Sandeep Chatterjee, Ph.D.
- Ex. 1003: Curriculum Vitae of Sandeep Chatterjee, Ph.D.
- Ex. 1004: Prosecution History of U.S. Patent No. 7,103,640
- Ex. 1005: WIPO Application No. 1997/043717 to Kahn et al.
- Ex. 1006: U.S. Patent No. 6,473,781 to Skagerwall et al.

- Ex. 1007: R. Vingralek, Distributed file organization with scalable cost/performance (1993)
- Ex. 1011: Japanese Patent Application Publication No. H09-231180 to Sato et al.
- Ex. 1014: RFC 768, User Datagram Protocol (Aug. 28, 1980)
- Ex. 1015: M. C. Norrie et al., The Database Research Group at ETH Zurich, SIGMOD Record (March 1994)
- Ex. 1016: U.S. Patent No. 5,764,756
- Ex. 1019: First Amended Complaint in Kove IO, Inc. v. Google LLC, Case No. 1:23-cv-04244 (N.D. Ill. Nov. 14, 2023)
- Ex. 1020: Declaration of Sylvia D. Hall-Ellis, Ph.D.
- Ex. 1022: Amazon Web Services, Inc. v. Kove IO, Inc., IPR2020-00276, Paper 23 (June 16, 2020)
- Ex. 1024: Memorandum Opinion and Order in Kove IO, Inc. v. Amazon Web Services, Inc., Case No. 1:18-cv-08175 (N.D. Ill. Dec. 17, 2021)
- Ex. 1025: Memorandum Opinion and Order in Kove IO, Inc. v. Amazon Web Services, Inc., Case No. 1:18-cv-08175 (N.D. Ill. Feb. 6, 2024)
- Ex. 1026: Request for Ex Parte Reexamination of U.S. Patent No. 7,103,640 in Ex Parte Reexamination No. 90/014,552 (July 23, 2020)

- Ex. 1027: Order Denying Request for Ex Parte Reexamination in Ex Parte Reexamination No. 90/014,552 (Sept. 9, 2020)
- Ex. 1028: Request for Ex Parte Reexamination of U.S. Patent No. 7,103,640 in Ex Parte Reexamination No. 90/019,036 (Nov. 19, 2021)
- Ex. 1029: Order Granting Request for Ex Parte Reexamination in Ex Parte Reexamination No. 90/019,036 (Dec. 23, 2021)
- Ex. 1030: Notice of Intent to Issue Ex Parte Reexamination Certificate in Ex Parte Reexamination No. 90/019,036 (Sept. 22, 2022)
- Ex. 1031: Request for Ex Parte Reexamination of U.S. Patent No. 7,103,640 in Ex Parte Reexamination No. 90/019,166 (Feb. 17, 2023)
- Ex. 1032: Order Granting Request for Ex Parte Reexamination in Ex Parte Reexamination No. 90/019,166 (Apr. 4, 2023)
- Ex. 1033: 2020 to 2023 Northern District of Illinois Orders Regarding Motions to Stay
- Ex. 1034: Agreed Order Setting Amended Patent Case Schedule in Kove IO, Inc. v. Google LLC, Case No. 1:23-cv-04244 (N.D. Ill. Feb. 20, 2024)
- Ex. 1035: Federal Court Management Statistics (December 2023)
- Ex. 1036: Memorandum by Director Vidal (June 21, 2022)
- Ex. 1052: Order for Staying Discovery Process until July 15, 2024 in Kove IO, Inc. v. Google LLC, Case No. 1:23-cv-04244 (N.D. Ill. May 1, 2024)

- Ex. 1053: Northern District of Illinois Local Patent Rules
- Ex. 1055: Google's Motion to Stay and for Expedited Briefing Schedule in Kove IO, Inc. v. Google LLC, Case No. 1:23-cv-04244 (N.D. Ill. Apr. 30, 2024)
- Ex. 1056: Joseph B. Greene, Oracle8 Server Unleashed (1998)
- Ex. 1057: Joseph B. Greene, Oracle DBA Survival Guide (1995)
- Ex. 1058: Betty Salzberg, File Structures (1988)
- Ex. 1059: Andrew P. Black & Yeshayahu Artsy, Implementing Location Independent Invocation (1989)
- Ex. 2013: Joint Claim Construction Chart in *Kove IO, Inc. v. Amazon Web Services, Inc.*, Case No. 1:18-cv-08175 (N.D. Ill. May 29, 2020) (Dkt. 382)

3. In forming the opinions set forth herein, I have considered: 1) The documents listed above; 2) my education, knowledge, skills, and experience in computer science, including, for example, the topics of networking, caching and mass data storage optimization, parallel and distributed computing, and high-performance computing; and 3) the level of skill of a person having ordinary skill in the art (POSITA) at the time of the date of invention of the ’640 patent.

III. BACKGROUND AND QUALIFICATIONS

4. Attached hereto as Appendix A is a true and correct copy of my Curriculum Vitae (“CV”). I received a Bachelor of Arts degree in Mathematics and

Computer Science from Calvin University in 1983, a Master of Science in Computer Science from Purdue University in 1985, and a Ph.D. in Computer Science from Purdue University in 1987.

5. I am a Distinguished Professor in the Department of Computer Science at the University of California, Irvine, where I have been a faculty member since 2001. The Distinguished Professor title at University of California, Irvine is a campus-level distinction reserved for above-scale faculty who have achieved the highest levels of scholarship over the course of their careers and have earned national and international distinctions and honors of the highest level. I was a professor in the Department of Computer Science at Johns Hopkins University from 1987-2001.

6. I have authored and coauthored over 350 publications, including several widely adopted books, such as *Introduction to Computer Security* and *Algorithm Design and Applications*. My research includes contributions to data structures and algorithms, information security and privacy, networking, graph algorithms, computational geometry, distributed and parallel algorithms, and cloud security. For example, I have published research articles on topics in cloud computing and storage, hashing, data structures, and network and distributed computing. Using the indexing scheme of my CV, examples of such publications include P-3, P-5, B-1, B-3 through B-14, Ch-4, Ch-7, Ch-8, Ch-10, Ch-12, J-7, J-26, J-36, J-38, J-41, J-45, J-56, J-60, J-69, J-72, J-78, J-83, J-84, C-41, C-43, C-51, C-

53, C-62, C-63, C-64, C-72, C-77, C-78, C-85, C-104, C-105, C-107, C-111, C-122, C-125, C-133, C-147, C-151, C-152, C-153, C-155, C-156, C-159, C-161, C-162, C-163, C-165, C-167, C-168, C-171, C-172, C-174, C-180, C-182, C-193, C-199, C-200, C-202, C-207, C-209, and C-210. Further, I have published research articles on topics in audio and video creation, encoding, and distribution, as well as authoring research videos, including publications P-5, B-14, J-20, J-37, J-65, J-66, J-68, J-72, C-36, C-38, C-54, C-64, C-74, C-112, C-120, C-123, and C-159.

7. In addition, I have consulting experience in matters involving algorithms, cryptography, machine learning, digital rights management, computer security, networking, software, video distribution, and storage technologies.

8. I am a Fellow of the American Association for the Advancement of Science (AAAS), a Fulbright Scholar, a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), and a Fellow of the Association for Computing Machinery (ACM). I am a foreign member of the Royal Danish Academy of Science and Letters. I am also a recipient of the IEEE Computer Society Technical Achievement Award and the Pond Award for Excellence in Undergraduate Teaching.

9. My research has been supported by the Defense Advanced Research Projects Agency (DARPA), the National Science Foundation (NSF), the Office of Naval Research (ONR), the Army Research Office (ARO), and the National Security

Agency (NSA). For example, I was co-principle investigator on an approximately $700K NSF grant funding (grants 6 and 19 in my CV) to build distributed data repositories and network query infrastructures for astrophysical data; a $350K NSF grant to build out network connectivity and applications at Johns Hopkins University (CV, grant 11); a $900K grant from NSF to study high-bandwidth distributed computing (CV, grant 24); an approximately $500K grant from the ONR to study scalable methods for the analysis of network-based data (CV, grant 31); a $500K grant from NSF to study trustworthy cloud computing (CV, grant 33); an approximately $400K NSF grant to study privacy-preserving cloud computing (CV, grant 34); and an approximately $150K grant from NSF to study security protocols for advanced data structures (CV, grant 37).

10. I am a co-inventor on several U.S. patents, including U.S. Patent No. 7,257,711, "Efficient Authenticated Dictionaries with Skip Lists and Commutative Hashing," which discloses secure distributed data authentication schemes based on cryptographic hash functions and digital signatures; U.S. Patent No. 7,299,219, "High Refresh-Rate Retrieval of Freshly Published Content using Distributed Crawling," which discloses a technology for quickly retrieving website data that can change frequently, so as to be stored in a search engine; U.S. Patent No. 8,681,145, "Attribute Transfer Between Computer Models Including Identifying Isomorphic Regions in Polygonal Meshes," which teaches how to map one mesh-based

computer model to another, with applications to animated video creation; and U.S. Patent No. 9,152,716, "Techniques for Verifying Search Results Over a Distributed Collection," which discloses a system for searching the Internet so as to produce cryptographically verifiable search results that can be produced by a search engine.

11. I have taught courses at Johns Hopkins University, Brown University, and University of California, Irvine, at both the undergraduate and graduate levels. Topics of my courses have included computer security, algorithms, data structures, networking, algorithm engineering, computational geometry, computer graphics, and parallel processing. In addition, I have mentored 25 Ph.D. students over the years, who have written their Ph.D. theses on topics in algorithms, data structures, networking, parallel processing, and computer security and privacy.

12. I have served as an editor on several technical journals, including Computational Geometry: Theory and Applications, Journal of Computer & System Sciences, Journal of Graph Algorithms and Applications, Int. Journal of Computational Geometry & Applications, and Information Processing Letters. I have also served on many program committees (PCs) for top conferences and workshops in Computer Science, including serving as PC chair in several instances, including ACM Symposium on Computational Geometry (SoCG), ACM Symposium on Theory of Computing (STOC), Workshop/Symposium on Algorithms and Data Structures (WADS), Algorithm Engineering and

Experimentation (ALENEX, which I co-founded with Dr. Catherine McGeoch in 1999), IEEE Symposium on Foundations of Computer Science (FOCS), ACM-SIAM Symposium on Discrete Algorithms (SODA), International Symposium on Graph Drawing (GD), International Colloquium on Automata, Languages, and Programming (ICALP), ACM Conference on Computer and Communications Security (CCS), European Symposium on Algorithms (ESA), IEEE International Parallel and Distributed Processing, Symposium (IPDPS), ACM Symposium on Parallel Algorithms and Architectures (SPAA), ACM Symposium on Advances in Geographic Information Systems (GIS), IEEE Symposium on Security and Privacy (S&P), IEEE International Conference on Big Data, IEEE International Conference on Data Engineering (ICDE), and International Symposium on Algorithms and Computation (ISAAC).

IV. LEGAL PRINCIPLES APPLIED IN THIS DECLARATION

13. Counsel for Patent Owner has informed me of the legal principles that apply for purposes of my declaration.

A. Claim Construction

14. I understand that the words of a claim are generally given their ordinary and customary meaning, which I understand is the meaning that the term would have to the person of ordinary skill in the art in question at the time of the invention. I understand that the person of ordinary skill in the art is deemed to read the claim

term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification.

15. I understand that claim construction focuses on the "intrinsic evidence," which consists of the claims themselves, the specification, and the prosecution history. I understand that the claims can provide helpful context for how the claim term is used. I understand that the specification is highly relevant to the claim construction analysis and usually dispositive concerning the meaning of a claim term. I further understand, however, that it is inappropriate to import limitations from preferred embodiments recited in the specification into the claim language.

16. I understand that "extrinsic evidence" may also be considered when determining the meaning of a claim. I understand that there are different sources of extrinsic evidence, including dictionaries, inventor testimony, expert testimony, and learned treatises. I understand that intrinsic evidence is generally favored over extrinsic evidence, and that extrinsic evidence may not be used to contradict the meaning of the claim term when read in light of the intrinsic evidence.

B. Patentability

17. While I am not an attorney, I have been informed that a patent is presumed valid, and that each claim of a patent (whether an independent or dependent claim) is presumed valid independently of the validity of other claims. I understand that the Patent Office will find a patent claim unpatentable in an *inter*

partes review if it concludes that it is more likely than not that the claim is unpatentable.

18. I understand that during an *inter partes* review proceeding, the standard for finding claims of an issued U.S. patent unpatentable is the "preponderance of the evidence standard."

19. I understand that issues of patentability relating to the claims of the '640 patent challenged in the Petition are to be considered under the relevant pre-AIA sections of Title 35 of the United States Code. I have been provided an understanding of those sections as noted below.

1. Anticipation

20. I understand for a claim to be unpatentable as anticipated under 35 U.S.C. § 102, every element and limitation of the claimed invention must be found in a single prior art reference, but also it must describe those elements arranged or combined as required in the claim. Although anticipation can be based on inherency, the missing disclosure must be necessarily present, not merely probably or possibly present, in the prior art.

21. I understand that a limitation can be inherently disclosed as a part of an anticipation analysis, but the standard for inherency is quite high and strict. Inherency may not be established by probabilities or possibilities. Inherency requires inevitability. I understand that to be inherent in a reference, the alleged limitation

must be inevitable or necessarily present in the art. Such a showing must be accompanied by some evidence that makes clear that the missing matter alleged to be inherent is necessarily present or the natural result flowing from the operation as taught would result in performance of the questioned function.

22. I understand that the Asserted Patents predate the America Invents Act and the pre-AIA version of 35 U.S.C. § 102 applies to any anticipation analysis. I have been instructed that under the pre-AIA version of the law, a claim is anticipated under § 102(a) only if the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent.

23. I have been instructed that under the pre-AIA law, a claim is anticipated under § 102(b) only if the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States.

24. Pre-AIA anticipation law also included a provision allowing for anticipation under § 102(e) where the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty

defined in section 351(a) shall have the effects for the purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

25. References that are ambiguous to the presence or description of a particular claim element do not anticipate a claim.

26. I also understand that for a reference to qualify as "prior art" for anticipation or obviousness, it must meet certain criteria. For example, I also understand that a prior art reference must be enabling. That is, the description in a prior art reference must be sufficient to enable a person of skill in the art at the time of the invention to make and use the claimed invention without undue experimentation. Several factors govern whether a disclosure would require undue experimentation. These are: (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims.

2. Obviousness

27. I understand for a claim to be unpatentable as obvious under 35 U.S.C. § 103, the differences between the claimed invention and the prior art must be such

that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person of ordinary skill in the art to which the claimed invention pertains.

28. I understand that in considering whether a claimed invention is obvious, one may consider whether there was a reason that would have prompted a person having ordinary skill in the art to which the claim invention pertains to combine known elements in a way the claimed invention does, taking into account such factors as: (1) whether the claimed invention was merely the predictable result of combining familiar prior art elements according to their known function(s); (2) whether the prior teaches or suggests the desirability of combining elements claimed in the invention; (3) whether prior art teaches away from combining elements in the claimed invention; and (4) whether a person having ordinary skill in the art had used a known technique to improve similar devices in the same way. I am informed that it is not sufficient to merely assert that it was obvious to try a combination of prior art elements in hindsight; knowledge of a problem and motivation to solve it are entirely different from a motivation to combine particular references.

29. I am informed that objective factors tending to show that a patent is not obvious include, among others: (1) evidence of copying the claimed invention(s); (2) long-felt but unmet need for the claimed invention(s); (3) commercial success of the claimed invention(s); (4) skepticism as to the solution; (5) industry acceptance

of the claimed invention(s); and (6) praise by others for the claimed invention(s). I understand all these factors may bear on whether a patent holder can overcome an initial impression of obviousness, subject to the requirement that the patent holder establish a nexus—in other words, a direct connection or link—between the adduced evidence and claimed invention's merits.

30. I understand that obviousness cannot be predicated on the mere identification in the prior art of individual components of claimed limitations. It is not appropriate to pick and choose among the individual elements of assorted prior art references to recreate the claimed invention. It is also not enough to show that the prior art references can be combined (i.e., are combinable). Rather, to prove obviousness, there must have been sufficient motivation at the time of the invention for a person of ordinary skill in the art to combine or modify the references in the manner proposed to arrive at the claimed invention. I also understand that motivation may not be gleaned from impermissible hindsight reasoning. For example, the reason to combine the prior art to arrive at the claimed invention cannot be based in whole or in part on what the patent in question teaches or discloses. I understand that the inquiry into secondary considerations is one way to test hindsight analysis.

31. I understand that it is Petitioner's burden to prove that a person of ordinary skill in the art would have been motivated to combine prior art references.

I understand that the motivation to combine must be supported by evidence and articulated explanation. When considering obviousness, I understand that it is insufficient to simply say that a skilled artisan, once presented with a combination of references, would have understood that they could be combined.

32. Rather, Petitioner must show that a person of ordinary skill in the art would have been motivated to combine or modify the prior art to arrive at the claimed invention. Conclusory statements alone are insufficient, and any obviousness analysis must be supported by a reasoned explanation as to why a person of ordinary skill in the art would have been motivated to combine the prior art. For example, "common sense" or "intuition" alone cannot support a motivation to combine without explaining why they would lead a person of ordinary skill in the art to solve the problem at hand with the particular elements of the claimed invention at the time of invention.

33. I understand that there is no motivation to combine references when a feature from one reference would be redundant or superfluous in the other reference. I further understand that obviousness cannot be found in an absence of a specific explanation as to why a particular combination is not redundant.

34. I understand that there is no motivation to combine when the combination would be inoperable and, thus, "teaches away" from the combination. To the extent that references teach away from the claimed invention, they cannot

establish obviousness. Prior art teaches away from an invention when a person of ordinary skill would be discouraged or diverted from following the path leading to the invention. I also understand that if a proposed combination would require modification of prior art and that modification would render the prior art unsatisfactory for its intended purpose, then there is no motivation to make the proposed combination and modification. I also understand that when prior art teaches away from combining prior art references, the discovery of a successful way to combine them is unlikely to be obvious.

35. I understand that to determine the scope and content of the prior art, one must consider whether the prior art was reasonably relevant to the particular problem the inventors faced in making the claimed invention.

36. To determine whether any material differences existed between the scope and content of the prior art and each asserted claim, one must consider the claimed invention as a whole to determine whether or not the claim would have been obvious in light of the prior art. If the prior art discloses all the elements in separate references, I must consider whether it would have been obvious to combine those references. I understand that a claim is not obvious just because all elements of a claim already existed.

37. I understand that a motivation to conduct further testing or research that may lead to the claimed invention does not necessarily render a claim obvious. I

further understand that an invention is not necessarily rendered obvious simply because a party asserts it was obvious to try a certain combination. Rather, the question is whether a person of ordinary skill would have had good reason to pursue the known options within his or her technical grasp, and whether such pursuit would have led to anticipated success. I understand that an invention would not have been obvious to try to a person or ordinary skill in the art if any of those findings cannot be made.

V. BACKGROUND

A. Overview of the ’640 Patent

38. The ’640 patent describes an innovative approach to efficiently manage and retrieve data stored across a network of distributed data storage locations. In large-scale distributed data environments, data can reside in multiple repositories, complicating the process of locating and retrieving information related to specific entities. The ’640 patent teaches techniques to efficiently separate the “where” (determining the appropriate data storage server(s) to query) from the “what” (the data content itself), thereby streamlining data access.

39. As an example, the ‘640 patent teaches that data entities are stored in data repositories, where each data entity is associated with a unique identifier. Ex. 1001, 4:7-9, 34-36. (“An ‘identifier string’ or an ‘identifier’ is a unique string with which zero or more location strings are associated in an NDTP server. … NDTP

defines an entity key (or "identifier") as a unique string used to refer to an entity about which a distributed query is performed"). A network of data location servers stores the mappings between identifiers and the locations of the corresponding data in the data repositories. *See, e.g., id.,* 24:4-6 ("NDTP servers maintain a mapping between entity identifiers and data locations.") The patent further teaches that it is expected that the list of data location servers may change over time. *Id.*, 16:4-13. The specification provides:

> The NDTP server redirection mechanism also permits construction of NDTP server clusters (described below). It is expected that the identifier string hash function will be defined at the time NDTP is implemented, but the actual list of NDTP servers **90** will change from application to application and within a single application throughout the lifetime of the system. Therefore, it is necessary for clients to be able to discover updated NDTP server lists, and any other relevant dynamic parameters of the server selection function as these inputs change.

Id., 16:4-13.

40. In the following, I briefly summarize certain embodiments relating to the claims of the '640 patent.

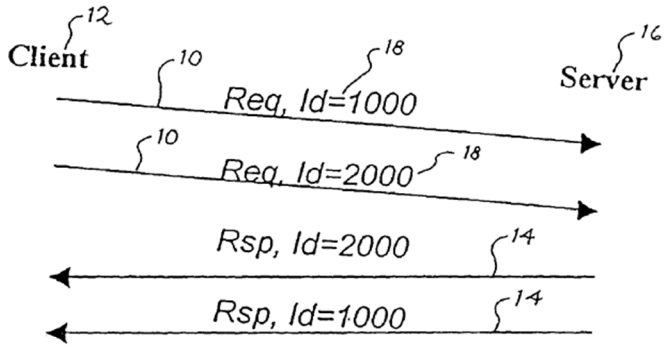
B. Overview of the Claims

41. Distributed data collection involves storing data stored and retrieved among multiple databases or data repositories connected by a network. Conventional distributed data collection environments maintained a static relationship of data and its location. In this regard, conventional distributed data collection environments maintained a static relationship of data and its location. Every time data moved from one location to the next, all of the systems that maintained the static relationship had to be updated. As a result, while conventional distributed data collection environments allowed for dispersed storage, doing so made reliably locating and retrieving the data challenging, particularly where data is added or removed dynamically. *Id*., 1:37-41.

42. The ’640 patent addresses the issues with conventional systems, which were fundamentally limited in the types of searches that could be performed and the forms of data returned based on the search. *Id*., 1:43-53. For example, the ’640 patent states, “One example is where a client requests files based on a subject, like a person’s name. In the search results, therefore, only text files of peoples’ names may be retrieved. Another problem in current retrieval systems is that the client may receive text and image files in the search results, but could not seamlessly access the image files. Yet another problem in current retrieval systems is that video and sound files related to the request may not even be found in the search results. For example,

a doctor might be able to retrieve medical records on a specific patient, but cannot view an MRI or X-Ray results associated with that record." *Id.*, 1:45-55.

43. The '640 patent addresses the issues with conventional systems in two ways. First, the '640 patent teaches separating the data location information from the data itself. *See e.g., id.*, 1:62-65, 1:14-18, 20:4-8, Fig. 11. Second, the '640 patent teaches several ways clients can request location information associated with an identifier string, where each request has a corresponding response message returned by the server receiving the request. *Id.*, 6:32-34. An example of NDTP protocol requests and responses are depicted in Figure 1:

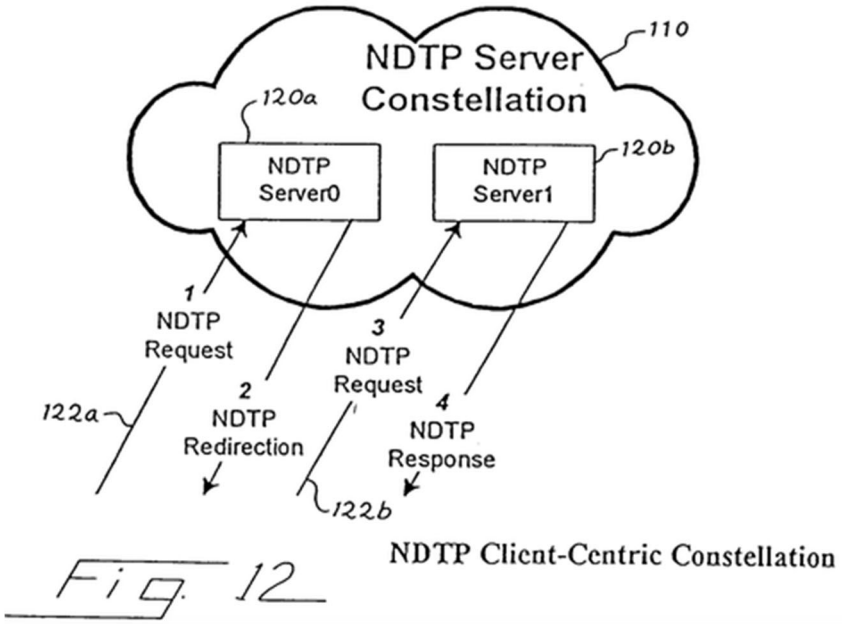


Use Of Request Identifiers

Fig. 1

Id., 1001, Fig. 1.

44. The '640 patent teaches different configurations for clients can request location information associated with an identifier string. The specification describes an "NDTP Client-Centric Constellation" schematic illustrated in Fig. 12:



Ex. 1001, Fig. 12. Fig. 12 shows a configuration in which the client sends a request (1 NTDP Request) to a server (NDTP Server0) in the network; and, if that server (NDTP Server0) does not have the requested data, it will send an "NDTP Redirection" response, or "redirect message," (labeled "2 NDTP Redirection" on Fig. 12) back to the client. The client uses the information contained in the NDTP Redirection response to send the request to another server (NDTP Server1) that does have the requested data, and that server then sends that response (4 NDTP Response) back to the client. *Id.*, 17:9-21. As the specification further explains:

> [the] NDTP redirection mechanism uses a NDTP_RDR_RSP message to indicate that the server **120** *a* to which the NDTP request **122** *a* was directed does not contain any of the location strings associated with the identifier string supplied in the NDTP request **122** *a*. **The NDTP_RDR_RSP message contains all the information required for the originator of the NDTP request 122 *a* [i.e., the client] to reissue the original NDTP request 122 *b* to a different NDTP server 120 *b* that does have location strings associated with the identifier string supplied in the NDTP request 122 *b*.**

Id., 17:45-54

45. The patent teaches that responses to client queries are always returned by the queried server, rather than some other server. The specification repeatedly and consistently teaches that a client may query a server in the network, and it is that queried server that will provide a response back to the client. *Id*., 2:36:40; 2:62-65; 3:3-6; 4:14-18; 4:29-33; 6:32-44; 9:15-21; 11:46-48; 12:50-54; 14:48-52; 16:53-56; 17:14-21; 17:49-54; 18:21-35. As a result, client requests can be efficiently serviced by a distributed network of location servers that may be dynamically changing.

46. The independent claims at issue (claims 10, 17, 18) all claim the above-described "redirect message" functionality. For example, claim 10 states:

[10.pre] A method for retrieving data location information for data stored in a distributed network, comprising the steps of:

[10.a] receiving at a first client a data query for retrieving data associated with an identification string, wherein the data is stored at a data repository in the distributed network and wherein a location string associated with the identification string of the data is stored in at least one of a plurality of data location servers;

[10.b] transmitting a data location request from the first client to a first data location server to retrieve the location string associated with the identification string in the data query, the data location request including the identification string;

[10.c] (**i**) if the first data location server does not possess the location string, transmitting a redirect message to the first client, (**ii**) the redirect message containing information for use by the first client to calculate a location of a second data location server, (**iii**) wherein the second data location server contains the location string;

[10.d] calculating the location of the second data location server at the first client; and

[10.e] transmitting the data query from the first client to the second data location server.

47. Claim 10 describes a method in which a request for data location information is transmitted from a client to a first data location server. If the queried first data location server does not have the requested location string, that first data location server transmits a "redirect message" back to the client, where the "redirect message" that "contains information for use by the first client to calculate a location of a second data location server." *Id*., 21:38-61.

48. For example, the '640 patent describes ways in which the information for client redirection can be provided in a redirect message. (1) The redirect message can include a data location server table, and in which case, the patent specification that the client can then uses a hash function on the identifier string and use the server table to calculate the location of the correct server. *See id.*, 14:56-15:34. (2) The redirect message can include a transmitted function that the client applies to the identifier string to calculate the location (e.g., URL) of the correct data location server. *See id.*, 15:35-16:3. The specification teaches that in both mechanisms, it is the data location server that received the query that directly sends the redirect message to the client. *Id.*, 14:48-55.

49. I understand the claim to be a method in which a request for data location information is transmitted from a client to a first data location server. If that queried data location server does not have the requested location string, it transmits a "redirect message" back to the client, wherein the "redirect message"

must "contain[] information for use by the first client to calculate a location of a second data location server." *Id*., 21:38-61.

50. A POSA's understanding of element [10.c] is consistent with the patent's prosecution history. When the examiner issued the decision confirming the patentability of the "redirect message"-based claims in 'Reexamination No. 90/014,552, the examiner pointed out the prosecution history:

> This limitation was also the focus of the Applicant's remarks filed in response to the 2/9/05 Office action. The Applicant argued, "Referring to claim 24, when a user enters a request at a client for data at a first client, the data query includes an identifier string (e.g. a file name or URI) and expects to receive information (a location string) on where the data corresponding to that filename resides. ...During this navigation process, if a data location server does not possess the sought after location string, it transmits a redirect message back along the communication path the data location request traveled to the first client. <u>The redirect message that is sent back to the first server contains information with which the first client is configured to determine a location of a second data location server that does contain the sought after location string. In other words, the redirect message allows the</u>

> first server to calculate a new data location server address so that the first server "redirects" its query to the right data location server.
>
> ...Similarly, the method of claim 33 also includes includes the feature of redirection, however claim 33 addresses a more simplified scenario such as shown in FIG. 12, where there are not necessarily any intervening devices between the client and the data location servers.
>
> New independent claims 41, and 42 relate to system configurations adapted to incorporating software instructions implementing the redirection process."

Ex. 1027, 13-14.

51. The reexamination proceedings and prosecution history thus confirm my understanding that the '640 patent's redirect message provides the client the information necessary to determine the correct data location server and redirect its query to that server.

52. Claim element [10.c] is substantively common to all the claims I understand are at issue, specifically claim elements [17.c] and [18.e]. I have been asked only to address certain of Google's arguments relating to these claim elements in this Declaration.

C. Overview of Kahn

53. "Kahn" is WIPO Application No. 1997/043717 to Kahn et al. Kahn discloses a system for managing digital objects in a network, where the objects are stored at server locations accessible in the network using a storage technique that renders the digital objects secure against unauthorized access. Ex. 1005, 3:15-19. Kahn discloses that a "digital object" is "any set of sequences of bits or digits and an associated unique identifier which we call a 'handle'." *Id*., 1:10-12. Kahn further discloses, "the pointer to the object (versus identifier information for the object) is stored in multiple servers on the network" and "[t]he identifiers are generated in a manner to distribute the pointer information with the unique identifier information) relatively evenly among the servers, using a hashing algorithm." *Id*., 4:18-22.

54. Kahn describes that handle management systems 54 are "used to find the location of digital objects" and "[a] handle for an object may be associated with zero or more object pointers," which "contain location information for locating digital objects." *Id*., 28:29-34. In Kahn, "[h]andle servers 58 process handle query requests," such that a handle server accepts a handle as input and returns a list of pointers associated with the handle, where each pointer comprises a domain name of a storage system (repository) for the associated digital object. *Id*., 29:5-12.

55. Separate to handle servers 58, Kahn describes a "handle directory server", which is also referred to as a "handle server directory 59." *Id*., 29:18-20,

38:9-11. The handle server directory 59 holds a table 149 that associates hash ranges 150 with domain names of handle servers 58. *Id*., 46:22-24, Fig. 7. A client in Kahn downloads the table that associates hash ranges with handle server domain names from the handle server directory. *Id*., 46:29-32. A client uses this table to determine which handle server 58 to send a request for a list of pointers associated with a handle. *Id*., 47:1-5. The client then sends a handle request to the handle server 58 and if the handle server finds the associated list of points for the handle, it returns it. *Id*., 47:10-13. But if the handle was sent to the wrong handle server 58, it returns a "not-responsible-for-handle" message. At that point, the client system can download the hash range/handle-server-domain-name table from the handle server directory 59 again and attempt the mapping again. *Id*., 47:13-18.

D. Overview of Vingralek

56. Vingralek is a technical report titled "Distributed file organization with scalable cost/performance".

57. Vingralek presents a distributed file organization system for record-structured, disk-resident files with key-based exact-match access. The file is organized into buckets that are spread across multiple servers, where a server may hold multiple buckets. Client requests are serviced by mapping keys onto buckets and looking up the corresponding server in an address table, which is stored at the client.

58. In Vingralek's system, there is an indirection between bucket numbers and server numbers, so that multiple buckets can be assigned to the same server. This indirection is implemented by an address table, and updates to the address table are propagated to clients and other servers in a deferred manner. *Id*. at 5. Vingralek also says, "Hashing is used merely to distribute keys across buckets. The internal organization of buckets can be chosen freely, and may vary between servers." *Id*. at 7.

59. Vingralek discloses a key-value store with a process for looking up the value associated with a key such that when a client *c* invokes an operation on key *K* (e.g., to retrieve the record(s) with key *K*), it applies to *K* the hash functions *h* until it finds in its copy of the address table a server where *K* should reside and *c* sends *K* to that server. When a server s in Vingralek receives a key *K* from the client, it applies to *K* the hash functions *h* until it finds in its copy of the address table a server s' where *K* should reside as far as s is concerned. If *K* does belong to the server that received it (i.e., if $s = s'$), the server performs the requested operation. However, if *K* was sent to the wrong server, the server forwards it to s', and updates the client's view with its file level *L*, and its address table. Eventually, *K* is received by the correct server and the client operation is executed. Further, clients gradually bring address table up-to-date, but the number of iterations required to do this can be unbounded. *Id*. at 9-10.

VI. PRIORITY DATE OF THE '640 PATENT

60. For purposes of this proceeding, I have been asked to assume the priority date of the '640 patent is July 8, 1998, which is the earliest possible priority date.

VII. LEVEL OF ORDINARY SKILL

61. In my opinion, a personal of ordinary skill in the art (POSA or POSITA) with respect to the '640 patent as of the priority date would have a Bachelor's degree in Computer Science (or equivalent), and one to two years of industry experience in software engineering, networking, or data storage and retrieval. An advanced degree in Computer Science, or equivalent, could be substituted for one to two years of industry experience in software engineering, networking, or data storage and retrieval. Further, four or more years of industry experience in software engineering, networking, or data storage and retrieval could be substituted for a bachelor's degree in computer science and one to two years of industry experience in software engineering, networking, or data storage and retrieval. For instance, the '640 Patent states that its "invention relates generally to the storage and retrieval of information, and in particular, to a system and method for managing global search and retrieval of information across a network." Ex. 1001, 1:29-33.

62. I have reviewed Dr. Chatterjee's description of the level of ordinary skill in the art with respect to the '640 patent. Ex. 1002, ¶ 20. I disagree.

63. However, my opinions in this Declaration regarding the ’640 patent and the prior art would not differ under either the perspective of a POSITA as I have defined above or under Dr. Chatterjee’s definition at the time of the invention of the ’640 patent.

VIII. CLAIM CONSTRUCTION

64. I have been asked to apply the constructions of certain claim terms presented below. I have applied these constructions in my analysis and in forming my opinions set forth in this Declaration. For other claim terms, I have been asked to apply their plain and ordinary meaning to a POSITA, at the time of the invention, in view of the language of the claims, specification, and prosecution history. The relevant claim constructions are as follows:

’640 Patent Terms	Constructions
identifier identification string identifier string	a unique encoding that identifies an individual entity, and with which zero or more data location [specifiers/strings] are associated in a location server
location information location string	information pertaining to one or more locations of data and/or the identities of one or more location servers

location server	a network-attached component that maintains a set of identifier/location mappings that are modified or returned in response to location request messages from clients
client	a network-attached component (which may be software or hardware) that initiates update or lookup of identifier/location mappings from a location server with location request messages
plurality of location servers	location servers in non-hierarchical structures

IX. KAHN'S HANDLE SERVERS DO NOT TRANSMIT A "REDIRECT MESSAGE"

A. transmitting a redirect message to a client

65. The claims require that the queried location server must "transmit[] a redirect message" back to the querying client if it does not have the requested information. *See* §V.B. Claim 18 expressly states this requirement ("the location server transmits a redirect message to the client"), and a POSITA, in view of the specification would understand that claims 10 and 17. As an initial matter, the '640 patent teaches that a goal of the invention is a mechanism that would "permit queries to be directed only at data repositories with relevant information." Ex. 1001, 1:66-2:3. The specification also consistently discloses configurations in which the client

queries a data location server in a network and, if that queried server does not have the requested information, it is that queried server which returns a redirection message containing information useable to determine the right server.[1] *See e.g.*, *id*. 14:26-67, 17:9-19:14. The specification, by contrast, does not describe any configuration in which the client queries one server but a different server or system component returns a redirect message or any information for client redirection. Moreover, besides this embodiment relating to the redirect message, the patent specification further describes the queried server as the server that responds to the client in other contexts. *See, e.g. id*., 2:36:40; 2:62-65; 3:3-6; 4:14-18; 4:29-33; 6:32-44; 9:15-21; 11:46-48; 12:50-54; 14:48-52; 16:53-56; 17:14-21; 17:49-54; 18:21-35. In view of the specification's repeated and consistent disclosure, as well as the prosecution history of the claims, a POSITA would understand that in all of the claims that teach transmission of a redirect message for client redirection, the redirect message must be transmitted to the client by the queried location server, as opposed to another server, such as a server that is not a location server in the system.

66. I have been asked to analyze two theories by which Kahn allegedly discloses "transmitting a redirect message" back to the client, as claim elements

[1] In addition to this embodiment, the specification talks repeatedly (and only) about a queried server being the entity that responds to the client that queried it.

[10.c], [17c], [18.e] require. The first theory maps the "redirect message" to Kahn's return of a "not-responsible-for-handle" message. As described above, Kahn teaches that if the handle server does not have the requested information, it transmits back to the client either a "not responsible" or "handle not found" message. *See* §V.C. This is illustrated in Ex. 1005, Fig. 8, which is reproduced and further annotated below to highlight the points at which the handle server returns either a pointer corresponding to the handle in the request (if the server contains it) or sends a "not-responsible-for-handle" message.

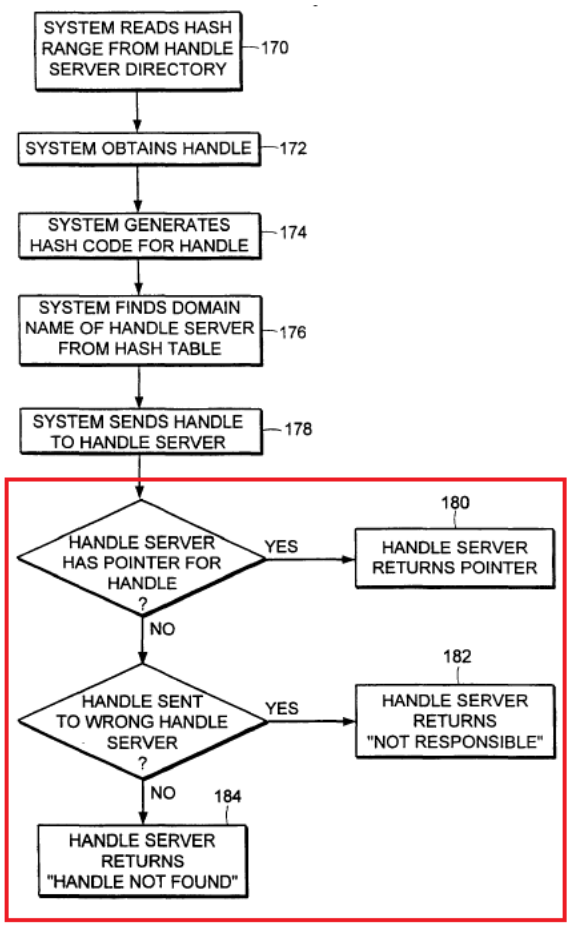


FIG. 8

67. The "not-responsible-for-handle" message cannot be the "redirect message" required by the claims and described by the specification. There is no redirection of the client in the "not-responsible-for-handle" message. Instead, the "not-responsible-for-handle" message merely provides the information that the server does not contain the requested pointers for the requested handle, and nothing else. The "not-responsible-for-handle" message does not redirect the client to any other handle server. Specifically, the "not-responsible-for-handle" message does not "contain information for use by the client to calculate a location of a second data location server," as the claim elements at issue provide that a redirect message must.

68. The second theory that I have been asked to analyze is one that maps the "redirect message" to a "hash range/handle-server-domain-name table." As an initial matter, Kahn discloses a "handle directory server", which is also referred to as a "handle server directory." Ex. 1005, 29:18-20 ("The handle server directory 59 allows users to find the correct handle server for processing a given handle"), 38:9-11 ("As seen in Fig. 34, the handle server system 1230 includes handle servers 1232 and handle directory servers 1234 located at certain well known locations.") , 46:29-32 ("In a first step 170, a client system downloads the table that associates hash ranges with handle server domain names from the handle server directory for future use."). The "handle directory server" and "handle server" are different servers, for example, as illustrated in Fig. 34, which is annotated below to identify the "handle

servers 1232" and "handle directory servers 1234" in "handle server system 1230" (*id.*, 38:9-11):

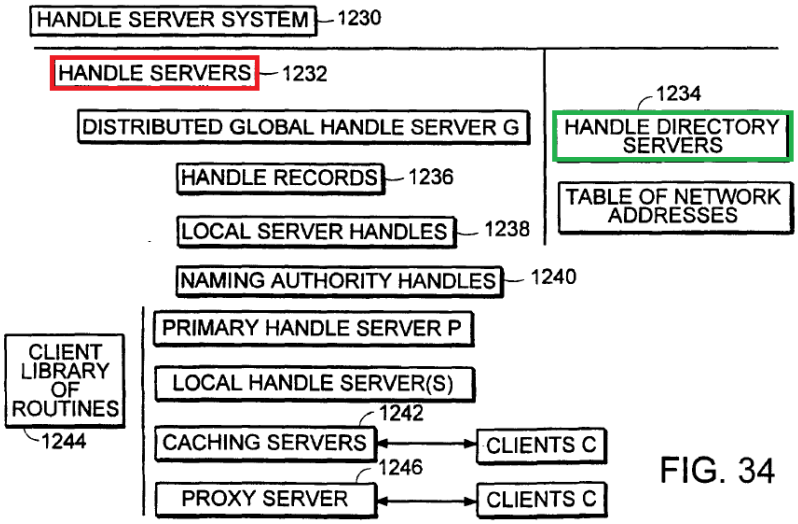


FIG. 34

69. The "redirect message" cannot map to a "hash range/handle-server-domain-name table." Even if a client's download of a "hash range/handle-server-domain-name table" from the handle directory server equates to the requirement of "transmitting" a redirect message, the table is still being retrieved from a server other than the queried handle server. In fact, the client downloads "hash range/handle-server-domain-name table" from a handle directory server, which is not a handle server. For example, the Kahn states:

> The system subsequently sends the handle to the handle server as part of a request pointer information UDP packet (step 178).
>
> The handle server then returns its response to the requesting system. If the handle server found the pointers, a list of pointers is returned (step

> 180). This could include pointers to use one or more repositories and one or more RMS's. **If the handle was sent to the wrong handle server, it returns a not-responsible-for-handle message (step 182).** In this case, **the client system should download the hash range/handle server-domain-name table from the handle server directory** again and attempt the mapping again. The requester will determine how many times to try before giving up (and this same approach is used in other similar situations described below).

Id., 47:5-21 (emphases added). However, as explained above, the claim requires that the "redirect message" be transmitted by the location server that the client server queried, not some other server (let alone a server that is not a location server).

B. a redirect message containing information for use by the client to calculate a location of a second data location server

70. As explained in the foregoing, a "not-responsible-for-handle" message does not include information required for client redirection. *See* § IX.A. The "not-responsible-for-handle" message does not "contain information for use by the client to calculate a location of a second data location server." It's a simple notification to the client that the handle server it queried is not the right one, and nothing more. Ex. 1005, 47:13-19.

71. I have also been asked to evaluate the theory that Kove's complaint filed against Google in a parallel patent infringement case (Ex. 1019) "reads the 'redirect message' on a cache miss response due to stale or incorrect location information." To the extent that Google is saying that a cache miss is inherently a redirect message, I disagree that a cache miss response is inherently a redirect message, and I disagree that such an argument is implied by Kove's initial complaint. The asserted claims are clear that the redirect message is not ***any*** type of redirect message, cache miss message, or other type of "not found" message. Instead, the claimed redirect message must be "containing information for use by the first client to calculate a location of a second data location server." This is evident from the description of using a "location algorithm which calculates a location of a second data location server," which suggests the redirect message contains information used for this calculation, as required by the claims. *See* Ex. 1001, cls. 10, 17, 18. The claims require that the redirect message must "contain information for use by the client to calculate" the location of the correct data location server. Kahn's "not responsible" message does not contain any such information.

72. The Petition and Dr. Goodrich's declaration also argues that the transmission of the "hash range/handle-server-domain-name table," rather than the "not-responsible-for-handle" message, meets the claim's requirement of transmitting a "redirect message". Ex. 1002, ¶68 ("the hash range/handle-server-

domain-name table ('redirect message') is downloaded by the client/requesting system ('transmitted…to the first client') in response to client/requesting system receiving a not-responsible-for-handle-message"); *see also*, Pet. 26-27. However, the client downloads the "hash range/handle-server-domain-name table" from a handle directory server, which is distinct from the handle server. *See* §IX.A; Ex. 1001, 29:18-20, 38:9-11, 46:29-32, 47:5-21. This is contrary to the claims' requirement that the server that received the request, i.e., in the case of the alleged mapping to Kahn's handle server, be the server that transmits a redirect message to the client.

X. KAHN AND VINGRALEK TOGETHER DO NOT TEACH "REDIRECT MESSAGE"

73. I have been asked to analyze Google's asserted combination of the Kahn and Vingralek references, which Google alleges renders the claims obvious, specifically with respect to teaching the "redirect message"-related claim limitations. As I explained above, Kahn does not teach either limitation. *See* §IX.A, B. As I explain below, combining Kahn and Vingralek does not teach the limitations either and does not render the claim obvious, including for the following reasons: (1) Vingralek does not cure the deficiencies of Kahn. (2) Google's alleged combination of Kahn and Vingralek depends on assuming that Kahn's handle servers store hash tables, but a POSITA would understand that Kahn does not.

A. Vingralek's System

74. As explained above, Vingralek teaches a "distributed file organization for record-structured, disk-resident files with key-based exact-match access." Ex. 1007 at 3. In the Vingralek system, a client *c* sends a key *K* to a server *s*. *Id*. at 9. Server *s* applies certain hash functions to *K* until it identifies a server *s'* that it thinks has the records associated with *K*. *Id.* Vingralek goes on to explain:

> If *K* does belong to the server that received it (i.e., if *s = s'),* the server performs the requested operation. However, **if *K* has been sent to the wrong server, the server forwards it to *s'*, and updates the client's view with its file level *L*, and its address table.** Eventually, *K* is received by the correct server and the client operation is executed. Further, as an important side effect, clients gradually bring their perception of the file up-to-date, so that the probability of wrongly addressed messages is significantly reduced.

Id. at 10 (emphasis added). In other words, if the queried server *s* does not have the requested information, server *s* performs the calculation to identify server *s'* and forwards the key on. Server *s* also "updates the client's view with its file level *L,* and its address table." Vingralek explains that:

> [e]ach client *c* and each server *s* have their own perception of the file that is characterized by their value of the file level, denoted as L_c and

> L_s, respectively, and a copy of the address table that they currently have. The client's and the server's perception of the file may or may not coincide with the current picture of the file (i.e., they may have stale information on the file level and the address table).

Id. at 9.

75. This means that the next time the client *c* sends a new request, it will have updated (less stale) information to use to identify a new server to query. Importantly, this updated information is *not* used by the client to resolve its initial request involving *K* – as Vingralek teaches, that work is done by server *s*, not the client ("if *K* has been sent to the wrong server, the server forwards it to *s* ").

B. Kahn's "handle servers" do not store hash tables

76. Petitioner and Dr. Chatterjee points to the following citations in Kahn's in support of the assertion that Kahn's "handle server store copies the hash table": Ex. 1005, 38:9-17 and 46:29-32 in support. Ex1002, ¶103; Pet. 49. This is incorrect. The first citation says:

> As seen in Fig. 34, the handle server system 1230 includes handle servers 1232 and handle directory servers 1234 located at certain well known locations. **The directory servers will maintain a table of network addresses of handle servers (generally, each handle server will contain such a directory).** This table will 15 generally be

> downloaded by each participating site frequently enough to be "acceptably" up-to-date at all times.

Ex. 1005, 38:9-17 (emphasis added).

77. Here, Kahn also describes each handle server contains a "directory" that is a "table of network address of handle servers." However, this directory is not a hash table. Instead, this table maps domain names of handle servers to their network addresses, and Kahn acknowledges that this table must be downloaded frequently enough to be "acceptably" up to date at all times. *Id*., 38:9-17, Fig. 34. For example, Kahn consistently distinguishes domain names from network (IP) addresses. *See*, *e.g.*, *id*., 29:5-28, 35:18-19, 39:18-23, 44:30-32, 45:5-21, 46:22-24, 46:29-32, 47:1-21, 56:27-57:2.

78. The "directory" that each handle server generally contains is the "table of network address of handle servers." This is not a hash table. The second citation says:

> In a first step 170, **a client system downloads the table that associates hash ranges** with handle server domain names **from the handle server directory** for future use.

Id., 46:29-32 (emphasis added).

79. Here, Kahn describes that there is a table that associates hash ranges with handle server domain names. However, this table originates at a handle

directory server, which is distinct from a handle server. *See* §IX.A, B. Kahn also teaches in this disclosure from its specification that the client downloads such a table, rather than a handle server. In full, Kahn does not disclose that the "handle server stores a copy of the hash table" at any point in its specification.

C. No motivation to modify Kahn in view of Vingralek

80. Petitioner and Dr. Chatterjee provide two theories for why a POSITA would have been motivated to modify Kahn in view of Vingralek: (1) Kahn and Vingralek both disclose that "client and handle server store copies of the hash table" and therefore a POSITA would have been motivated to "consider the teachings of Vingralek when implementing" Kahn (Pet. 46; Ex. 1002, ¶¶98-99); (2) modifying Kahn to "include deferred hash table and hash function updates from the handle server" would "reduce communication overhead associated with Kahn's existing method" (Pet., 50-51; Ex. 1002, ¶¶103-105). I disagree with both theories.

81. Petitioner and Dr. Chatterjee's first theory depends on the incorrect notion that Kahn's handle servers store copies of the hash table. They do not. *See supra* §X.B. Kahn thereby essentially differs from Vingraek, in which the servers do contain copies of hash tables. *See id*. As previously explained, that Kahn's only disclosure that a handle server contains a "directory" is that "[g]enerally, each handle server will contain such a directory." Ex. 1005, 38:9-17. In context, the directory stored in the handle server, however, is a table of network addresses of the handle

servers rather than a "hash range/handle-server-domain-name table," which Kahn teaches is only stored in a handle server directory. *Id*., 46:29-47:8, Fig. 7.

82. Petitioner and Dr. Chatterjee's second theory fails because a POSITA would understand that modifying Kahn in view of Vingralek's teachings would *not* "reduce communication overhead associated with Kahn's existing method." To modify Kahn in the manner required to approach the claim limitation would require that each handle server be configured to transmit the hash table to the client. As an initial matter, Kahn's handle servers do not store copies of the "hash range/handle-server-domain-name table" (i.e., an alleged hash table), so the handle servers would need to modified to be required to maintain copies of the alleged hash tables. However, a POSITA would understand that to maintain an accurate, current, and consistent hash table in the handle servers to achieve the claim's requirement of providing information in a redirect message to calculate the correct server (one that contains and not merely potentially contains the requested information) would require frequent updates and downloads of the hash table by each handle server to maintain sufficient synchronization. Therefore, a POSITA would understand that, far from reducing communication overhead with such an extensive modification and requiring continuous synchronicity between servers in a distributed network would result in an increasing workload and burden on the handle servers of Kahn's existing system.

83. A POSITA would not look to Vingralek to incorporate a "redirect message" into Kahn's system. Kahn already teaches a technique to locate a handle server with requested information, when the incorrect handle server is queried – and Kahn's solution differs from the claimed invention, as I explain above. Vingralek's method of a server transmitting an updated address table to the client is not an efficient or reliable modification to Kahn's system. Even if Kahn were modified in accordance with Vingralek so that handle servers store address tables (Kahn teaches that hash tables are stored in different servers, not handle servers), there is no evidence or basis to suggest that Kahn's handle servers would then transmit reliable address tables to the client. In my opinion, a POSITA would consider that Kahn already provides a solution for retrieving an updated address table (i.e., by downloading it from the hash server directory). Ex. 1005, 46:29-32.

84. Thus, there would not be a perceived benefit in changing Kahn using Vingralek's teachings. Incorporating Vingralek's scheme into Kahn would introduce additional complexity and inefficiency, where there would need to be multiple client redirects due to inaccurate address tables leading to the identification of incorrect servers that do not contain requested information.

D. No Reasonable Expectation of Success

85. In my opinion, a POSA would not have a reasonable expectation of success to modify Kahn with Vingralek to satisfy the requirements of claims 10, 17,

18. Kahn and Vingralek do not teach a location server configured to redirect a client's query using a redirect message. As I explained above, Kahn's handle servers do not transmit a "redirect message" to a client. *See supra* §IX.A, B. As further indicated above, in Vingralek, when a client queries a server, the server pushes an updated address table to the client. Ex. 1007 at 9-10. The pushed updated address table does not redirect the client's query. *Id*. The queried server attempts to locate the requested data in another server by forwarding the query to the other server. *Id*. For example, Vingralek states "if *K* has been sent to the wrong server, the server forwards it to *s'* … Eventually, *K* is received by the correct server and the client operation is executed." *Id*. The updated address table itself does not redirect the client's query. The client may use it sometime in the future to attempt to locate the correct server. As such, a POSITA would not have a reasonable expectation of arriving at the claimed invention by modifying Kahn with Vingralek, as neither reference teaches a location server "redirecting" a client's query.

I hereby declare, under penalty of perjury under the laws of the United States, that the foregoing is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements are punishable by fine or imprisonment or both.

Executed on November 19, 2024, in Irvine, CA.

Michael T. Goodrich

APPENDIX A

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July '12 to June '13	Chair, Dept. of Computer Science Univ. of California, Irvine
October '06 to June '12	Assoc. Dean for Faculty Dev., Bren School of Info. and Comp. Sci. Univ. of California, Irvine
July '01 to March '07	Professor, Dept. of Computer Science Univ. of California, Irvine
Fall '00	Visiting Professor of Computer Science Brown Univ.
July '96 to June '02	Professor of Computer Science (on leave, from July '01) Johns Hopkins Univ.
July '92 to June '96	Associate Professor of Computer Science Johns Hopkins Univ.
Spring '94	Visiting Associate Professor of Computer Science Univ. of Illinois, Urbana-Champaign
July '87 to June '92	Assistant Professor of Computer Science Johns Hopkins Univ.
Aug. '83 to June '87	Teaching Assistant, Research Assistant Purdue Univ.
Summer '83	Summer intern Argonne National Laboratory

RESEARCH INTERESTS

Algorithm and data structure design
Networking and parallel and distributed computing
Computer security and information assurance and privacy
Machine learning and computer vision
Databases and high-performance data management
Information visualization and graph drawing
Computational geometry and computer graphics

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PRIZES, HONORS, AND AWARDS

- *Compere Loveless Fellowship in Computer Sciences*, Purdue Univ., 1985
- *Research Initiation Award*, National Science Foundation, 1988
- *Oraculum Award for Excellence in Teaching*, Johns Hopkins, 1993, 1994, 1995
- *ACM Recognition of Service Award*, 1996
- *Robert B. Pond, Sr. Award for Excellence in Undergraduate Teaching*, Johns Hopkins, 1998
- *Elected Senior Member*, the Institute of Electrical and Electronics Engineers (IEEE), 1999
- *Spirit of Technology Transition Award*, DARPA Dynamic Coalitions Program, 2002
- *Brown Univ. Award for Technological Innovation* (with R. Tamassia, N. Triandopoulos, D. Yao, and D. Ellis), 2006
- *ACM Distinguished Scientist*, 2006
- *2006 IEEE Computer Society Technical Achievement Award*, "for outstanding contributions to the design of parallel and distributed algorithms for fundamental combinatorial and geometric problems"
- *Fulbright Scholar*, 2007, for senior specialist service to University of Aarhus, Denmark
- *Fellow of the San Diego Supercomputer Center*, 2007
- *Fellow of the American Association for the Advancement of Science (AAAS)*, "for distinguished contributions to parallel and distributed algorithms for combinatorial and geometric problems, and excellence in teaching, academic and professional service, and textbook writing," 2007
- *Named as Chancellor's Professor*, for "demonstrated unusual academic merit and whose continued promise for scholarly achievement is unusually high," Univ. of California, Irvine, 2007
- *Fellow of the Institute of Electrical and Electronics Engineers (IEEE)*, "for contributions to parallel and distributed algorithms for combinatorial and geometric problems," 2009
- *Fellow of the ACM*, "for contributions to data structures and algorithms for combinatorial and geometric problems," 2009
- *ICS Dean's Award for Research*, "for contributions in the area of parallel and distributed algorithms," 2014
- *Chancellor's Award for Excellence in Fostering Undergraduate Research*, Univ. of California, Irvine, 2016
- *Faculty Mentor of the Month*, Undergraduate Research Opportunities Program (UROP), Univ. of California, Irvine, April 2016
- *Elected as a foreign member*, Royal Danish Academy of Sciences and Letters, April 2018
- *Named as Distinguished Professor*, for achieving "the highest levels of scholarship" over the course of a career and having "earned national and international level distinctions and honors of the highest level," Univ. of California, Irvine, 2019
- *Recipient of The Alejandro López-Ortiz Best Paper Award*, for "Zip-zip Trees: Making Zip Trees More Balanced, Biased, Compact, or Persistent," 18th Algorithms and Data Structures Symposium, 2023.

PUBLICATIONS

Google Scholar Citation Statistics:

- Total citations: over 18,000
- H-index (top H publications with at least H citations): 73

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Patents and Patent Applications:

P-1. M.T. Goodrich and R. Tamassia, "An Efficient Dynamic Distributed Cryptographic Accumulator," International Patent Application Pub. No. WO 02/39212, May 16, 2002.

P-2. G. Ateniese, B. de Medeiros, and M.T. Goodrich, "Intermediated Delivery Scheme for Asymmetric Fair Exchange of Electronic Items," U.S. Patent Application Pub. No. US 2004/0073790, April 15, 2004.

P-3. M.T. Goodrich and R. Tamassia, "Efficient Authenticated Dictionaries with Skip Lists and Commutative Hashing," U.S. Patent No. 7,257,711, August 14, 2007.

P-4. J.W. Green, J.L. Schultz, Y. Amir, and M.T. Goodrich, "High Refresh-Rate Retrieval of Freshly Published Content using Distributed Crawling," U.S. Patent No. 7,299,219, November 20, 2007.

P-5. R. Tamassia, M.T. Goodrich, and N. Triandopoulos, "Super-efficient Verification of Dynamic Outsourced Databases," International Patent Application Pub. No. WO 2008/014002, January 31, 2008.

P-6. M.T. Goodrich, R. Tamassia, and N. Triandopoulos, "Load-balanced Distributred Authentication Structures," International Patent Application Pub. No. WO 2008/014004, January 31, 2008.

P-7. M.T. Goodrich, D. Yao, and R. Tamassia, "Notarized Federated Identity Management," International Patent Application Pub. No. WO 2008/020991, February 21, 2008.

P-8. R. Tamassia, M.T. Goodrich, N. Triandopoulos, and C. Papamanthou, "Authentication for Operations over an Outsourced File System Stored by an Untrusted Unit," International Patent Application Pub. No. WO 2008/147400, December 4, 2008.

P-9. R. Tamstorf, M.T. Goodrich, D. Eppstein, "Attribute Transfer Between Computer Models Including Identifying Isomorphic Regions in Polygonal Meshes," U.S. Patent No. 8,681,145, March 25, 2014.

P-10. N. Triandopoulos, M.T. Goodrich, D. Nguyen, O. Ohrimenko, C. Papamanthou, R. Tamassia, C.V. Lopes, "Techniques for Verifying Search Results Over a Distributed Collection," U.S. Patent No. 9,152,716, October 6, 2015.

Books and Monographs:

B-1. M.T. Goodrich and R. Tamassia, *Data Structures and Algorithms in Java*, John Wiley and Sons, Inc., 1998.

B-2. M.T. Goodrich and C.C. McGeoch, eds., *Algorithm Engineering and Experimentation*, Lecture Notes in Computer Science (LNCS), Vol. 1619, Springer-Verlag, 1999.

B-3. M.T. Goodrich and R. Tamassia, *Data Structures and Algorithms in Java, Second Edition*, John Wiley and Sons, Inc., 2001.

B-4. M.T. Goodrich and R. Tamassia, *Algorithm Design: Foundations, Analysis, and Internet Examples*, John Wiley and Sons, Inc., 2002.

B-5. M.T. Goodrich and S.G. Kobourov, eds., *10th Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science, Vol. 2528, Springer-Verlag, 2002.

B-6. M.T. Goodrich, R. Tamassia, and D. Mount, *Data Structures and Algorithms in C++*, John Wiley and Sons, Inc., 2004.

B-7. M.T. Goodrich and R. Tamassia, *Data Structures and Algorithms in Java, Third Edition*, John Wiley and Sons, Inc., 2004.

B-8. M.T. Goodrich and R. Tamassia, *Data Structures and Algorithms in Java, Fourth Edition*, John Wiley and Sons, Inc., 2006.

B-9. M.T. Goodrich and R. Tamassia, *Data Structures and Algorithms in Java, Fifth Edition*, John Wiley and Sons, Inc., 2011.

B-10. M.T. Goodrich and R. Tamassia, *Introduction to Computer Security*, Addison-Wesley, 2011.

B-11. M.T. Goodrich, R. Tamassia, and D. Mount, *Data Structures and Algorithms in C++, Second Edition*, John Wiley and Sons, Inc., 2011.

B-12. M.T. Goodrich, R. Tamassia, and M. Goldwasser, *Data Structures and Algorithms in Python*, John Wiley and Sons, Inc., 2013.

B-13. M.T. Goodrich, R. Tamassia, and M. Goldwasser, *Data Structures and Algorithms in Java, Sixth Edition*, John Wiley and Sons, Inc., 2014.

B-14. M.T. Goodrich and R. Tamassia, *Algorithm Design and Applications*, Wiley, 2015.

B-15. M.T. Goodrich and R. Tamassia, *Algorithm Design and Applications*, interactive e-book, `www.zybooks.com/catalog/goodrich-algorithm-design-and-applications/`, zyBooks (a division of Wiley), 2022.

Book Chapters:

Ch-1. M.J. Atallah and M.T. Goodrich, "Deterministic Parallel Computational Geometry," in *Synthesis of Parallel Algorithms*, J.H. Reif, ed., Morgan Kaufmann, 497–536, 1993.

Ch-2. M.T. Goodrich, "The Grand Challenges of Geometric Computing," in *Developing a Computer Science Agenda for High-Performance Computing*, U. Vishkin, ed., ACM Press, 64–68, 1994.

Ch-3. M.T. Goodrich, "Parallel Algorithms in Geometry," *CRC Handbook of Discrete and Computational Geometry*, J.E. Goodman and J. O'Rourke, eds., CRC Press, Inc., 669–682, 1997.

Ch-4. M.T. Goodrich and K. Ramaiyer, "Geometric Data Structures," *Handbook of Computational Geometry*, J.-R. Sack and J. Urrutia, eds., Elsevier Science Publishing, 463–489, 2000.

Ch-5. M.T. Goodrich and R. Tamassia, "Simplified Analyses of Randomized Algorithms for Searching, Sorting, and Selection," *Handbook of Randomized Computing*, S. Rajasekaran, P.M. Pardalos, J.H. Reif, and J.D.P. Rolim, eds., Kluwer Academic Publishers, Vol. 1, 23–34, 2001.

Ch-6. M.T. Goodrich, "Parallel Algorithms in Geometry," *Handbook of Discrete and Computational Geometry, Second Edition*, J.E. Goodman and J. O'Rourke, eds., Chapman & Hall/CRC Press, Inc., 953–967, 2004. (Revised version of Ch-3.)

Ch-7. C. Duncan and M.T. Goodrich, "Approximate Geometric Query Structures," *Handbook of Data Structures and Applications*, Chapman & Hall/CRC Press, Inc., 26-1–26-17, 2005.

Ch-8. M.T. Goodrich, R. Tamassia, and L. Vismara, "Data Structures in JDSL," *Handbook of Data Structures and Applications*, Chapman & Hall/CRC Press, Inc., 43-1–43-22, 2005.

Ch-9. Y. Cho, L. Bao and M.T. Goodrich, "Secure Location-Based Access Control in WLAN Systems," *From Problem Toward Solution: Wireless and Sensor Networks Security*, Zhen Jiang and Yi Pan, eds., Nova Science Publishers, Inc., Chapter 17, 2007.

Ch-10. M.T. Goodrich and M.J. Nelson, "Distributed Peer-to-Peer Data Structures," *Handbook of Parallel Computing: Models, Algorithms and Applications*, R. Rajasekaran and J. Reif, eds., CRC Press, 17-1–17-17, 2008.

Ch-11. C.A. Duncan and M.T. Goodrich, "Planar Orthogonal and Polyline Drawing Algorithms," *Handbook of Graph Drawing and Visualization*, CRC Press, Inc., 223–246, 2013.

Ch-12. M.T. Goodrich, R. Tamassia, and L. Vismara, "Data Structures in JDSL," *Handbook of Data Structures and Applications*, 2nd edition, Chapman and Hall/CRC, Taylor & Francis, Inc., 43-1–43-22, 2018.

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Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
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Journal Papers:

J-1. M.J. Atallah and M.T. Goodrich, "Efficient Parallel Solutions to Some Geometric Problems," *Journal of Parallel and Distributed Computing*, **3**(4), 1986, 492–507.

J-2. M.T. Goodrich, "Finding the Convex Hull of a Sorted Point Set in Parallel," *Information Processing Letters*, **26**, 1987, 173–179.

J-3. H. ElGindy and M.T. Goodrich, "Parallel Algorithms for Shortest Path Problems in Polygons," *The Visual Computer*, **3**(6), 1988, 371–378.

J-4. M.J. Atallah and M.T. Goodrich, "Parallel Algorithms For Some Functions of Two Convex Polygons," *Algorithmica*, **3**, 1988, 535–548.

J-5. M.J. Atallah, R. Cole, and M.T. Goodrich, "Cascading Divide-and-Conquer: A Technique for Designing Parallel Algorithms," *SIAM Journal on Computing*, **18**(3), 1989, 499–532.

J-6. M.T. Goodrich, "Triangulating a Polygon in Parallel," *Journal of Algorithms*, **10**, 1989, 327–351.

J-7. M.T. Goodrich and M.J. Atallah, "On Performing Robust Order Statistics in Tree-Structured Dictionary Machines," *Journal of Parallel and Distributed Computing*, **9**(1), 1990, 69–76.

J-8. M.T. Goodrich and J.S. Snoeyink, "Stabbing Parallel Segments with a Convex Polygon," *Computer Vision, Graphics and Image Processing*, **49**, 1990, 152–170.

J-9. J. Johnstone and M.T. Goodrich, "A Localized Method for Intersecting Plane Algebraic Curve Segments," *The Visual Computer*, **7**(2–3), 1991, 60–71.

J-10. M.T. Goodrich, "Intersecting Line Segments in Parallel with an Output-Sensitive Number of Processors," *SIAM Journal on Computing*, **20**(4), 1991, 737–755.

J-11. R. Cole and M.T. Goodrich, "Optimal Parallel Algorithms for Point-Set and Polygon Problems," *Algorithmica*, **7**, 1992, 3–23.

J-12. M.T. Goodrich, "A Polygonal Approach to Hidden-Line and Hidden-Surface Elimination," *Computer Vision, Graphics, and Image Processing: Graphical Models and Image Processing*, **54**(1), 1992, 1–12.

J-13. M.T. Goodrich, S. Shauck, and S. Guha, "Parallel Methods for Visibility and Shortest Path Problems in Simple Polygons," *Algorithmica*, **8**, 1992, 461–486, with addendum in *Algorithmica*, **9**, 1993, 515–516.

J-14. M.T. Goodrich, C. Ó'Dúnlaing, and C. Yap "Constructing the Voronoi Diagram of a Set of Line Segments in Parallel," *Algorithmica*, **9**, 1993, 128–141.

J-15. M.T. Goodrich, "Constructing the Convex Hull of a Partially Sorted Set of Points," *Computational Geometry: Theory and Applications*, **2**, 1993, 267–278.

J-16. M.T. Goodrich, "Constructing Arrangements Optimally in Parallel," *Discrete and Computational Geometry*, **9**, 1993, 371–385.

J-17. M.T. Goodrich, M.J. Atallah, and M. Overmars, "Output-Sensitive Methods for Rectilinear Hidden Surface Removal," *Information and Computation*, **107**(1), 1993, 1–24.

J-18. M.J. Atallah, P. Callahan, and M.T. Goodrich, "P-Complete Geometric Problems," *Int. Journal of Computational Geometry & Applications*, **3**(4), 1993, 443–462.

J-19. M.J. Atallah, M.T. Goodrich, and S.R. Kosaraju, "Parallel Algorithms for Evaluating Sequences of Set-Manipulation Operations," *Journal of the ACM*, **41**(6), 1994, 1049–1088.

J-20. M.T. Goodrich, "Efficient Piecewise-Linear Function Approximation Using the Uniform Metric," *Discrete and Computational Geometry*, **14**, 1995, 445–462.

J-21. H. Brönnimann and M.T. Goodrich, "Almost Optimal Set Covers in Finite VC-Dimension," *Discrete and Computational Geometry*, **14**, 1995, 463–479.

J-22. M.T. Goodrich, "Planar Separators and Parallel Polygon Triangulation," *J. Computer and*

EX2001
Kove IO, Inc.
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System Sciences, **51**(3), 1995, 374–389.

J-23. M.T. Goodrich, M. Ghouse, and J. Bright, "Sweep Methods for Parallel Computational Geometry," *Algorithmica*, **15**(2), 1996, 126–153.

J-24. M.T. Goodrich and S.R. Kosaraju, "Sorting on a Parallel Pointer Machine with Applications to Set Expression Evaluation," *Journal of the ACM*, **43**(2), 1996, 331–361.

J-25. A. Garg, M.T. Goodrich, and R. Tamassia, "Planar Upward Tree Drawings with Optimal Area," *International Journal of Computational Geometry & Applications*, **6**(3), 1996, 333–356.

J-26. M.H. Nodine, M.T. Goodrich, and J.S. Vitter, "Blocking for External Graph Searching," *Algorithmica*, **16**(2), 1996, 181–214.

J-27. R. Cole, M.T. Goodrich, C. Ó Dúnlaing, "A Nearly Optimal Deterministic Parallel Voronoi Diagram Algorithm," *Algorithmica*, **16**, 1996, 569–617.

J-28. G. Das and M.T. Goodrich, "On the Complexity of Optimization Problems for 3-Dimensional Convex Polyhedra and Decision Trees," *Computational Geometry: Theory and Applications*, **8**, 1997, 123–137.

J-29. M.T. Goodrich and R. Tamassia, "Dynamic Ray Shooting and Shortest Paths in Planar Subdivisions via Balanced Geodesic Triangulations," *J. Algorithms*, **23**, 1997, 51–73.

J-30. M. Ghouse and M.T. Goodrich, "Fast Randomized Parallel Methods for Planar Convex Hull Construction," *Computational Geometry: Theory and Applications*, **7**, 1997, 219–235.

J-31. L.P. Chew, M.T. Goodrich, D.P. Huttenlocher, K. Kedem, J.M. Kleinberg, and D. Kravets, "Geometric Pattern Matching under Euclidean Motion," *Computational Geometry: Theory and Applications*, **7**, 1997, 113-124.

J-32. M.T. Goodrich and E.A. Ramos, "Bounded-Independence Derandomization of Geometric Partitioning with Applications to Parallel Fixed-Dimensional Linear Programming," *Discrete & Computational Geometry*, **18**(4), 1997, 397–420.

J-33. M.T. Goodrich, "An Improved Ray Shooting Method for Constructive Solid Geometry Models via Tree Contraction," *International Journal of Computational Geometry & Applications*, **8**(1), 1998, 1–23.

J-34. G. Barequet, A.J. Briggs, M.T. Dickerson, and M.T. Goodrich, "Offset-Polygon Annulus Placement Problems," *Computational Geometry: Theory and Applications*, **11**(3–4), 1998–99, 125–141.

J-35. M.T. Goodrich and R. Tamassia, "Dynamic Trees and Dynamic Point Location," *SIAM J. Comput.*, **28**(2), 1999, 612–636.

J-36. G. Barequet, S.S. Bridgeman, C.A. Duncan, M.T. Goodrich, and R. Tamassia, "GeomNet: Geometric Computing Over the Internet," *IEEE Internet Computing*, **3**(2), 1999, 21–29.

J-37. M.T. Goodrich, J.S.B. Mitchell, and M.W. Orletsky, "Approximate Geometric Pattern Matching Under Rigid Motion," *IEEE Trans. on Pattern Analysis and Machine Intelligence*, **21**(4), 1999, 371–379.

J-38. M.T. Goodrich, "Communication-Efficient Parallel Sorting," *SIAM Journal on Computing*, **29**(2), 1999, 416–432.

J-39. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, "Balanced Aspect Ratio Trees and Their Use for Drawing Very Large Graphs," *Journal of Graph Algorithms and Applications*, **4**(3), 2000, 19–46. Also available at www.cs.brown.edu/publications/jgaa/.

J-40. M.T. Goodrich and C.G. Wagner, "A Framework for Drawing Planar Graphs with Curves and Polylines," *Journal of Algorithms*, **37**, 2000, 399–421.

J-41. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, "Balanced Aspect Ratio Trees: Combining

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Kove IO, Inc.
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Google, LLC v. Kove IO, Inc.
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the Benefits of k-D Trees and Octrees," *J. Algorithms*, **38**, 2001, 303–333.

J-42. G. Barequet, M. Dickerson, and M.T. Goodrich, "Voronoi Diagrams for Polygon-Offset Distance Functions," *Discrete and Computational Geometry*, **25**(2), 2001, 271–291.

J-43. C.C. Cheng, C.A. Duncan, M.T. Goodrich, and S.G. Kobourov, "Drawing Planar Graphs with Circular Arcs," *Discrete and Computational Geometry*, **25**(3), 2001, 405–418.

J-44. N.M. Amato, M.T. Goodrich, and E.A. Ramos, "A Randomized Algorithm for Triangulating a Simple Polygon in Linear Time," *Discrete and Computational Geometry*, **26**(2), 2001, 245–265.

J-45. R. Tamassia, M.T. Goodrich, L. Vismara, M. Handy, G. Shubina, R. Cohen, B. Hudson, R.S. Baker, N. Gelfand, and U. Brandes, "JDSL: The Data Structures Library in Java," *Dr. Dobbs Journal*, **323**, 2001, 21–31.

J-46. G. Barequet, D.Z. Chen, O. Daescu, M.T. Goodrich, and J.S. Snoeyink, "Efficiently Approximating Polygonal Paths in Three and Higher Dimensions," *Algorithmica*, **33**(2), 2002, 150–167.

J-47. T. Chan, M.T. Goodrich, S.R. Kosaraju, and R. Tamassia, "Optimizing Area and Aspect Ratio in Straight-Line Orthogonal Tree Drawings," *Computational Geometry: Theory and Applications*, **23**(2), 2002, 153–162.

J-48. C.A. Duncan, M.T. Goodrich, and S.G. Kobourov, "Planarity-Preserving Clustering and Embedding for Large Planar Graphs," *Computational Geometry: Theory and Applications*, **24**(2), 2003, 95–114.

J-49. A.L. Buchsbaum and M.T. Goodrich, "Three-Dimensional Layers of Maxima," *Algorithmica*, **39**, 2004, 275–286.

J-50. G. Barequet, M.T. Goodrich, and C. Riley, "Drawing Graphs with Large Vertices and Thick Edges," *J. of Graph Algorithms and Applications* (JGAA), **8**(1), 2004, 3–20.

J-51. G. Barequet, M.T. Goodrich, A. Levi-Steiner, and D. Steiner, "Contour Interpolation by Straight Skeletons," *Graphical Models* (GM), **66**(4), 2004, 245–260.

J-52. P. Gajer, M.T. Goodrich, and S.G. Kobourov, "A Multi-Dimensional Approach to Force-Directed Layouts of Large Graphs," *Computational Geometry: Theory and Applications*, **29**(1), 3–18, 2004.

J-53. G. Barequet, P. Bose, M.T. Dickerson, and M.T. Goodrich, "Optimizing a Constrained Convex Polygonal Annulus," *J. of Discrete Algorithms* (JDA), **3**(1), 1–26, 2005.

J-54. A. Bagchi, A.L. Buchsbaum, and M.T. Goodrich, "Biased Skip Lists," *Algorithmica*, **42**(1), 31–48, 2005.

J-55. M. Dickerson, D. Eppstein, M.T. Goodrich, J.Y. Meng, "Confluent Drawings: Visualizing Non-planar Diagrams in a Planar Way," *J. of Graph Algorithms and Applications* (JGAA), **9**(1), 31–52, 2005.

J-56. A. Bagchi, A. Chaudhary, M.T. Goodrich, C. Li, and M. Shmueli-Scheuer, "Achieving Communication Efficiency through Push-Pull Partitioning of Semantic Spaces to Disseminate Dynamic Information," *IEEE Trans. on Knowledge and Data Engineering* (TKDE), **18**(10), 1352–1367, 2006.

J-57. D. Eppstein, M.T. Goodrich, and J.Y. Meng, "Confluent Layered Drawings," *Algorithmica*, **47**(4), 439–452, 2007.

J-58. A. Bagchi, A. Chaudhary, D. Eppstein, and M.T. Goodrich, "Deterministic Sampling and Range Counting in Geometric Data Streams," *ACM Transactions on Algorithms*, **3**(2), Article 16, 2007, 18 pages.

J-59. D. Eppstein, M.T. Goodrich, and D. Hirschberg, "Improved Combinatorial Group Testing

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Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
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Algorithms for Real-World Problem Sizes," *SIAM Journal on Computing*, **36**(5), 1360–1375, 2007.

J-60. D. Eppstein, M.T. Goodrich, and J.Z. Sun, "Skip Quadtrees: Dynamic Data Structures for Multidimensional Point Sets," *Int. Journal on Computational Geometry and Applications*, **18**(1/2), 131–160, 2008.

J-61. M.T. Goodrich, "Probabilistic Packet Marking for Large-Scale IP Traceback," *IEEE/ACM Transactions on Networking*, **16**(1), 15–24, 2008.

J-62. M.T. Goodrich and D.S. Hirschberg, "Improved Adaptive Group Testing Algorithms with Applications to Multiple Access Channels and Dead Sensor Diagnosis," *Journal of Combinatorial Optimization*, **15**(1), 95–121, 2008.

J-63. M.T. Goodrich, R. Tamassia, and D. Yao, "Notarized Federated ID Management and Authentication," *Journal of Computer Security*, **16**(4), 399–418, 2008.

J-64. M.T. Goodrich, "Pipelined Algorithms to Detect Cheating in Long-Term Grid Computations," *Theoretical Computer Science*, **408**, 199–207, 2008.

J-65. D. Eppstein, M.T. Goodrich, E. Kim, and R. Tamstorf, "Motorcycle Graphs: Canonical Quad Mesh Partitioning," *Computer Graphics Forum*, special issue on papers from 6th European Symp. on Geometry Processing (SGP), **27**(6), 1477–1486, 2008.

J-66. M.T. Goodrich, M. Sirivianos, J. Solis, C. Soriente, G. Tsudik, E. Uzun, "Using Audio in Secure Device Pairing," *Int. J. Security and Networks*, **4**(1/2), 57–68, 2009.

J-67. M.T. Goodrich, "On the Algorithmic Complexity of the Mastermind Game with Black-Peg Results," *Information Processing Letters*, **109**, 675–678, 2009.

J-68. D. Eppstein, M.T. Goodrich, E. Kim, and R. Tamstorf, "Approximate Topological Matching of Quad Meshes," *The Visual Computer*, **25**(8), 771–783, 2009.

J-69. D. Eppstein and M.T. Goodrich, "Succinct Greedy Geometric Routing Using Hyperbolic Geometry," *IEEE Transactions on Computers*, **60**(11), 1571–1580, 2011. Posted online Dec. 2010, IEEE Computer Society Digital Library.

J-70. D. Eppstein, M.T. Goodrich, and D. Strash, "Linear-Time Algorithms for Geometric Graphs with Sublinearly Many Edge Crossings," *SIAM Journal on Computing*, **39**(8), 3814–3829. 2010.

J-71. M.T. Goodrich, R. Tamassia, and N. Triandopoulos, "Efficient Authenticated Data Structures for Graph Connectivity and Geometric Search Problems," *Algorithmica*, **60**(3), 505–552, 2011.

J-72. D. Eppstein and M.T. Goodrich, "Straggler Identification in Round-Trip Data Streams via Newton's Identities and Invertible Bloom Filters," *IEEE Transactions on Knowledge and Data Engineering* (TKDE), **23**(2), 297–306, 2011.

J-73. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, "Planar Drawings of Higher-Genus Graphs," *Journal of Graph Algorithms and Applications*, **15**(1), 7–32, 2011.

J-74. M.T. Dickerson, M.T. Goodrich, T.D. Dickerson, and Y.D. Zhuo "Round-Trip Voronoi Diagrams and Doubling Density in Geographic Networks," *Transactions on Computational Science*, M.L. Gavrilova et al. (Eds.), Vol. 14, LNCS 6970, 211–238, 2011.

J-75. M.T. Goodrich, "Randomized Shellsort: A Simple Data-Oblivious Sorting Algorithm," *Journal of the ACM*, **58**(6), Article No. 27, 2011.

J-76. C.A. Duncan, D. Eppstein, M.T. Goodrich, S. Kobourov, and M. Nöllenburg, "Lombardi Drawings of Graphs," *Journal of Graph Algorithms and Applications (JGAA)*, **16**(1), 85–108, 2012.

J-77. E. Wolf-Chambers, D. Eppstein, M.T. Goodrich, and M. Löffler, "Drawing Graphs in the

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Google, LLC v. Kove IO, Inc.
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Plane with a Prescribed Outer Face and Polynomial Area," *Journal of Graph Algorithms and Applications (JGAA)*, **16**(2), 243–259, 2012.

J-78. M.T. Goodrich, D. Nguyen, O. Ohrimenko, C. Papamanthou, R. Tamassia, N. Triandopoulos, and C.V. Lopes, "Efficient Verification of Web-Content Searching Through Authenticated Web Crawlers," *Proc. VLDB*, **5**(10):920-931, 2012.

J-79. D. Eppstein, M.T. Goodrich, D. Strash, and L. Trott, "Extended Dynamic Subgraph Statistics Using h-Index Parameterized Data Structures," *Theoretical Computer Science*, **447**, 44–52, 2012.

J-80. M.T. Goodrich, "Learning Character Strings via Mastermind Queries, With a Case Study Involving mtDNA," *IEEE Transactions on Information Theory*, **58**(11), 6726–6736, 2012.

J-81. A.U. Asuncion and M.T. Goodrich, "Nonadaptive Mastermind Algorithms for String and Vector Databases, with Case Studies," *IEEE Transactions on Knowledge and Data Engineering* (TKDE), **25**(1), 131–144, 2013.

J-82. C.A. Duncan, D. Eppstein, M.T. Goodrich, S. Kobourov, and M. Nöllenburg, "Drawing Trees with Perfect Angular Resolution and Polynomial Area," *Discrete & Computational Geometry*, **49**(2), 157–182, 2013.

J-83. E. Angelino, M.T. Goodrich, M. Mitzenmacher and J. Thaler, "External Memory Multimaps," *Algorithmica*, **67**(1), 23–48, 2013.

J-84. D. Eppstein, M.T. Goodrich, M. Löffler, D. Strash and L. Trott, "Category-Based Routing in Social Networks: Membership Dimension and the Small-World Phenomenon," *Theoretical Computer Science*, **514**, 96–104, 2013.

J-85. M.T. Goodrich, "Spin-the-bottle Sort and Annealing Sort: Oblivious Sorting via Round-robin Random Comparisons," *Algorithmica*, **68**(4), 835–858, 2014.

J-86. Michael J. Bannister, William E. Devanny, David Eppstein, and M.T. Goodrich, "The Galois Complexity of Graph Drawing: Why Numerical Solutions are Ubiquitous for Force-Directed, Spectral, and Circle Packing Drawings," *Journal of Graph Algorithms and Applications*, **19**(2), 619–656, 2015.

J-87. C. Duncan, D. Eppstein, M.T. Goodrich, S.G. Kobourov and M. Löffler, "Planar and Poly-Arc Lombardi Drawings," *Journal of Computational Geometry* (JoCG), **9**(1), 328–355, 2018.

J-88. G. Barequet, D. Eppstein, M.T. Goodrich, and N. Mamano, "Stable-Matching Voronoi Diagrams: Combinatorial Complexity and Algorithms," *Journal of Computational Geometry* (JoCG), **11**(1), 26–59, 2020.

J-89. M.T. Goodrich, Z.M. Liang, and S. Zhao, "Inverse-Rendering Based Analysis of the Fine Illumination Effects in the Salvator Mundi," *Leonardo*, **53**(4), 380–386, 2020.

J-90. W.E. Devanny, M.T. Goodrich, S. Irani, "A Competitive Analysis for the Start-Gap Algorithm for Online Memory Wear Leveling," *Information Processing Letters*, **116**, 106042, 2021.

J-91. G. Barequet, M. De, and M.T. Goodrich, "Convex-Straight-Skeleton Voronoi Diagrams for Segments and Convex Polygons," *Algorithmica*, **83**(7), 2245–2272, 2021.

J-92. G. Da Lozzo, D. Eppstein, M.T. Goodrich, and S. Gupta, "C-Planarity Testing of Embedded Clustered Graphs with Bounded Dual Carving-Width," *Algorithmica*, **83**(8), 2471–2502, 2021.

J-93. M. Shinder, M.T. Goodrich, O. Gila, M. Dillencourt, "Beyond Big O: Teaching Experimental Algorithmics," *Journal of Computing Sciences in Colleges*, **37**(10), 23–36, 2022.

J-94. P. Choudhary, M.T. Goodrich, S. Gupta, H. Khodabandeh, P. Matias, and V. Raman, "Improved Kernels for Tracking Paths," *Information Processing Letters*, **181**, 106360, 2023.

J-95. M. Dillencourt and M.T. Goodrich, "Simplified Chernoff Bounds with Powers-of-Two Probabilities," *Information Processing Letters*, **182**, 106397, 2023.

J-96. S. Han, V. Chakraborty, M.T. Goodrich, S. Mehrotra, S. Sharma, "VEIL: A Storage and Communication Efficient Volume-Hiding Algorithm," *Proc. ACM Management of Data* (SIGMOD), **1**(4), 265:1-265:27, 2023.

J-97. M.A. Bender, M. Farach-Colton, M.T. Goodrich, and H. Komlos, "History-Independent Dynamic Partitioning: Operation-Order Privacy in Ordered Data Structures," *Proc. ACM Management of Data* (PODS), **2**(2), 108:1-108:27, 2024. **Best Paper Award**

J-98. M. Dillencourt, M.T. Goodrich, and M. Mitzenmacher, "Leveraging Parameterized Chernoff Bounds for Simplified Algorithm Analyses," *Information Processing Letters*, **187**, 106516, 2025 (posted online June 2024).

Papers in Proceedings:

C-1. M.J. Atallah and M.T. Goodrich, "Efficient Parallel Solutions to Geometric Problems," *1985 IEEE Int. Conf. on Parallel Processing (ICPP)*, 411–417. (Proceedings version of J-1.)

C-2. F. Berman, M.T. Goodrich, C. Koelbel, W. Robison, and K. Showell, "Prep-P: A Mapping Preprocessor for CHiP Computers," *1985 IEEE Int. Conf. on Parallel Processing*, 731–733.

C-3. M.J. Atallah and M.T. Goodrich, "Parallel Algorithms For Some Functions of Two Convex Polygons," *24th Allerton Conf. on Communication, Control and Computing*, 1986, 758–767. (Proceedings version of J-4.)

C-4. M.J. Atallah and M.T. Goodrich, "Efficient Plane Sweeping in Parallel," *2nd ACM Symp. on Computational Geometry* (SoCG), 1986, 216–225.

C-5. M.T. Goodrich, "A Polygonal Approach to Hidden-Line Elimination," *25th Allerton Conf. on Communication, Control, and Computing*, 1987, 849–858. (Proceedings version of J-12.)

C-6. M.J. Atallah, R. Cole, and M.T. Goodrich, "Cascading Divide-and-Conquer: A Technique for Designing Parallel Algorithms," *28th IEEE Symp. on Foundations of Computer Science* (FOCS), 1987, 151-160. (Proceedings version of J-5.)

C-7. M.J. Atallah, M.T. Goodrich, and S.R. Kosaraju, "Parallel Algorithms for Evaluating Sequences of Set-Manipulation Operations," *3rd Aegean Workshop on Computing* (AWOC), *Lecture Notes in Computer Science* (LNCS): 319, Springer-Verlag, 1988, 1–10. (Proceedings version of J-19.)

C-8. R. Cole and M.T. Goodrich, "Optimal Parallel Algorithms for Polygon and Point-Set Problems," *4th ACM Symp. on Computational Geometry* (SoCG), 1988, 201–210. (Proceedings version of J-11.)

C-9. M.T. Goodrich, "Intersecting Line Segments in Parallel with an Output-Sensitive Number of Processors," *1989 ACM Symp. on Parallel Algorithms and Architectures* (SPAA), 127–137. (Proceedings version of J-10.)

C-10. M.T. Goodrich and S.R. Kosaraju, "Sorting on a Parallel Pointer Machine with Applications to Set Expression Evaluation," *30th IEEE Symp. on Foundations of Computer Science* (FOCS), 1989, 190–195. (Proceedings version of J-24.)

C-11. M.T. Goodrich, C. Ó'Dúnlaing, and C. Yap "Constructing the Voronoi Diagram of a Set of Line Segments in Parallel," *Lecture Notes in Computer Science 382, Algorithms and Data Structures* (WADS), Springer-Verlag, 1989, 12–23. (Proceedings version of J-14.)

C-12. M.T. Goodrich and J.S. Snoeyink, "Stabbing Parallel Segments with a Convex Polygon," *Lecture Notes in Computer Science 382, Algorithms and Data Structures* (WADS), Springer-Verlag, 1989, 231–242. (Proceedings version of J-8.)

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
Page 62 of 93

C-13. J. Johnstone and M.T. Goodrich, "A Localized Method for Intersecting Plane Algebraic Curve Segments," *New Advances in Computer Graphics: Proc. of Computer Graphics International '89*, R.A. Earnshaw, B. Wyvel, eds., Springer-Verlag, 1989, 165–181. (Proceedings version of J-9.)

C-14. M.J. Atallah, P. Callahan, and M.T. Goodrich, "P-Complete Geometric Problems," *2nd ACM Symp. on Parallel Algorithms and Architectures* (SPAA), 1990, 317–326. (Proceedings version of J-18.)

C-15. R. Cole, M.T. Goodrich, C. Ó Dúnlaing, "Merging Free Trees in Parallel for Efficient Voronoi Diagram Construction", *17th Int. Conf. on Automata, Languages, and Programming* (ICALP), 1990, 432–445. (Proceedings version of J-27.)

C-16. M.T. Goodrich, M.J. Atallah, and M. Overmars, "An Input-Size/Output-Size Trade-Off in the Time-Complexity of Rectilinear Hidden-Surface Removal", *17th Int. Conf. on Automata, Languages, and Programming* (ICALP), 1990, 689–702. (Proceedings version of J-17.)

C-17. M.T. Goodrich, M. Ghouse, and J. Bright, "Generalized Sweep Methods for Parallel Computational Geometry," *2nd ACM Symp. on Parallel Algorithms and Architectures* (SPAA), 1990, 280–289. (Proceedings version of J-23.)

C-18. M.T. Goodrich, "Applying Parallel Processing Techniques to Classification Problems in Constructive Solid Geometry," *1st ACM-SIAM Symp. on Discrete Algorithms* (SODA), 1990, 118–128. (Proceedings version of J-33.)

C-19. M.T. Goodrich, S. Shauck, and S. Guha, "Parallel Methods for Visibility and Shortest Path Problems in Simple Polygons," *6th ACM Symp. on Computational Geometry* (SoCG), 1990, 73–82. (Proceedings version of J-13.)

C-20. M. Ghouse and M.T. Goodrich, "In-Place Techniques for Parallel Convex Hull Algorithms," *3rd ACM Symp. on Parallel Algorithms and Architectures* (SPAA), 1991, 192–203. (Proceedings version of J-30.)

C-21. M.T. Goodrich, "Constructing Arrangements Optimally in Parallel," *3rd ACM Symp. on Parallel Algorithms and Architectures* (SPAA), 1991, 169–179. (Proceedings version of J-16.)

C-22. M.T. Goodrich and R. Tamassia, "Dynamic Trees and Dynamic Point Location," *23rd ACM Symp. on Theory of Computing* (STOC), 1991, 523–533. (Proceedings version of J-35.)

C-23. M.T. Goodrich, "Using Approximation Algorithms to Design Parallel Algorithms that May Ignore Processor Allocation," *32nd IEEE Symp. on Foundations of Computer Science* (FOCS), 1991, 711–722.

C-24. M.T. Goodrich, "Planar Separators and Parallel Polygon Triangulation," *24th ACM Symp. on Theory of Computing* (STOC), 1992, 507–516. (Proceedings version of J-22.)

C-25. M.T. Goodrich, Y. Matias, U. Vishkin, "Approximate Parallel Prefix Computation and Its Applications," *7th IEEE Int. Parallel Processing Symp* (IPPS), 1993, 318–325.

C-26. M. Ghouse and M.T. Goodrich, "Experimental Evidence for the Power of Random Sampling in Practical Parallel Algorithms," *7th IEEE Int. Parallel Processing Symp* (IPPS), 1993, 549–556.

C-27. L.P. Chew, M.T. Goodrich, D.P. Huttenlocher, K. Kedem, J.M. Kleinberg, and D. Kravets, "Geometric Pattern Matching under Euclidean Motion," *5th Canadian Conf. on Computational Geometry* (CCCG), 1993, 151–156. (Proceedings version of J-31.)

C-28. M.T. Goodrich, "Geometric Partitioning Made Easier, Even in Parallel," *9th ACM Symp. on Computational Geometry* (SoCG), 1993, 73–82.

C-29. M.T. Goodrich and R. Tamassia, "Dynamic Ray Shooting and Shortest Paths via Balanced Geodesic Triangulations," *9th ACM Symp. on Computational Geometry* (SoCG), 1993, 318–

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
Page 63 of 93

327. (Proceedings version of J-29.)

C-30. A. Garg, M.T. Goodrich, and R. Tamassia, "Area-Efficient Upward Tree Drawings," *9th ACM Symp. on Computational Geometry* (SoCG), 1993, 359–368. (Proceedings version of J-25.)

C-31. M.H. Nodine, M.T. Goodrich, and J.S. Vitter, "Blocking for External Graph Searching," *12th ACM Symp. on Principles of Database Systems* (PODS), 1993, 222–232. (Proceedings version of J-26.)

C-32. E.M. Arkin, M.T. Goodrich, J.S.B. Mitchell, D. Mount, and S.S. Skiena, "Point Probe Decision Trees for Geometric Concept Classes," *Lecture Notes in Computer Science 709: Algorithms and Data Structures* (WADS), Springer-Verlag, 1993, 95–106.

C-33. M.T. Goodrich, J.J. Tsay, D.E. Vengroff, and J.S. Vitter, "External-Memory Computational Geometry," *34th IEEE Symp. on Foundations of Computer Science* (FOCS), 1993, 714–723.

C-34. M.T. Goodrich, Y. Matias, and U. Vishkin, "Optimal Parallel Approximation Algorithms for Prefix Sums and Integer Sorting," *5th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 1994, 241–250.

C-35. H. Brönnimann and M.T. Goodrich, "Almost Optimal Set Covers in Finite VC-Dimension," *10th ACM Symp. on Computational Geometry* (SoCG), 1994, 293–302. (Proceedings version of J-21.)

C-36. M.T. Goodrich, "Efficient Piecewise-Linear Function Approximation Using the Uniform Metric," *10th ACM Symp. on Computational Geometry* (SoCG), 1994, 322–331. (Proceedings version of J-20.)

C-37. M.J. Atallah, M.T. Goodrich, and K. Ramaiyer, "Biased Finger Trees and Three-Dimensional Layers of Maxima," *10th ACM Symp. on Computational Geometry* (SoCG), 1994, 150–159.

C-38. M.T. Goodrich, J.S.B. Mitchell, and M.W. Orletsky, "Practical Methods for Approximate Geometric Pattern Matching under Rigid Motions," *10th ACM Symp. on Computational Geometry* (SoCG), 1994, 103–112. (Proceedings version of J-37.)

C-39. N.M. Amato, M.T. Goodrich, E.A. Ramos, "Parallel Algorithms for Higher-Dimensional Convex Hulls," *35th IEEE Symp. on Foundations of Computer Science* (FOCS), 1994, 683–694.

C-40. P.J. Tanenbaum, M.T. Goodrich, and E.R. Scheinerman, "Characterization and Recognition of Point-Halfspace and Related Orders," *2nd Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science 894, Springer-Verlag, 1994, 234–245.

C-41. Y.J. Chiang, M.T. Goodrich, E.F. Grove, R. Tamassia, D.E. Vengroff, and J.S. Vitter, "External-Memory Graph Algorithms," *6th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 1995, 139–149.

C-42. N.M. Amato, M.T. Goodrich, and E.A. Ramos, "Computing Faces in Segment and Simplex Arrangements," *27th ACM Symp. on Theory of Computing* (STOC), 1995, 672–682.

C-43. P. Callahan, M.T. Goodrich, and K. Ramaiyer, "Topology B-Trees and Their Applications," *1995 Workshop on Algorithms and Data Structures* (WADS), Lecture Notes in Computer Science 955, Springer-Verlag, 381–392.

C-44. G. Das and M.T. Goodrich, "On the Complexity of Approximating and Illuminating Three-Dimensional Convex Polyhedra," *1995 Workshop on Algorithms and Data Structures* (WADS), Lecture Notes in Computer Science 955, Springer-Verlag, 74–85. (Proceedings version of J-28.)

C-45. M.T. Goodrich, "Fixed-Dimensional Parallel Linear Programming via Relative ϵ-Approximations," *7th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 1996, 132–141.

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
Page 64 of 93

(Proceedings version of J-32.)

C-46. M. Chrobak, M.T. Goodrich, and R. Tamassia, "Convex Drawings of Graphs in Two and Three Dimensions," *12th ACM Symp. on Computational Geometry* (SoCG), 1996, 319–328.

C-47. M.T. Goodrich, "Communication-Efficient Parallel Sorting," *28th ACM Symp. on Theory of Computing* (STOC), 1996, 247–256. (Proceedings version of J-38.)

C-48. T. Chan, M.T. Goodrich, S.R. Kosaraju, and R. Tamassia, "Optimizing Area and Aspect Ratio in Straight-Line Orthogonal Tree Drawings," *4th Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science 1190, Springer-Verlag, 1996, 63–75. (Proceedings version of J-47.)

C-49. M.T. Goodrich, "Randomized Fully-Scalable BSP Techniques for Multi-Searching and Convex Hull Construction," *8th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 1997, 767–776.

C-50. C.A. Duncan, M.T. Goodrich, and E.A. Ramos, "Efficient Approximation and Optimization Algorithms for Computational Metrology," *8th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 1997, 121–130.

C-51. M.T. Goodrich, M. Orletsky, and K. Ramaiyer, "Methods for Achieving Fast Query Times in Point Location Data Structures," *8th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 1997, 757–766.

C-52. M.T. Goodrich, L.J. Guibas, J. Hershberger, P.J. Tanenbaum, "Snap Rounding Line Segments Efficiently in Two and Three Dimensions," *13th ACM Symp. on Computational Geometry* (SoCG), 1997, 284–293.

C-53. G. Barequet, S.S. Bridgeman, C.A. Duncan, M.T. Goodrich, and R. Tamassia, "Classical Computational Geometry in GeomNet," *13th ACM Symp. on Computational Geometry* (SoCG), 1997, 412–414.

C-54. G. Barequet, A. Briggs, M. Dickerson, C. Dima, and M.T. Goodrich, "Animating the Polygon-Offset Distance Function," *13th ACM Symp. on Computational Geometry* (SoCG), 1997, 479–480, and the *Video Review for the 13th ACM Symp. on Computational Geometry* (SoCG).

C-55. G. Barequet, A. Briggs, M. Dickerson, and M.T. Goodrich, "Offset-Polygon Annulus Placement Problems," *1997 Workshop on Algorithms and Data Structures* (WADS), 1997, 378–391. (Proceedings version of J-34.)

C-56. G. Barequet, M. Dickerson, and M.T. Goodrich, "Voronoi Diagrams for Polygon-Offset Distance Functions," *1997 Workshop on Algorithms and Data Structures* (WADS), 1997, 200–209. (Proceedings version of J-42.)

C-57. N. Gelfand, M.T. Goodrich, and R. Tamassia, "Teaching Data Structure Design Patterns," *29th ACM SIGCSE Technical Symp. on Computer Science Education*, 1998, 331–335.

C-58. M.T. Goodrich and R. Tamassia, "Teaching the Analysis of Algorithms with Visual Proofs," *29th ACM SIGCSE Technical Symp. on Computer Science Education*, 1998, 207–211.

C-59. G. Barequet, D.Z. Chen, O. Daescu, M.T. Goodrich, and J.S. Snoeyink, "Efficiently Approximating Polygonal Paths in Three and Higher Dimensions," *1998 ACM Symp. on Computational Geometry* (SoCG), 1998, 317–326. (Proceedings version of J-46.)

C-60. M.T. Goodrich and C.G. Wagner, "A Framework for Drawing Planar Graphs with Curves and Polylines," *6th Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science 1547, Springer-Verlag, 1998, 153–166. (Proceedings version of J-40.)

C-61. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, "Balanced Aspect Ratio Trees and Their Use for Drawing Very Large Graphs," *6th Int. Symp. on Graph Drawing* (GD), Lecture Notes in

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
Page 65 of 93

Computer Science 1547, Springer-Verlag, 1998, 111–124. (Proceedings version of J-39.)

C-62. M.T. Goodrich, M. Handy, B. Hudson, and R. Tamassia, "Abstracting Positional Information in Data Structures: Locators and Positions in JDSL," *Object-Oriented Programming, Systems, Languages & Applications (OOPSLA) '98 Technical Notes*, 1998.

C-63. M.T. Goodrich and J.G. Kloss II, "Tiered Vector: An Efficient Dynamic Array for JDSL," *Object-Oriented Programming, Systems, Languages & Applications (OOPSLA) '98 Technical Notes*, 1998.

C-64. M.T. Goodrich, M. Handy, B. Hudson, and R. Tamassia, "Accessing the Internal Organization of Data Structures in the JDSL Library," *Int. Workshop on Algorithm Engineering and Experimentation* (ALENEX), Springer-Verlag, Lecture Notes in Computer Science, Vol. 1619, 1999, 124–139.

C-65. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, "Balanced Aspect Ratio Trees: Combining the Benefits of k-D Trees and Octrees," *10th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 1999, 300–309. (Proceedings version of J-41.)

C-66. R.S. Baker, M. Boilen, M.T. Goodrich, R. Tamassia, and B.A. Stibel, "Testers and Visualizers for Teaching Data Structures," *30th ACM SIGCSE Technical Symp. on Computer Science Education*, 1999, 261–265.

C-67. M.T. Goodrich and R. Tamassia, "Using Randomization in the Teaching of Data Structures and Algorithms," *30th ACM SIGCSE Technical Symp. on Computer Science Education*, 1999, 53–57. (Proceedings version of Ch-5.)

C-68. G. Barequet, C. Duncan, M.T. Goodrich, S. Kumar, M. Pop, "Efficient Perspective-Accurate Silhouette Computation," *15th ACM Symp. on Computational Geometry* (SoCG), 1999, 417–418, and the *Video Review for the 15th ACM Symp. on Computational Geometry* (SoCG).

C-69. C.C. Cheng, C.A. Duncan, M.T. Goodrich, and S.G. Kobourov, "Drawing Planar Graphs with Circular Arcs," *7th Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science 1731, Springer-Verlag, 1999, 117–126. (Proceedings version of J-43.)

C-70. C.A. Duncan, M.T. Goodrich, and S.G. Kobourov, "Planarity-Preserving Clustering and Embedding for Large Planar Graphs," *7th Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science 1731, Springer-Verlag, 1999, 186–196. (Proceedings version of J-48.)

C-71. M.T. Goodrich and J.G. Kloss II, "Tiered Vectors: Efficient Dynamic Arrays for Rank-Based Sequences," *1999 Workshop on Algorithms and Data Structures* (WADS), Lecture Notes in Computer Science 1663, Springer-Verlag, 1999, 205–216.

C-72. M.T. Goodrich, "Competitive Tree-Structured Dictionaries," *11th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 2000, 494–495.

C-73. N.M. Amato, M.T. Goodrich, and E.A. Ramos, "Computing the Arrangement of Curve Segments: Divide-and-Conquer Algorithms via Sampling," *11th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 2000, 705–706.

C-74. S. Bridgeman, M.T. Goodrich, S.G. Kobourov, and R. Tamassia, "PILOT: An Interactive Tool for Learning and Grading," *31st ACM SIGCSE Technical Symp. on Computer Science Education*, 2000, 139–143.

C-75. S. Bridgeman, M.T. Goodrich, S.G. Kobourov, and R. Tamassia, "SAIL: A System for Generating, Archiving, and Retrieving Specialized Assignments in LaTeX," *31st ACM SIGCSE Technical Symp. on Computer Science Education*, 2000, 300–304.

C-76. N.M. Amato, M.T. Goodrich, and E.A. Ramos, "Linear-Time Triangulation of a Simple Polygon Made Easier Via Randomization," *16th ACM Symp. on Computational Geometry*

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
Page 66 of 93

(SoCG), 2000, 201-212. (Proceedings version of J-44.)

C-77. A.L. Buchsbaum, M.T. Goodrich, and J.R. Westbrook, "Range Searching Over Tree Cross Products," *8th European Symp. on Algorithms* (ESA), Lecture Notes in Computer Science 1879, Springer-Verlag, 2000, 120–131.

C-78. C.A. Duncan, M.T. Dickerson, and M.T. Goodrich, "k-D Trees are Better When Cut on the Longest Side," *8th European Symp. on Algorithms* (ESA), Lecture Notes in Computer Science 1879, Springer-Verlag, 2000, 179–190.

C-79. P. Gajer, M.T. Goodrich, and S.G. Kobourov, "A Fast Multi-Dimensional Algorithm for Drawing Large Graphs," *8th Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science 1984, Springer-Verlag, 2001, 211–221. (Proceedings version of J-52.)

C-80. G. Ateniese, B. de Medeiros, and M.T. Goodrich, "TRICERT: A Distributed Certified E-mail Scheme," *Network and Distributed Systems Security Symp.* (NDSS), 2001, 47–56.

C-81. M.T. Goodrich and R. Tamassia, "Teaching Internet Algorithmics," *32nd ACM SIGCSE Technical Symp. on Computer Science Education*, 2001, 129–133.

C-82. M. Pop, G. Barequet, C.A. Duncan, M.T. Goodrich, W. Hwang, and S. Kumar, "Efficient Perspective-Accurate Silhouette Computation and Applications," *17th ACM Symp. on Computational Geometry* (SoCG), 2001, 60–68.

C-83. M.T. Goodrich and R. Tamassia, "Implementation of an Authenticated Dictionary with Skip Lists and Commutative Hashing," *DARPA Information Survivability Conf. & Exposition II* (DISCEX), IEEE Press, 2001, 68–82.

C-84. A. Bagchi, A. Chaudhary, R. Garg, M.T. Goodrich, and V. Kumar, "Seller-Focused Algorithms for Online Auctioning," *2001 Workshop on Algorithms and Data Structures* (WADS), Lecture Notes in Computer Science 2125, Springer-Verlag, 2001, 135–147.

C-85. A. Anagnostopoulos, M.T. Goodrich, R. Tamassia, "Persistent Authenticated Dictionaries and Their Applications," *Information Security Conf.* (ISC), Lecture Notes in Computer Science 2200, Springer-Verlag, 2001, 379–393.

C-86. M.T. Dickerson and M.T. Goodrich, "Matching Points to a Convex Polygonal Boundary," *13th Canadian Conf. on Computational Geometry* (CCCG), 2001, 8 pages.

C-87. M.T. Goodrich, R. Tamassia, and J. Hasic, "An Efficient Dynamic and Distributed Cryptographic Accumulator," *5th Information Security Conf.* (ISC), Lecture Notes in Computer Science 2433, Springer-Verlag, 2002, 372–388.

C-88. A.L. Buchsbaum and M.T. Goodrich, "Three-Dimensional Layers of Maxima," *10th European Symp. on Algorithms* (ESA), Lecture Notes in Computer Science 2461, Springer-Verlag, 2002, 257–267. (Proceedings version of J-49.)

C-89. A. Bagchi, A.L. Buchsbaum, and M.T. Goodrich, "Biased Skip Lists," *13th Int. Symp. on Algorithms and Computation* (ISAAC), Lecture Notes in Computer Science 2518, Springer-Verlag, 2002, 1–13. (Proceedings version of J-54.)

C-90. M.T. Goodrich, "Efficient Packet Marking for Large-Scale IP Traceback," *9th ACM Conf. on Computer and Communications Security* (CCS), 2002, 117–126. (Proceedings version of J-61.)

C-91. M.T. Goodrich, R. Tamassia, N. Triandopoulos, and R. Cohen, "Authenticated Data Structures for Graph and Geometric Searching," *RSA Conf.—Cryptographers' Track* (CT-RSA), Lecture Notes in Computer Science 2612, Springer-Verlag, 2003, 295–313. (Proceedings version of J-71.)

C-92. M.T. Goodrich, M. Shin, R. Tamassia, and W.H. Winsborough, "Authenticated Dictionaries for Fresh Attribute Credentials," *1st Int. Conf. on Trust Management* (iTrust), Lecture Notes in Computer Science 2692, Springer-Verlag, 2003, 332–347.

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
Page 67 of 93

C-93. G. Barequet, M.T. Goodrich, A. Levi-Steiner, and D. Steiner, "Straight-Skeleton Based Contour Interpolation," *14th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 2003, 119–127. (Proceedings version of J-51.)

C-94. G. Barequet, M.T. Goodrich, and C. Riley, "Drawing Graphs with Large Vertices and Thick Edges," *2003 Workshop and Data Structures and Algorithms* (WADS), Lecture Notes in Computer Science 2748, Springer-Verlag, 2003, 281–293. (Proceedings version of J-50.)

C-95. A. Bagchi, A. Chaudhary, M.T. Goodrich, and S. Xu, "Constructing Disjoint Paths for Secure Communication," *17th Int. Symp. on Distributed Computing* (DISC), Lecture Notes in Computer Science 2848, Springer-Verlag, 2003, 181–195.

C-96. M. Dickerson, D. Eppstein, M.T. Goodrich, J.Y. Meng, "Confluent Drawings: Visualizing Non-planar Diagrams in a Planar Way," *11th Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science 2912, Springer-Verlag, 2003, 1–12. (Proceedings version of J-55.)

C-97. F. Brandenberg, D. Eppstein, M.T. Goodrich, S. Kobourov, G. Liotta, P. Mutzel, "Selected Open Problems in Graph Drawing," *11th Int. Symp. on Graph Drawing* (GD), Lecture Notes in Computer Science 2912, Springer-Verlag, 2003, 515–539.

C-98. A. Bagchi, A. Chaudhary, D. Eppstein, and M.T. Goodrich, "Deterministic Sampling and Range Counting in Geometric Data Streams," *20th ACM Symp. on Computational Geometry* (SoCG), 144–151, 2004. (Proceedings version of J-58.)

C-99. M.T. Goodrich, J.Z. Sun, and R. Tamassia, "Efficient Tree-Based Revocation in Groups of Low-State Devices," *Advances in Cryptology* (CRYPTO), Springer, Lecture Notes in Computer Science 3152, 511–527, 2004.

C-100. D. Eppstein, M.T. Goodrich, and J.Y. Meng, "Confluent Layered Drawings," *12th Int. Symp. on Graph Drawing* (GD), Springer, Lecture Notes in Computer Science 3383, 184–194, 2004. (Proceedings version of J-57.)

C-101. M.J. Atallah, K.B. Frikken, M.T. Goodrich, and R. Tamassia, "Secure Biometric Authentication for Weak Computational Devices," *9th Int. Conf. on Financial Cryptography and Data Security*, Springer, Lecture Notes in Computer Science 3570, 357–371, 2005.

C-102. M.T. Goodrich, "Leap-Frog Packet Linking and Diverse Key Distributions for Improved Integrity in Network Broadcasts," *IEEE Symp. on Security and Privacy* (S&P), 196–207, 2005.

C-103. D. Eppstein, M.T. Goodrich, and J.Z. Sun, "The Skip Quadtree: A Simple Dynamic Data Structure for Multidimensional Data," *21st ACM Symp. on Computational Geometry* (SoCG), 296–305, 2005. (Proceedings version of J-60.)

C-104. M.J. Atallah, M.T. Goodrich, and R. Tamassia, "Indexing Information for Data Forensics," *3rd Applied Cryptography and Network Security Conf.* (ACNS), Lecture Notes in Computer Science 3531, Springer, 206–221, 2005.

C-105. W. Du and M.T. Goodrich, "Searching for High-Value Rare Events with Uncheatable Grid Computing," *3rd Applied Cryptography and Network Security Conf.* (ACNS), Lecture Notes in Computer Science 3531, Springer, 122–137, 2005.

C-106. L. Arge, D. Eppstein, and M.T. Goodrich, "Skip-Webs: Efficient Distributed Data Structures for Multi-Dimensional Data Sets," *24th ACM Symp. on Principles of Distributed Computing* (PODC), 2005.

C-107. D. Eppstein, M.T. Goodrich, and D. Hirschberg, "Improved Combinatorial Group Testing for Real-World Problem Sizes," *Workshop on Algorithms and Data Structures* (WADS), Lecture Notes in Computer Science 3608, Springer, 86–98, 2005. (Proceedings version of J-59.)

C-108. A. Chaudhary and M.T. Goodrich, "Balanced Aspect Ratio Trees Revisited," *Workshop on*

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
Page 68 of 93

Algorithms and Data Structures (WADS), Lecture Notes in Computer Science 3608, Springer, 73–85, 2005.

C-109. M.T. Goodrich, R. Tamassia, and D. Yao, "Accredited DomainKeys: A Service Architecture for Improved Email Validation," *2nd Conf. on Email and Anti-Spam* (CEAS), 1–8, 2005.

C-110. M.T. Goodrich, G.S. Lueker, and J.Z. Sun, "C-Planarity of Extrovert Clustered Graphs," *13th Int. Symp. Graph Drawing* (GD), 211–222, 2005.

C-111. D. Eppstein, M.T. Goodrich, J.Y. Meng, "Delta-Confluent Drawings," *13th Int. Symp. Graph Drawing* (GD), 165–176, 2005.

C-112. M.T. Goodrich, M.J. Nelson, and J.Z. Sun, "The Rainbow Skip Graph: A Fault-Tolerant Constant-Degree Distributed Data Structure," *17th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 384–393, 2006.

C-113. M.T. Goodrich, M. Sirivianos, J. Solis, G. Tsudik, E. Uzun, "Loud And Clear: Human-Verifiable Authentication Based on Audio," *26th IEEE Int. Conf. on Distributed Computing Systems* (ICDCS), 1–8, 2006. (Proceedings version of J-66.)

C-114. M.T. Goodrich, R. Tamassia, and D. Yao, "Notarized Federated Identity Management for Web Services," *20th IFIP WG Working Conf. on Data and Application Security* (DBSec), Springer, Lecture Notes in Computer Science, Vol. 4127, 133–147, 2006. (Proceedings version of J-63.)

C-115. M.T. Goodrich and D.S. Hirschberg, "Efficient Parallel Algorithms for Dead Sensor Diagnosis and Multiple Access Channels," *18th ACM Symp. on Parallelism in Algorithms and Architectures* (SPAA), 118–127, 2006. (Proceedings version of J-62.)

C-116. Y. Cho, L. Bao, and M.T. Goodrich, "LAAC: A Location-Aware Access Control Protocol," *2006 3rd Annual Int. Conf. on Mobile and Ubiquitous Systems - Workshop on Ubiquitous Access Control* (IWUAC), 1–7, 2006.

C-117. M.B. Dillencourt, D. Eppstein, and M.T. Goodrich, "Choosing Colors for Geometric Graphs via Color Space Embeddings," *14th Int. Symp. Graph Drawing* (GD), Lecture Notes in Computer Science, Vol. 4372, Springer, 294–305, 2006.

C-118. D. Eppstein, M.T. Goodrich, and N. Sitchinava, "Guard Placement for Wireless Localization," *23rd ACM Symp. on Computational Geometry* (SoCG), 27–36, 2007.

C-119. M.T. Goodrich, C. Papamanthou, and R. Tamassia, "On the Cost of Persistence and Authentication in Skip Lists," *6th Workshop on Experimental Algorithms* (WEA), LNCS 4525, 94–107, 2007.

C-120. M.J. Atallah, M. Blanton, M.T. Goodrich, and S. Polu, "Discrepancy-Sensitive Dynamic Fractional Cascading, Dominated Maxima Searching, and 2-d Nearest Neighbors in Any Minkowski Metric," *Workshop on Algorithms and Data Structures* (WADS), LNCS, Vol. 4619, Springer, 114–126, 2007.

C-121. D. Eppstein and M.T. Goodrich, "Space-Efficient Straggler Identification in Round-Trip Data Streams via Newton's Identities and Invertible Bloom Filters," *Workshop on Algorithms and Data Structures* (WADS), LNCS, Vol. 4619, Springer, 2007, 638–649. (Proceedings version of J-72.)

C-122. M.T. Goodrich and J.Z. Sun, "Checking Value-Sensitive Data Structures in Sublinear Space," *18th Int. Symp. on Algorithms and Computation* (ISAAC), LNCS, vol. 4835, Springer, 2007, 353–364.

C-123. M.T. Goodrich, R. Tamassia, and N. Triandopoulos, "Super-Efficient Verification of Dynamic Outsourced Databases," *RSA Conf.—Cryptographers' Track* (CT-RSA), LNCS, vol. 4964, Springer, 2008, 407–424.

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
Page 69 of 93

C-124. D. Eppstein, M.T. Goodrich, E. Kim, and R. Tamstorf, "Approximate Topological Matching of Quadrilateral Meshes," *IEEE Int. Conf. on Shape Modeling and Applications* (SMI), 2008, 83–92. (Proceedings version of J-68.)

C-125. G. Barequet, D. Eppstein, M.T. Goodrich, and A. Waxman, "Straight Skeletons of Three-Dimensional Polyhedra," *16th European Symp. on Algorithms* (ESA), LNCS, vol. 5193, 2008, 148–160.

C-126. M.T. Goodrich, C. Papamanthou, R. Tamassia, and N. Triandopoulos, "Athos: Efficient Authentication of Outsourced File Systems," *11th Information Security Conf.* (ISC), LNCS, vol. 5222, 2008, 80–96.

C-127. L. Arge, M.T. Goodrich, M. Nelson, and N. Sitchinava, "Fundamental Parallel Algorithms for Private-Cache Chip Multiprocessors," *20th ACM Symp. on Parallelism in Algorithms and Architectures* (SPAA), 2008, 197–206.

C-128. D. Eppstein and M.T. Goodrich, "Succinct Greedy Graph Drawing in the Hyperbolic Plane," *16th Int. Symp. on Graph Drawing* (GD), LNCS, vol. 5417, Springer, 2008, 14–25. (Proceedings version of J-69.)

C-129. D. Eppstein and M.T. Goodrich, "Studying (Non-Planar) Road Networks Through an Algorithmic Lens," *16th ACM SIGSPATIAL Int. Conf. on Adv. in Geographic Information Systems* (GIS), 2008, 125–134. **Best Paper Award**.

C-130. M. Dickerson and M.T. Goodrich, "Two-Site Voronoi Diagrams in Geographic Networks," *16th ACM SIGSPATIAL Int. Conf. on Adv. in Geographic Information Systems* (GIS), 2008, 439–442.

C-131. D. Eppstein, M.T. Goodrich, and D. Strash, "Linear-Time Algorithms for Geometric Graphs with Sublinearly Many Crossings," *20th ACM-SIAM Symp. on Discrete Algorithms* (SODA), 2009, 150–159. (Proceedings version of J-70.)

C-132. M.T. Goodrich, "The Mastermind Attack on Genomic Data," *30th IEEE Symp. on Security and Privacy* (S&P), 2009, 204–218. (Proceedings version of J-80.)

C-133. W. Du, D. Eppstein, M.T. Goodrich, and G.S. Lueker, "On the Approximability of Geometric and Geographic Generalization and the Min-Max Bin Covering Problem," *Algorithms and Data Structures Symp.* (WADS), LNCS, vol. 5664, Springer, 2009, 242–253.

C-134. M.T. Goodrich, R. Tamassia, and N. Triandopoulos, J.Z. Sun, "Reliable Resource Searching in P2P Networks," *5th Int. ICST Conf. on Security and Privacy in Communication Networks* (SecureComm), Lecture Notes of ICST, vol. 19, Springer, 2009, 437–447.

C-135. C.A. Duncan, M.T. Goodrich, S.G. Kobourov, "Planar Drawings of Higher-Genus Graphs," *17th Int. Symp. on Graph Drawing* (GD), LNCS, Springer, vol. 5849, 2009, 45–56. (Proceedings version of J-73.)

C-136. D. Eppstein, M.T. Goodrich, L. Trott, "Going Off-road: Transversal Complexity in Road Networks," *17th ACM SIGSPATIAL Int. Conf. on Adv. in Geographic Information Systems* (GIS), 2009, 23–32.

C-137. M.T. Goodrich and Darren Strash, "Succinct Greedy Geometric Routing in the Euclidean Plane," *20th Int. Symp. on Algorithms and Computation* (ISAAC), LNCS, vol. 5878, Springer, 2009, 781–791.

C-138. M.T. Goodrich, "Randomized Shellsort: A Simple Oblivious Sorting Algorithm," *21st ACM-SIAM Symp. on Discrete Algorithms* (SODA), 2010, 1262–1277. (Proceedings version of J-75.)

C-139. L. Arge, M.T. Goodrich, and N. Sitchinava, "Parallel External Memory Graph Algorithms," *24th IEEE Int. Parallel & Distributed Processing Symp.* (IPDPS), 2010, 1–11.

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
Page 70 of 93

C-140. G. Wang, T. Luo, M.T. Goodrich, W. Du, and Z. Zhu, "Bureaucratic Protocols for Secure Two-Party Sorting, Selection, and Permuting," *5th ACM Symp. on Information, Computer and Communications Security*, 2010, 226–237.

C-141. M.T. Dickerson, M.T. Goodrich, and T.D. Dickerson, "Round-Trip Voronoi Diagrams and Doubling Density in Geographic Networks," *7th Int. Symp. on Voronoi Diagrams in Science and Engineering* (ISVD), IEEE Press, 132–141, 2010. (Proceedings version of J-74.)

C-142. M.T. Dickerson, D. Eppstein, and M.T. Goodrich, "Cloning Voronoi Diagrams via Retroactive Data Structures," *18th European Symp. on Algorithms* (ESA), LNCS, vol. 6346, 2010, 362–373.

C-143. C.A. Duncan, D. Eppstein, M.T. Goodrich, S. Kobourov, and M. Nöllenburg, "Lombardi Drawings of Graphs," *18th Int. Symp. on Graph Drawing* (GD), LNCS, vol. 6502, 2010, 195–207. (Proceedings version of J-76.)

C-144. E. Wolf-Chambers, D. Eppstein, M.T. Goodrich, and M. Löffler, "Drawing Graphs in the Plane with a Prescribed Outer Face and Polynomial Area," *18th Int. Symp. on Graph Drawing* (GD), LNCS, vol. 6502, 2010, 129–140. (Proceedings version of J-77.)

C-145. C.A. Duncan, D. Eppstein, M.T. Goodrich, S. Kobourov, and M. Nöllenburg, "Drawing Trees with Perfect Angular Resolution and Polynomial Area," *18th Int. Symp. on Graph Drawing* (GD), LNCS, vol. 6502, 2010, 183–194. (Proceedings version of J-82.)

C-146. A.U. Asuncion and M.T. Goodrich, "Turning Privacy Leaks into Floods: Surreptitious Discovery of Social Network Friendships and Other Sensitive Binary Attribute Vectors," *Workshop on Privacy in the Electronic Society* (WPES), held in conjunction with the 17th ACM Conf. on Computer and Communications Security (CCS), 2010, 21–30. (Proceedings version of J-81.)

C-147. D. Eppstein, M.T. Goodrich, D. Strash, and L. Trott, "Extended Dynamic Subgraph Statistics Using h-Index Parameterized Data Structures," *4th Annual Int. Conf. on Combinatorial Optimization and Applications* (COCOA), LNCS, vol. 6508, 2010, 128–141. (Proceedings version of J-79.)

C-148. M.T. Goodrich and D. Strash, "Priority Range Trees," *21st Int. Symp. on Algorithms and Computation* (ISAAC), LNCS, vol. 6506, 2010, 97–108.

C-149. D. Eppstein, M.T. Goodrich, R. Tamassia, "Privacy-Preserving Data-Oblivious Geometric Algorithms for Geographic Data," *18th ACM SIGSPATIAL Int. Conf. on Adv. in Geographic Information Systems* (GIS), 2010, 13–22.

C-150. M.T. Goodrich, "Spin-the-bottle Sort and Annealing Sort: Oblivious Sorting via Round-robin Random Comparisons," *8th Workshop on Analytic Algorithmics and Combinatorics* (ANALCO), in conjunction with the ACM-SIAM Symp. on Discrete Algorithms (SODA), 2011. (Proceedings version of J-85.)

C-151. M.T. Goodrich and F. Kerschbaum, "Privacy-Enhanced Reputation-Feedback Methods to Reduce Feedback Extortion in Online Auctions," *ACM Conf. on Data and Application Security and Privacy (CODASPY)*, 2011, 273–282.

C-152. M.T. Goodrich, "Data-Oblivious External-Memory Algorithms for the Compaction, Selection, and Sorting of Outsourced Data," *23rd ACM Symp. on Parallelism in Algorithms and Architectures* (SPAA), 2011, 379–388.

C-153. M.T. Goodrich and M. Mitzenmacher, "Large-Scale Multimaps," *23rd ACM Symp. on Parallelism in Algorithms and Architectures* (SPAA), 2011, 259–260.

C-154. D. Eppstein, M.T. Goodrich, F. Uyeda, and G. Varghese, "What's the Difference? Efficient Set Synchronization without Prior Context," *SIGCOMM* 218–229, 2011.

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
Page 71 of 93

C-155. D. Eppstein, M.T. Goodrich, and M. Löffler, "Tracking Moving Objects with Few Handovers," *Algorithms and Data Structures Symp.* (WADS), 362–373, LNCS, vol. 6844, 2011.

C-156. M.T. Goodrich and M. Mitzenmacher, "Privacy-Preserving Access of Outsourced Data via Oblivious RAM Simulation," *38th Int. Colloquium on Automata, Languages and Programming (ICALP)*, LNCS, vol. 6756, 2011, 576–587.

C-157. M.T. Goodrich and P. Pszona, "External-Memory Network Analysis Algorithms for Naturally Sparse Graphs," *European Symp. on Algorithms (ESA)*, LNCS, vol. 6942, 664–676, 2011.

C-158. C. Duncan, D. Eppstein, M.T. Goodrich, S.G. Kobourov and M. Löffler, "Planar and Poly-Arc Lombardi Drawings," *Int. Symp. Graph Drawing (GD)*, LNCS, vol. 7034, 308–319, 2011. (Proceedings version of J-87.)

C-159. R. Chernobelskiy, K. Cunningham, M.T. Goodrich, S.G. Kobourov and L. Trott, "Force-Directed Lombardi-Style Graph Drawing," *Int. Symp. Graph Drawing (GD)*, LNCS, vol. 7034, 320–331, 2011.

C-160. M.T. Goodrich and M. Mitzenmacher, "Invertible Bloom Lookup Tables," *49th Allerton Conf. on Communication, Control, and Computing*, IEEE Press, **invited paper**, 2011.

C-161. M.T. Goodrich, M. Mitzenmacher, O. Ohrimenko, and R. Tamassia, "Oblivious RAM Simulation with Efficient Worst-Case Access Overhead," *ACM Cloud Computing Security Workshop (CCSW)*, in conjunction with the 17th ACM Conf. on Computer and Communications Security (CCS), 95–100, 2011.

C-162. M.T. Goodrich and J.A. Simons, "Fully Retroactive Approximate Range and Nearest Neighbor Searching," *22nd Int. Symp. on Algorithms and Computation (ISAAC)*, Springer, LNCS, vol. 7074, 292–301, 2011.

C-163. E. Angelino, M.T. Goodrich, M. Mitzenmacher and J. Thaler, "External Memory Multimaps," *22nd Int. Symp. on Algorithms and Computation (ISAAC)*, Springer, LNCS, vol. 7074, 384–394, 2011. (Proceedings version of J-83.)

C-164. M.T. Goodrich, N. Sitchinava, and Q. Zhang, "Sorting, Searching, and Simulation in the MapReduce Framework," *22nd Int. Symp. on Algorithms and Computation (ISAAC)*, Springer, LNCS, vol. 7074, 374–383, 2011.

C-165. D. Eppstein, M.T. Goodrich, M. Löffler, D. Strash and L. Trott, "Category-Based Routing in Social Networks: Membership Dimension and the Small-World Phenomenon," *IEEE Int. Conf. on Computational Aspects of Social Networks* (CASoN), 102–107, 2011. (Proceedings version of J-84.)

C-166. M.T. Goodrich, O. Ohrimenko, M. Mitzenmacher, and R. Tamassia, "Privacy-Preserving Group Data Access via Stateless Oblivious RAM Simulation," *23rd ACM-SIAM Symp. on Discrete Algorithms* (SODA), 157–167, 2012.

C-167. M.T. Goodrich, O. Ohrimenko, M. Mitzenmacher, and R. Tamassia, "Practical Oblivious Storage," *2nd ACM Conf. on Data and Application Security and Privacy* (CODASPY). 13–24, 2012.

C-168. M.T. Goodrich and M. Mitzenmacher, "Anonymous Card Shuffling and its Applications to Parallel Mixnets," *39th Int. Colloquium on Automata, Languages and Programming* (ICALP), Springer, LNCS, vol. 6756, 576–587, 2012.

C-169. M.T. Goodrich, O. Ohrimenko, and R. Tamassia, "Graph Drawing in the Cloud: Privately Visualizing Relational Data using Small Working Storage," *20th Int. Symp. on Graph Drawing* (GD), Springer, LNCS, vol. 7704, 43–54, 2012.

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
Page 72 of 93

C-170. F.J. Brandenburg, D. Eppstein, A. Gleissner, M.T. Goodrich, K. Hanauer, and J. Reislhuber, "On the Density of Maximal 1-Planar Graphs," *20th Int. Symp. on Graph Drawing* (GD), Springer, LNCS, vol. 7704, 327–338, 2012.

C-171. M.J. Bannister, D. Eppstein, M.T. Goodrich, and L. Trott, "Force-Directed Graph Drawing Using Social Gravity and Scaling," *20th Int. Symp. on Graph Drawing* (GD), Springer, LNCS, vol. 7704, 414–425, 2012.

C-172. M.T. Goodrich and J.A. Simons, "More Graph Drawing in the Cloud: Data-Oblivious st-Numbering, Visibility Representations, and Orthogonal Drawing of Biconnected Planar Graphs," *20th Int. Symp. on Graph Drawing* (GD), Springer, LNCS, vol. 7704, 569–570, 2012.

C-173. M.T. Goodrich, D.S. Hirschberg, M. Mitzenmacher, and J. Thaler, "Cache-Oblivious Dictionaries and Multimaps with Negligible Failure Probability," *Mediterranean Conf. on Algorithms* (MedAlg), Springer, LNCS, vol. 7659, 203–218, 2012.

C-174. D. Eppstein, M.T. Goodrich, and D.S. Hirschberg, "Combinatorial Pair Testing: Distinguishing Workers from Slackers," *Algorithms and Data Structures Symp.* (WADS), Springer, LNCS, vol. 8037, 316–327, 2013.

C-175. D. Eppstein, M.T. Goodrich, and J.A. Simons, "Set-Difference Range Queries," *25th Canadian Conf. on Computational Geometry* (CCCG), 2013, http://www.cccg.ca/proceedings/2013/.

C-176. M.T. Goodrich and P. Pszona, "Cole's Parametric Search Technique Made Practical," *25th Canadian Conf. on Computational Geometry* (CCCG), 2013, http://www.cccg.ca/proceedings/2013/.

C-177. L. Arge, M.T. Goodrich, F. van Walderveen, "Computing Betweenness Centrality in External Memory," *IEEE Int. Conf. on Big Data* (BigData), 368–375, 2013.

C-178. M.T. Goodrich and P. Pszona, "Achieving Good Angular Resolution in 3D Arc Diagrams," *21st Int. Symp. Graph Drawing* (GD), Springer, LNCS, vol. 8242, 161–172, 2013.

C-179. M.T. Goodrich and P. Pszona, "Streamed Graph Drawing and the File Maintenance Problem," *21st Int. Symp. Graph Drawing* (GD), Springer, LNCS, vol. 8242, 256–267, 2013.

C-180. M.T. Goodrich, "Zig-zag Sort: A Simple Deterministic Data-Oblivious Sorting Algorithm Running in $O(n \log n)$ Time," *46th ACM Symp. on Theory of Computing* (STOC), 684–693, 2014.

C-181. D. Eppstein, M.T. Goodrich, M. Mitzenmacher, and P. Pszona, "Wear Minimization for Cuckoo Hashing: How Not to Throw a Lot of Eggs into One Basket," *Symp. on Experimental Algorithms* (SEA), Springer, LNCS, vol. 8504, 162–173, 2014.

C-182. O. Ohrimenko, M.T. Goodrich, and R. Tamassia, an E. Upfal, "The Melbourne Shuffle: Improving Oblivious Storage in the Cloud," *41st Int. Colloq. on Automata, Languages, and Programming* (ICALP), Springer, LNCS, vol. 8573, 556–567, 2014.

C-183. M.J. Bannister, W.E. Devanny, M.T. Goodrich, J.A. Simons, and Lowell Trott, "Windows into Geometric Events: Data Structures for Time-Windowed Querying of Temporal Point Sets," *26th Canadian Conf. on Computational Geometry* (CCCG), 2014.

C-184. M.J. Bannister, W.E. Devanny, D. Eppstein and M.T. Goodrich, "The Galois Complexity of Graph Drawing: Why Numerical Solutions are Ubiquitous for Force-Directed, Spectral, and Circle Packing Drawings," *22nd Int. Symp. Graph Drawing* (GD), Springer, LNCS, vol. 8871, 149–161, 2014. (Proceedings version of J-86.)

C-185. M.J. Alam, D. Eppstein, M.T. Goodrich, S. Kobourov and S. Pupyrev, "Balanced Circle Packings for Planar Graphs," *22nd Int. Symp. Graph Drawing* (GD), Springer, LNCS,

vol. 8871, 125–136, 2014.

C-186. M. Bannister, M.T. Goodrich, and P. Sampson, "Force-Directed 3D Arc Diagrams," *22nd Int. Symp. Graph Drawing* (GD), Springer, LNCS, vol. 8871, 521–522, 2014.

C-187. M.T. Goodrich and P. Pszona, "Two-Phase Bicriterion Search for Finding Fast and Efficient Electric Vehicle Routes," *22nd ACM SIGSPATIAL Int. Conf. on Adv. Geographic Information Systems* (GIS), 193–202, 2014.

C-188. M.T. Goodrich and J. Simons, "Data-Oblivious Graph Algorithms in Outsourced External Memory," *8th Int. Conf. on Combinatorial Optimization and Applications* (COCOA), LNCS, Vol. 8881, 241–257, 2014.

C-189. M.T. Goodrich, T. Johnson, M. Torres, "Knuthian Drawings of Series-Parallel Flowcharts," *23rd Int. Symp. on Graph Drawing and Network Visualization* (GD), Springer, LNCS, vol. 9411, 556–557, 2015. (See also http://arxiv.org/abs/1508.03931.)

C-190. M.T. Goodrich and A. Eldawy, "Parallel Algorithms for Summing Floating-Point Numbers," *28th ACM Symp. on Parallel Algorithms and Architectures* (SPAA), 13–22, 2016.

C-191. W.E. Devanny, M.T. Goodrich, and K. Jetviroj, "Parallel Equivalence Class Sorting: Algorithms, Lower Bounds, and Distribution-Based Analysis," *28th ACM Symp. on Parallel Algorithms and Architectures* (SPAA), 265–274, 2016.

C-192. D. Eppstein, M.T. Goodrich, J. Lam, N. Mamano, M. Mitzenmacher, and M. Torres, "Models and Algorithms for Graph Watermarking," *19th Information Security Conf.* (ISC), 283–301, 2016. **Best Student Paper Award**.

C-193. E. Ghosh, M.T. Goodrich, O. Ohrimenko, R. Tamassia, "Verifiable Zero-Knowledge Order Queries and Updates for Fully Dynamic Lists and Trees," *10th Conf. on Security and Cryptography for Networks* (SCN), 216–236, 2016.

C-194. M.T. Goodrich, E. Kornaropoulos, M. Mitzenmacher, R. Tamassia, "More Practical and Secure History-Independent Hash Tables," *21st European Symp. on Research in Computer Security* (ESORICS), 20-38, 2016.

C-195. J.J. Besa Vial, W.E. Devanny, D. Eppstein, and M.T. Goodrich, "Scheduling Autonomous Vehicle Platoons Through an Unregulated Intersection," *2016 Workshop on Algorithmic Approaches for Transportation Modeling, Optimization, and Systems* (ATMOS), 5:1–5:14.

C-196. M.J. Alam, M.B. Dillencourt, and M.T. Goodrich, "Capturing Lombardi Flow in Orthogonal Drawings by Minimizing the Number of Segments," *24th Int. Symp. on Graph Drawing and Network Visualization* (GD), LNCS, Vol. 9801, 608–610, 2016.

C-197. M.J. Alam, M.T. Goodrich, and T. Johnson, "Sibling-First Recursive Graph Drawing for Java Bytecode," *24th Int. Symp. on Graph Drawing and Network Visualization* (GD), LNCS, Vol. 9801, 611–612, 2016.

C-198. M.T. Goodrich, S. Gupta, and M. Torres, "A Topological Algorithm for Determining How Road Networks Evolve Over Time," *24th ACM SIGSPATIAL Int. Conf. on Advances in Geographic Information Systems* (GIS), 31:1–31:10, 2016.

C-199. M.J. Alam, M.T. Goodrich, and T. Johnson, "J-Viz: Finding Algorithmic Complexity Attacks via Graph Visualization of Java Bytecode," *13th IEEE Symp. on Visualization for Cyber Security* (VizSec), 1–8, 2016.

C-200. M.T. Goodrich, E. Kornaropoulos, M. Mitzenmacher, and R. Tamassia, "Auditable Data Structures," *2nd IEEE European Symp. on Security and Privacy* (EuroS&P), 285–300, 2017.

C-201. D. Eppstein, M.T. Goodrich, M. Mitzenmacher, and M. Torres, "2-3 Cuckoo Filters for Faster Triangle Listing and Set Intersection," *36th ACM SIGMOD-SIGACT-SIGART Symp. on Principles of Database Systems* (PODS), 247–260, 2017.

C-202. D. Eppstein, M.T. Goodrich, and N. Mamano, "Algorithms for Stable Matching and Clustering in a Grid," *18th International Workshop on Combinatorial Image Analysis* (IWCIA), 117–131, 2017.

C-203. G. Ateniese, M.T. Goodrich, V. Lekakis, C. Papamanthou, E. Paraskevas, and R. Tamassia, "Accountable Storage," *15th International Conference on Applied Cryptography and Network Security* (ACNS), 623–644, 2017.

C-204. D. Eppstein and M.T. Goodrich, "Using Multi-Level Parallelism and 2-3 Cuckoo Filters for Faster Set Intersection Queries and Sparse Boolean Matrix Multiplication," *29th ACM Symp. on Parallelism in Algorithms and Architectures* (SPAA), 137–139, 2017.

C-205. W.E. Devanny, J. Fineman, M.T. Goodrich, and T. Kopelowitz, "The Online House Numbering Problem: Min-Max Online List Labeling," *25th European Symp. on Algorithms* (ESA), 33:1–33:15, 2017.

C-206. M.T. Goodrich, "Answering Spatial Multiple-Set Intersection Queries Using 2-3 Cuckoo Hash-Filters," *25th ACM SIGSPATIAL Int. Conf. on Advances in Geographic Information Systems* (GIS), 65:1–65:4, 2017.

C-207. D. Eppstein, M.T. Goodrich, D. Korkmaz, and N. Mamano, "Defining Equitable Geographic Districts in Road Networks via Stable Matching," *25th ACM SIGSPATIAL Int. Conf. on Advances in Geographic Information Systems* (GIS), 52:1–52:4, 2017.

C-208. M.T. Goodrich, "BIOS ORAM: Improved Privacy-Preserving Data Access for Parameterized Outsourced Storage,' *ACM Workshop on Privacy in the Electronic Society* (WPES), 41–50, 2017.

C-209. J.J. Besa Vial, W.E. Devanny, D. Eppstein, M.T. Goodrich, and T. Johnson, "Quadratic Time Algorithms Appear to be Optimal for Sorting Evolving Data," *Algorithm Engineering & Experiments* (ALENEX), 87–96, 2018.

C-210. D. Eppstein, M.T. Goodrich, N. Mamano, "Reactive Proximity Data Structures for Graphs," *13th Latin American Theoretical Informatics Symp.* (LATIN), LNCS, Vol. 10807, Springer, 777–789, 2018.

C-211. M.T. Goodrich, "Isogrammic-Fusion ORAM: Improved Statistically Secure Privacy-Preserving Cloud Data Access for Thin Clients," *13th ACM ASIA Conf. on Information, Computer and Communications Security* (ASIACCS), 699–706, 2018.

C-212. J.J. Besa Vial, W.E. Devanny, D. Eppstein, M.T. Goodrich, and T. Johnson, "Optimally Sorting Evolving Data," *45th Int. Colloq. on Automata, Languages, and Programming* (ICALP), 81:1–81:13, 2018.

C-213. G. Barequet, D. Eppstein, M.T. Goodrich, and N. Mamano, "Stable-Matching Voronoi Diagrams: Combinatorial Complexity and Algorithms," *45th Int. Colloq. on Automata, Languages, and Programming* (ICALP), 89:1–89:14, 2018.

C-214. G. Da Lozzo, D. Eppstein, M.T. Goodrich, and S. Gupta, "Subexponential-Time and FPT Algorithms for Embedded Flat Clustered Planarity," *44th Int. Workshop on Graph-Theoretic Concepts in Computer Science* (WG), 111–124, 2018.

C-215. G. Barequet, M. De, and M.T. Goodrich, "Computing Convex-Straight-Skeleton Voronoi Diagrams for Segments and Convex Polygons," *24th International Computing and Combinatorics Conference* (COCOON), 130–142, 2018. (Proceedings version of J-91.)

C-216. M.T. Goodrich and T. Johnson, "Low Ply Drawings of Trees and 2-Trees," *30th Canadian Conference on Computational Geometry* (CCCG), 1–9, 2018.

C-217. D. Eppstein, M.T. Goodrich, J. Jorgensen, and M.R. Torres, "Geometric Fingerprint Recognition via Oriented Point-Set Pattern Matching," *30th Canadian Conference on*

Computational Geometry (CCCG), 1–16, 2018.

C-218. G. Da Lozzo, D. Eppstein, M.T. Goodrich, and S. Gupta, "C-Planarity Testing of Embedded Clustered Graphs with Bounded Dual Carving-Width," *14th Int. Symp. on Parameterized and Exact Computation* (IPEC), LIPIcs, vol. 148, 9:1–9:17, 2019. **Best Paper Award**.

C-219. J.J. Besa, G. Da Lozzo, and M.T. Goodrich, "Computing k-Modal Embeddings of Planar Digraphs," *European Symp. on Algorithms* (ESA), 19:1–19:16, 2019.

C-220. N. Mamano, A. Efrat, D. Eppstein, D. Frishberg, M.T. Goodrich, S. Kobourov, P. Matias, and V. Polishchuk, "New Applications of Nearest-Neighbor Chains: Euclidean TSP and Motorcycle Graphs," *30th Int. Symp. on Algorithms and Computation* (ISAAC), 51:1–51:21, 2019.

C-221. D. Eppstein, M.T. Goodrich, J.A. Liu, and P.A. Matias, "Tracking Paths in Planar Graphs," *30th Int. Symp. on Algorithms and Computation* (ISAAC), 54:1–54:17, 2019.

C-222. J.J. Besa, M.T. Goodrich, T. Johnson, and M.C. Osegueda, "Minimum-Width Drawings of Phylogenetic Trees," *13th Int. Conf. on Combinatorial Optimization and Applications* (COCOA), LNCS, vol. 11949, 39–55, 2019.

C-223. M.T. Goodrich, Z.M. Liang, and S. Zhao, "Inverse-Rendering Based Analysis of the Fine Illumination Effects in the Salvator Mundi," *ACM SIGGRAPH Art Papers Program, 47th International Conference and Exhibition on Computer Graphics and Interactive Techniques*, 380–386, 2020. (Proceedings version of J-89.)

C-224. R. Afshar, M.T. Goodrich, P. Matias, and M.C. Osegueda, "Reconstructing Binary Trees in Parallel," *32nd ACM Symp. on Parallelism in Algorithms and Architectures* (SPAA), 491–492, 2020.

C-225. R. Afshar, M.T. Goodrich, P. Matias, and M.C. Osegueda, "Reconstructing Biological and Digital Phylogenetic Trees in Parallel," *European Symp. on Algorithms* (ESA), 3:1–3:24, 2020.

C-226. R. Afshar, A. Amir, M.T. Goodrich, and P. Matias, "Adaptive Exact Learning in a Mixed-Up World: Dealing with Periodicity, Errors, and Jumbled-Index Queries in String Reconstruction," *27th International Symp. on String Processing and Information Retrieval* (SPIRE), 155–174, 2020.

C-227. M.T. Goodrich, R. Jacob, N. Sitchinava, "Atomic Power in Forks: A Super-Logarithmic Lower Bound for Implementing Butterfly Networks in the Nonatomic Binary Fork-Join Model," *ACM-SIAM Symp. on Discrete Algorithms* (SODA), 2141–2153, 2021.

C-228. R. Afshar, M.T. Goodrich, P. Matias, and M.C. Osegueda, "Parallel Network Mapping Algorithms," *33rd ACM Symp. on Parallelism in Algorithms and Architectures* (SPAA), 410–413, 2021.

C-229. M.T. Goodrich, S. Gupta, H. Khodabandeh, and P. Matias, "How to Catch Marathon Cheaters: New Approximation Algorithms for Tracking Paths," *17th Algorithms and Data Structures Symp.* (WADS), 442–456, 2021.

C-230. R. Afshar, M.T. Goodrich, P. Matias, and M.C. Osegueda, "Mapping Networks via Parallel kth-Hop Traceroute Queries," *39th Int. Symp. on Theoretical Aspects of Computer Science* (STACS), LIPIcs, Vol. 219, 4:1–4:21, 2022.

C-231. R. Afshar, M.T. Goodrich, and E. Ozel, "Efficient Exact Learning Algorithms for Road Networks and Other Graphs with Bounded Clustering Degrees," *20th Int. Symp. on Experimental Algorithms* (SEA), 9:1–9:18, 2022.

C-232. G. Barequet, S. Fukuzawa, M.T. Goodrich, D. Mount, M. Osegueda, and E. Ozel, "Diamonds are Forever in the Blockchain: Geometric Polyhedral Point-Set Pattern

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Page 76 of 93

Matching," *34th Canadian Conf. on Computational Geometry* (CCCG), 16–23, 2022.

C-233. R. Afshar and M.T. Goodrich, "Exact Learning of Multitrees and Almost-Trees Using Path Queries," *15th Latin American Theoretical Informatics Symp.* (LATIN), 293-311, 2022.

C-234. M.T. Goodrich and E. Ozel, "Modeling the Small-World Phenomenon with Road Networks," *30th ACM SIGSPATIAL Int. Conf. on Advances in Geographic Information Systems* (GIS), 46:1-46:10, 2022. **Best Paper Runner Up Award**.

C-235. M. Blanton, M.T. Goodrich, and C. Yuan, "Secure and Accurate Summation of Many Floating-Point Numbers," *23rd Privacy Enhancing Technologies Symp.* (PETS), 432–445, 2023.

C-236. M.T. Goodrich and R. Jacob, "Optimal Parallel Sorting with Comparison Errors," *35th ACM Symp. on Parallelism in Algorithms and Architectures* (SPAA), 355–365, 2023.

C-237. R. Afshar, M. Dillencourt, M.T. Goodrich, and E. Ozel "Noisy Sorting Without Searching: Data Oblivious Sorting with Comparison Errors," *21st Symposium on Experimental Algorithms* (SEA), 8:1–8:18, 2023.

C-238. O. Gila, M.T. Goodrich, and R. Tarjan, "Zip-zip Trees: Making Zip Trees More Balanced, Biased, Compact, or Persistent," *18th Algorithms and Data Structures Symp.* (WADS), 474–492, 2023. **Best Paper Award**

C-239. M.T. Goodrich and E. Ozel, "External-Memory Sorting with Comparison Errors," *18th Algorithms and Data Structures Symp.* (WADS), 493–506, 2023.

C-240. A. Chiu, D. Eppstein, and M.T. Goodrich, "Manipulating Weights to Improve Stress-Graph Drawings of 3-Connected Planar Graphs," *31st Int. Symp. on Graph Drawing and Network Visualization* (GD), LNCS, Vol. 14466, Springer, 141–149, 2023.

C-241. S. Fukuzawa, M.T. Goodrich, and S. Irani, "Quantum Tutte Embeddings," *31st Int. Symp. on Graph Drawing and Network Visualization* (GD), LNCS, Vol. 14466, Springer, 241–243, 2023.

C-242. O. Gila, M.T. Goodrich, and E. Ozel, "Highway Preferential Attachment Models for Geographic Routing," *16th Int. Conf. on Combinatorial Optimization and Applications* (COCOA), LNCS 14462, Springer, 56–80, 2023. **Best Paper Award**

C-243. M.T. Goodrich, R. Kitagawa, and V. Srindhar, "Dynamic Accountable Storage: An Efficient Protocol for Real-time Cloud Storage Auditing," *Int. Symp. on Algorithmic Aspects of Cloud Computing* (ALGOCLOUD), 2024.

C-244. D. Eppstein, M.T. Goodrich, and A.M. Illickan, "Drawing Planar Graphs and 1-Planar Graphs Using Cubic Bézier Curves with Bounded Curvature," *32nd Int. Symp. on Graph Drawing and Network Visualization* (GD), 39:1–39:17, 2024.

C-245. A. Chiu, A. Eldawy, and M.T. Goodrich, "Polygonally Anchored Graph Drawing," *32nd Int. Symp. on Graph Drawing and Network Visualization* (GD), 52:1–52:3, 2024.

C-246. M.T. Goodrich, R. Kitigawa, and M. Mitzenmacher, "Parallel Peeling of Invertible Bloom Lookup Tables in a Constant Number of Rounds," *Int. Conf. on Current Trends in Theory and Practice of Computer Science* (SOFSEM), 2025, accepted.

Other Publications:

O-1. M.T. Goodrich, "Guest Editor's Introduction," *Int. Journal of Computational Geometry & Applications*, **2**(2), 1992, 113–116.

O-2. M.T. Goodrich, "Parallel Algorithms Column 1: Models of Computation," *SIGACT News*, **24**(4), 1993, 16–21.

O-3. M.T. Goodrich, V. Mirelli, M. Orletsky, and J. Salowe, "Decision tree construction in fixed dimensions: Being global is hard but local greed is good," Technical Report TR-95-1, Johns

EX2001
Kove IO, Inc.
IPR2024-01017
Google, LLC v. Kove IO, Inc.
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Hopkins University, Department of Computer Science, Baltimore, MD 21218, May 1995.

O-4. R. Tamassia, P.K. Agarwal, N. Amato, D.Z. Chen, D. Dobkin, R.L.S. Drysdale, S. Fortune, M.T. Goodrich, J. Hershberger, J. O'Rourke, F.P. Preparata, J.-R. Sack, S. Suri, I.G. Tollis, J.S. Vitter, and S. Whitesides, "Strategic Directions in Computational Geometry Working Group Report," *ACM Computing Surveys*, **28A**(4), December 1996.

O-5. G.A. Gibson, J.S. Vitter, and J. Wilkes, A. Choudhary, P. Corbett, T.H. Cormen, C.S. Ellis, M.T. Goodrich, P. Highnam, D. Kotz, K. Li, R. Muntz, J. Pasquale, M. Satyanarayanan, D.E. Vengroff, "Report of the Working Group on Storage I/O Issues in Large-Scale Computing," *ACM Computing Surveys*, **28A**(4), December 1996.

O-6. T.H. Cormen and M.T. Goodrich, "A Bridging Model for Parallel Computation, Communication, and I/O," *ACM Computing Surveys*, **28A**(4), December 1996.

O-7. M.T. Goodrich, "Computer Science Issues in the National Virtual Observatory," in *Virtual Observatories of the Future*, ASP Conf. Series, vol. 225, R.J. Brunner, S.G. Djorgovski, and A.S. Szalay, eds., 329–332, 2001.

O-8. M.T. Goodrich, "Guest Editor's Foreword," *Algorithmica*, **33**(3), 271, 2002.

O-9. M.T. Goodrich, M. Shin, C.D. Straub, and R. Tamassia, "Distributed Data Authentication (System Demonstration)," *DARPA Information Survivability Conf. and Exposition*, IEEE Press, Volume 2, 58–59, 2003.

O-10. M.T. Goodrich and R. Tamassia, "Efficient and Scalable Infrastructure Support for Dynamic Coalitions," *DARPA Information Survivability Conf. and Exposition*, IEEE Press, Volume 2, 246–251, 2003.

O-11. M.T. Goodrich, "Simulating Parallel Algorithms in the MapReduce Framework with Applications to Parallel Computational Geometry," Second Workshop on Massive Data Algorithmics (MASSIVE), 2010. Available as *arXiv* preprint, 1004.4708, 2010.

O-12. D. Eppstein, M.T. Goodrich, and P. Baldi, "Privacy-Enhanced Methods for Comparing Compressed DNA Sequences," *arXiv* preprint, 1107.3593, 2011.

O-13. E. Ghosh, M.T. Goodrich, O. Ohrimenko, and R. Tamassia, "Poster: Zero-Knowledge Authenticated Order Queries and Applications," *IEEE Symp. on Security and Privacy*, 2015. (See also https://eprint.iacr.org/2015/283.)

O-14. F. Bayatbabolghani, M. Blanton, M. Aliasgari, and M.T. Goodrich, "Poster: Secure Computations of Trigonometric and Inverse Trigonometric Functions," *IEEE Symp. on Security and Privacy*, 2017. (See also https://fattaneh88.github.io/fbayatba/Proposal-sine-arctangent.pdf.)

O-15. F. Bayatbabolghani, M. Blanton, M. Aliasgari, and M.T. Goodrich, "Secure Fingerprint Alignment and Matching Protocols," *arXiv* preprint, 1702.03379, 2017.

O-16. M.Z. Liang, M.T. Goodrich, and S. Zhao, "On the Optical Accuracy of the Salvator Mundi," *arXiv* preprint, 1912.03416, 2019.

O-17. A. Chiu, M. Ghosh, R. Ahmed, K.-S. Jun, S. Kobourov, and M.T. Goodrich, "Graph Sparsifications using Neural Network Assisted Monte Carlo Tree Search," *arXiv* preprint, 2311.10316, 2023.

News Releases, Reviews, Interviews, and Media Mentions:

N-1. H. Masum, "Review of *Data Structures and Algorithms in Java* (2nd ed)," *ACM SIGACT News*, **32**(1), 3–5, 2001.

N-2. H. Masum, "Book Review: *Algorithm Design: Foundations, Analysis, and Examples*," *ACM SIGACT News*, **35**(2), 14–16, 2004.

N-3. "Domain Integrity: Brown Licenses Internet ID Verification Technology to Startup Firm," *Brown Univ. News Service*, https://www.brown.edu/Administration/News_Bureau/2005-06/05-031.html, September 20, 2005.

N-4. "Computer scientist elected to Royal Danish Academy of Sciences & Letters," *UCI News*, https://news.uci.edu/2018/04/24/uci-computer-scientist-elected-to-royal-danish-academy-of-sciences-letters/, April 24, 2018.

N-5. J. Yang, "Invertible Bloom Lookup Table," *CodeChain*, https://medium.com/codechain/invertible-bloom-lookup-table-37600927cfbe, May 6, 2018.

N-6. D. Trapp, "What Are Invertible Bloom Lookup Tables?," *Dash News*, https://dashnews.org/what-are-invertible-bloom-lookup-tables/, February 26, 2019.

N-7. "A virtual version of da Vinci's mystery glass orb has helped explain its weirdness," *MIT Technology Review*, https://www.technologyreview.com/2020/01/02/102309/a-virtual-version-of-da-vincis-mystery-glass-orb-has-helped-explain-its-weirdness/, January 2, 2020.

N-8. C. Kuesel, "Scientists may have solved the mystery behind the glass orb in 'Salvator Mundi,'" *Artsy*, https://www.artsy.net/article/artsy-editorial-scientists-solved-mystery-glass-orb-salvator-mundi, January 3, 2020.

N-9. S. Pappas, "Mystery of Orb in a Record-Breaking Leonardo Da Vinci Painting Deepens," *LiveScience*, https://www.livescience.com/da-vinci-light-orb-mystery.html, January 13, 2020.

N-10. S. Murray, "Computer Scientists Make a Splash in Art World Analyzing the *Salvator Mundi*," UCI ICS In The News, https://www.ics.uci.edu/community/news/view_news?id=1706, February 11, 2020.

N-11. A. Gorale, "Bitcoin in Bloom: How IBLTs Allow Bitcoin to Scale," *CCN*, https://www.ccn.com/bitcoin-in-bloom-how-iblts-allow-bitcoin-scale/, March 4, 2021.

N-12. R. Miller, "Mike Goodrich's New zyVersion: Bringing Interactivity to Algorithm Design and Application Textbook," *zyBooks*, https://www.zybooks.com/mike-goodrichs-new-zyversion-bringing-interactivity-to-algorithm-design-and-application-textbook/, October 3, 2022.

N-13. S. Murray, "ICS Researchers Receive Best Paper Award at Algorithms and Data Structures Symposium," UCI ICS In The News, https://www.ics.uci.edu/community/news/view_news?id=2351, July 18, 2023.

PROFESSIONAL SERVICE

Guest Editor:

Int. Journal of Computational Geometry & Applications, **2**(2), 1992
Journal of Computer & System Sciences, **52**(1), 1996
Computational Geometry: Theory and Applications, **12(1–2)**, 1999.
Algorithmica, **33**(3), 2002.

Editorial Board Membership:

Computational Geometry: Theory and Applications, 2006–2015
Journal of Computer & System Sciences, 1994–2011
Journal of Graph Algorithms and Applications, 1996–2011
Int. Journal of Computational Geometry & Applications, 1993–2010
Information Processing Letters, 1995–1997

Journal Advisory Board Membership:

Int. Journal of Computational Geometry & Applications, 2010–
Journal of Graph Algorithms and Applications, 2011–

Program Committee Service:

7th ACM Symp. on Computational Geometry (SoCG), 1991
1991 Workshop on Algorithms and Data Structures (WADS)
8th ACM Symp. on Computational Geometry (SoCG), 1992
25th ACM Symp. on Theory of Computing (STOC), 1993
Chair, 26th ACM Symp. on Theory of Computing (STOC), 1994
11th ACM Symp. on Computational Geometry (SoCG), 1995
DAGS '95 Conf. on Electronic Publishing and the Information Superhighway
1996 SIAM Discrete Mathematics Conference
1997 Workshop on Algorithms and Data Structures (WADS)
Int. Symp. on Graph Drawing (GD), 1997
1999 Workshop on Algorithms and Data Structures (WADS)
Co-chair, Workshop on Algorithm Engineering and Experimentation (ALENEX), 1999
Int. Symp. on Graph Drawing (GD), 2000
2000 Workshop on Algorithm Engineering (WAE)
41st IEEE Symp. on Foundations of Computer Science (FOCS), 2000
2001 Workshop on Algorithms and Data Structures (WADS)
Int. Symp. on Graph Drawing (GD), 2001
Workshop on Algorithm Engineering and Experimentation (ALENEX), 2002
18th ACM Symp. on Computational Geometry (SoCG), 2002
13th ACM-SIAM Symp. on Discrete Algorithms (SODA), 2002
Co-Chair, Graph Drawing 2002
Int. Symp. on Graph Drawing (GD), 2003
16th ACM-SIAM Symp. on Discrete Algorithms (SODA), 2005
32nd Int. Colloq. on Automata, Languages and Programming (ICALP), 2005
12th Int. Computing and Combinatorics Conference (COCOON), 2006
13th ACM Conf. on Computer and Communication Security (CCS), 2006
15th European Symp. on Algorithms (ESA), 2007
5th Int. Conference on Applied Cryptography and Network Security (ACNS), 2007
21st IEEE Int. Parallel & Distributed Processing Symp. (IPDPS), 2007
19th ACM Symp. on Parallelism in Algorithms and Architectures (SPAA), 2007
5th Workshop on Algorithms and Models for the Web-Graph (WAW), 2007
7th Int. Workshop on Experimental Algorithms (WEA), 2008
Second Int. Frontiers of Algorithmics Workshop (FAW), 2008
16th ACM SIGSPATIAL Int. Symp. on Adv. in Geographic Information Systems (GIS), 2008
17th ACM SIGSPATIAL Int. Symp. on Adv. in Geographic Information Systems (GIS), 2009
31st IEEE Symp. on Security and Privacy (S&P), 2010
18th Int. Symp. on Graph Drawing (GD), 2010
2011 Workshop on Analytic Algorithmics and Combinatorics (ANALCO)
8th Workshop on Algorithms and Models for the Web Graph (WAW), 2011
19th Int. Symp. on Graph Drawing (GD), 2011
24th ACM Symp. on Parallelism in Algorithms and Architectures (SPAA), 2012
20th European Symp. on Algorithms (ESA), 2012
2013 IEEE Int. Conf. on Big Data (BigData), 2013
30th IEEE Int. Conf. on Data Engineering (ICDE), 2014
21st ACM Conf. on Computer and Communication Security (CCS), 2014
Symp. on Algorithms and Data Structures (WADS), 2015
ACM Cloud Computing Security Workshop (CCSW), 2015
Int. Symp. on Graph Drawing (GD), 2015

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co-chair, 2016 Workshop on Algorithm Engineering and Experiments (ALENEX)
2016 Workshop on Massive Data Algorithmics (MASSIVE)
2016 Int. Symp. on Algorithms and Computation (ISAAC)
29th ACM Symp. on Parallelism in Algorithms and Architectures (SPAA), 2017
25th ACM SIGSPATIAL Int. Conf. on Adv. in Geographic Information Systems (GIS), 2017
26th European Symp. on Algorithms (ESA), 2018
26th ACM SIGSPATIAL Int. Conf. on Adv. in Geographic Information Systems (GIS), 2018
2nd SIAM Symp. on Simplicity in Algorithms (SOSA), 2019
ACM SIGSPATIAL Int. Workshop on Spatial Gems, 2019
2021 SIAM Symp. on Applied Computational & Discrete Algorithms (ACDA)
2023 SIAM Symp. on Algorithm Engineering and Experimentation (ALENEX)
35th ACM Symp. on Parallelism in Algorithms and Architectures (SPAA), 2023
7th SIAM Symp. on Simplicity in Algorithms (SOSA), 2024

Conference/Workshop Committee Service:

Conference chair, 12th ACM Symp. on Computational Geometry, 1996
Organizer, 1st CGC Workshop on Computational Geometry, 1996
Co-chair, 1999 Dagstuhl Workshop on Computational Geometry, 1999
Conference chair, Graph Drawing, 2002
Co-organizer, Hawaiian Workshop on Parallel Algorithms, 2017, 2019
Member, Symp. on Theory of Computing (STOC) Test of Time Award Committee, 2024

Steering Committee and Executive Committee Service:

Member at large, ACM SIG on Algorithms & Comp. Theory (SIGACT) Exec. Comm., 1993–97
Member, Exec. comm. for 1996 Federated Computing Research Conference (FCRC)
co-Founder and member, Steering Comm. for Workshop on Algorithm Engineering and Experimentation (ALENEX), 1999–2017 (chair, 2014–16)
co-Chair, Steering Comm. for ACM Symp. on Computational Geometry, 1999–2001
Member, Steering Comm. for Graph Drawing Conference, 2000–03, 2014–16
Conference Chair, ACM SIG on Algorithms & Comp. Theory (SIGACT), 2005–09

Center and Institute Affiliations:

Algorithms, Combinatorics and Optimization Center, UCI
Center for Algorithms and Theory of Computation, UCI
Center for Embedded and Cyber-physical Systems, UCI
Center for Machine Learning and Intelligent Systems, UCI
The Institute for Virtual Environments and Computer Games (IVECG), UCI
Secure Computing & Networking Center, UCI

Postdoctoral Fellows:

1. Timothy Chan, Johns Hopkins, 1996. (Now at Univ. of Illinois)
2. Gill Barequet, Johns Hopkins, 1996-98. (Now at Technion)
3. Pawel Gajer, Johns Hopkins, 2000. (Now at Univ. of Maryland)
4. Amitabh Chaudhary, UC-Irvine, 2002-2004. (Now at U. Chicago)
5. Amitabha Bagchi, UC-Irvine, 2002-2004. (Now at IIT-Dehli)
6. Martin Nöllenburg, UC-Irvine, 2010, mentored jointly with David Eppstein. (Now at TU Wien)
7. Maarten Löffler, UC-Irvine, 2010-2011, mentored jointly with David Eppstein. (Now at Utrecht University)
8. Md. Jawaherul Alam, UC-Irvine, 2015-16. (Now at Amazon)
9. Giordano Da Lozzo, UC-Irvine, 2016-2017, mentored jointly with David Eppstein. (Now at "Roma Tre" University)

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Ph.D. Students:

1. Mujtaba Ghouse, "Randomized Parallel Computational Geometry in Theory and Practice," Johns Hopkins Univ., May 1993.
2. Paul Tanenbaum, "On Geometric Representations of Partially Ordered Sets," Johns Hopkins Univ., May 1995 (co-advised with Edward Scheinerman).
3. Mark Orletsky, "Practical Methods for Geometric Searching Problems with Experimental Validation," Johns Hopkins Univ., May 1996.
4. Kumar Ramaiyer, "Geometric Data Structures and Applications," Johns Hopkins Univ., Aug. 1996.
5. Christian Duncan, "Balanced Aspect Ratio Trees," Johns Hopkins Univ., Aug. 1999.
6. Christopher Wagner, "Graph Visualization and Network Routing," Johns Hopkins Univ., Oct. 1999 (co-advised with Prof. Lenore Cowen).
7. Stephen Kobourov, "Algorithms for Drawing Large Graphs," Johns Hopkins Univ., May 2000.
8. Amitabha Bagchi, "Efficient Strategies for Topics in Internet Algorithmics," Johns Hopkins Univ., Oct. 2002.
9. Amitabh Chaudhary, "Applied Spatial Data Structures for Large Data Sets," Johns Hopkins Univ., Oct. 2002.
10. Breno De Medeiros, "New Cryptographic Primitives with Applications to Information Privacy and Corporate Confidentiality," Johns Hopkins Univ., May 2004 (co-advised with Giuseppe Ateniese).
11. "Jeremy" Yu Meng, "Confluent Graph Drawing," UC-Irvine, June 2006.
12. Jonathan Zheng Sun, "Algorithms for Hierarchical Structures, with Applications to Security and Geometry," UC-Irvine, Aug. 2006.
13. Nodari Sitchinava, "Parallel External Memory Model—A Parallel Model for Multi-core Architectures," UC-Irvine, Sep. 2009.
14. Darren Strash, "Algorithms for Sparse Geometric Graphs and Social Networks," UC-Irvine, May 2011 (co-advised with with David Eppstein).
15. Lowell Trott, "Geometric Algorithms for Social Network Analysis," UC-Irvine, May 2013.
16. Joseph Simons, "New Dynamics in Geometric Data Structures," UC-Irvine, May 2014.
17. Pawel Pszona, "Practical Algorithms for Sparse Graphs," UC-Irvine, May 2014.
18. William E. Devanny, "An Assortment of Sorts: Three Modern Variations on the Classic Sorting Problem," UC-Irvine, July 2017 (co-advised with David Eppstein).
19. Siddharth Gupta, "Topological Algorithms for Geographic and Geometric Graphs," UC-Irvine, Aug. 2018 (co-advised with with David Eppstein).
20. Timothy Johnson, "Graph Drawing Representations and Metrics with Applications," UC-Irvine, Aug. 2018.
21. Juan Besa, "Optimization Problems in Directed Graph Visualization," UC-Irvine, Aug. 2019.
22. Nil Mamano Grande, "New Applications of the Nearest-Neighbor Chain Algorithm," UC-Irvine, Sep. 2019 (co-advised with David Eppstein).
23. Pedro Matias, "Exact Learning of Sequences from Queries and Trackers," UC-Irvine, May 2021
24. Martha Osegueda, "Constructing, Counting and Matching Combinatorial and Geometric Shapes," UC-Irvine, May 2022
25. Ramtin Afshar, "Exact Learning of Graphs Using Queries," UC-Irvine, Feb. 2023
26. Evrim Ozel, "Efficient Algorithms for Road Networks and Noisy Sorting: an Experimental and Theoretical Perspective," UC-Irvine, May 2024

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Ph.D. Committee Service:

John Augustine	UC-Irvine	Advancement to candidacy, September 2003
Nikos Triandopoulos	Brown U.	Thesis prelim., February 2004
Einar Mykletun	UC-Irvine	Advancement to candidacy, March 2004
Kartic Subr	UC-Irvine	Advancement to candidacy, September 2004
S. Joshua Swamidass	UC-Irvine	Advancement to candidacy, April 2005
Jeong Hyun Yi	UC-Irvine	Thesis defense, August, 2005
Nodari Sitchinava	UC-Irvine	Advancement to candidacy, chair, December 2005
John Augustine	UC-Irvine	Thesis defense, July 2006
Maithili Narasimha	UC-Irvine	Thesis defense, August, 2006
Josiah Carlson	UC-Irvine	Advancement to candidacy, August 2006
Xiaomin Liu	UC-Irvine	Advancement to candidacy, September 2006
Gabor Madl	UC-Irvine	Advancement to candidacy, September 2006
Nikos Triandopoulos	Brown U.	Thesis defense, September 2006
Rabia Nuray-Turan	UC-Irvine	Advancement to candidacy, May 2007
S. Joshua Swamidass	UC-Irvine	Thesis defense, June 2007
Michael Sirivianos	UC-Irvine	Advancement to candidacy, June 2007
Kevin Wortman	UC-Irvine	Advancement to candidacy, August 2007
Di Ma	UC-Irvine	Advancement to candidacy, December 2007
Josiah Carlson	UC-Irvine	Thesis defense, December 2007
Michael Nelson	UC-Irvine	Advancement to candidacy, chair, March 2008
Minas Gjoka	UC-Irvine	Advancement to candidacy, June 2008
Sara Javanmardi	UC-Irvine	Advancement to candidacy, June 2008
Ali Zandi	UC-Irvine	Advancement to candidacy, September 2008
Jihye Kim	UC-Irvine	Thesis defense, September 2008
Darren Strash	UC-Irvine	Advancement to candidacy, December 2008
Kevin Wortman	UC-Irvine	Topic defense, January 2009
Nodari Sitchinava	UC-Irvine	Topic defense, chair, June 2009
Fabio Soldo	UC-Irvine	Advancement to candidacy, July 2009
Emil De Cristofaro	UC-Irvine	Advancement to candidacy, July 2009
Di Ma	UC-Irvine	Thesis defense, August 2009
Yanbin Lu	UC-Irvine	Advancement to candidacy, December 2009
Anh Le	UC-Irvine	Advancement to candidacy, April 2010
Lowell Trott	UC-Irvine	Advancement to candidacy, June 2010
Xiaomin Liu	UC-Irvine	Thesis defense, August 2010
Josh Olsen	UC-Irvine	Advancement to candidacy, September 2010
Yasser Altowim	UC-Irvine	Advancement to candidacy, December 2010
Angela Wong	UC-Irvine	Advancement to candidacy, May 2011
Joshua Hill	UC-Irvine	Advancement to candidacy, September 2011
Alex Abatzoglou	UC-Irvine	Advancement to candidacy, September 2011
Michael Wolfe	UC-Irvine	Masters Thesis defense, October 2011
Olya Ohrimenko	Brown Univ.	PhD Thesis proposal, October 2011
Yanbin Lu	UC-Irvine	PhD Thesis defense, November 2011
Chun Meng	UC-Irvine	Advancement to candidacy, December 2011
Abinesh Ramakrishnan	UC-Irvine	Advancement to candidacy, March 2012
Pegah Sattari	UC-Irvine	PhD Thesis defense, April 2012
Michael Bannister	UC-Irvine	PhD Thesis defense, May 2015

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Yingyi Bu	UC-Irvine	PhD Thesis defense, August 2015
Jenny Lam	UC-Irvine	PhD Thesis defense, November 2015
Timothy Johnson	UC-Irvine	Advancement to candidacy, chair, June 2016
Jiayu Xu	UC-Irvine	Advancement to candidacy, November 2016
Sky Faber	UC-Irvine	PhD Thesis defense, November 2016
Juan Jose Besa Vial	UC-Irvine	Advancement to candidacy, chair, March 2017
William Devanny	UC-Irvine	PhD Thesis defense, co-chair, July 2017
Ingo van Duijn	Aarhus Univ.	PhD Thesis defense, September 2017
Siddharth Gupta	UC-Irvine	Advancement to candidacy, January 2018
Boyang Wei	UC-Irvine	PhD Thesis defense, August 2018
Timothy Johnson	UC-Irvine	PhD Thesis defense, chair, August 2018
Siddharth Gupta	UC-Irvine	PhD Thesis defense, August 2018
Pedro Matias	UC-Irvine	Advancement to candidacy, chair, May 2019
Juan Jose Besa Vial	UC-Irvine	PhD Thesis defense, chair, August 2019
Sameera Chayyur	UC-Irvine	Advancement to candidacy, September 2019
Nil Mamano Grande	UC-Irvine	PhD Thesis defense, co-chair, September 2019
Yihan Sun	CMU	PhD Thesis defense, October 2019
Martha Osegueda	UC-Irvine	Advancement to candidacy, chair, June 2020
Tatiana Bradley	UC-Irvine	PhD Thesis defense, December 2020
Julius Ceasar Aguma	UC-Irvine	Advancement to candidacy, December 2020
Ramtin Afshar	UC-Irvine	Advancement to candidacy, chair, March 2021
Pedro Matias	UC-Irvine	PhD Thesis defense, chair, May 2021
Elham Havvaei	UC-Irvine	PhD Thesis defense, May 2021
Daniel Frishberg	UC-Irvine	Advancement to candidacy, May 2021
Hadi Khodabandeh	UC-Irvine	Advancement to candidacy, July 2021
Sameera Ghayyur	UC-Irvine	PhD topic defense, February 2022
Evrim Ozel	UC-Irvine	Advancement to candidacy, chair, May 2022
Rohith Gangam	UC-Irvine	Advancement to candidacy, May 2022
Martha Osegueda	UC-Irvine	PhD Thesis defense, chair, May 2022
Yanqi Gu	UC-Irvine	Advancement to candidacy, June 2022
Sameera Ghayyur	UC-Irvine	PhD Thesis defense, August 2022
Rasmus K. Petersen	Aarhus Univ.	PhD Thesis defense, Sept. 2022
Zihan Yu	UC-Irvine	Advancement to candidacy, Nov. 2022
Ramtin Afshar	UC-Irvine	PhD Thesis defense, chair, Feb. 2023
Shanshan Han	UC-Irvine	Advancement to candidacy, Feb. 2023
Zhanhang (Marco) Liang	UC-Irvine	Advancement to candidacy, Mar. 2023
Shion Fukuzawa	UC-Irvine	Advancement to candidacy, co-chair, Mar. 2023
Ryuto Kitagawa	UC-Irvine	Advancement to candidacy, chair, May 2024
Ofek Gila	UC-Irvine	Advancement to candidacy, chair, May 2024
Po-Chu Hsu	UC-Irvine	Advancement to candidacy, May 2024
Yanqi Gu	UC-Irvine	PhD Thesis defense, May 2024
Evrim Ozel	UC-Irvine	PhD Thesis defense, chair, May 2024
Hadi Khodabandeh	UC-Irvine	PhD Thesis defense, June 2024

University Service:

Ph.D. Requirements Committee, Dept. of Computer Science, chair: 1987–89
Graduate Admissions Committee, Dept. of Computer Science, 1991–1993 (chair: 1992)
Faculty Recruiting Committee, Dept. of Computer Science, 1993,95,96 (chair: 1996)

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Steering Committee, Whiting School of Engineering, 1990–93 (chair, 1993)
Johns Hopkins Homewood Academic Computing Oversight Committee, 1990–93
Curriculum Committee, Whiting School of Engineering, 1994–96
Strategic Planning Committee, Whiting School of Engineering, 1999–00
Graduate Policy Committee, UCI Dept. of Information & Computer Science (ICS), 2001–02
Faculty Search Committee in Cryptography, UCI Dept. of ICS, 2001–03
School of Info. and Computer Science Executive Committee, 2002–04
UCI Committee on Educational Policy (CEP), 2002–03, 2004–06
UCI Change of Major Criteria Committee, 2002–03
UCI CEP Policy Subcommittee, 2002–2003
Distinguished Faculty Search Committee, Bren School of ICS, 2004–11 (chair, 2007–08)
Equity Advisor, Bren School of ICS, 2005–09
Dean's Advisory Council, Bren School of ICS, 2007–13
Associate Dean for Faculty Development, Bren School of ICS, 2006–12
Chair, Department of Computer Science, Bren School of ICS, 2012–13
Master of Computer Science Development Committee, Bren School of ICS, 2013–16
Stragic Planning Committee, Dept. of Computer Science, Bren School of ICS, 2015–16
Executive Committee, Bren School of ICS, 2017–18
UC-Irvine Senate Committee on Scholarly Honors & Awards, 2017–20
UC-Irvine Special Research Program Review Committee for CalIT2, 2018–19
UC-Irvine Year of Scholarly Values Advisory Committee, 2024–
Master of Computer Science Steering/Admissions Comm., Bren School of ICS, 2016–22, 2024–

Courses Taught and Developed:

Advanced Parallel Computing (developed and taught at Johns Hopkins)
Cyber-Puzzlers (designed and taught at UCI)
Computer Literacy (taught at Purdue, developed at Johns Hopkins)
Computer Programming for Scientists and Engineers (taught at Purdue)
Computer Security Algorithms (developed and taught at UCI)
Computational Models (revised and taught at Johns Hopkins)
Computational Geometry (revised and taught at Johns Hopkins and UCI)
Compiler Theory and Design (revised and taught at Johns Hopkins)
Computer Graphics (taught at Johns Hopkins)
Cyber-Fraud Detection and Prevention (designed and taught at UCI)
Data Structures (revised and taught at Johns Hopkins and UCI)
Graph Algorithms (revised and taught at UCI)
Formal Languages and Automata Theory (revised and taught at UCI)
Fundamentals of Algorithms with Applications (revised and taught at UCI)
Introduction to Algorithms (developed and taught at Johns Hopkins and UCI)
Internet Algorithmics (developed and taught at Johns Hopkins, Brown, and UCI)
Design and Analysis of Algorithms (revised and taught at Johns Hopkins and UCI)
Parallel Algorithms (developed and taught at Johns Hopkins and Univ. of Illinois)
Project in Algorithms and Data Structures (revised and taught at UCI)
Text Processing and Pattern Matching (developed and taught at UCI)

Consulting:

The National Science Foundation, proposal panel member, 1990–
Army Research Laboratory, Fort Belvior, 1995
Battelle Research Triangle, Columbus Division, 1996

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AT&T, 1998
Univ. of Miami, 1999
Algomagic Technologies, Inc., 2000–2005
Brown University, 2000–2007
Purdue University, 2002
APAC Security, Inc., 2005
Walt Disney Animation Studios, 2009
Technical expert and expert witness, 2012–
3M, 2015

GRANTS AND CONTRACTS

1. PI, "Research Initiation Award: Parallel and Sequential Computational Geometry," National Science Foundation (NSF Grant CCR-8810568), $32,914, 1988–90.
2. co-PI, "Paradigms for Parallel Algorithm Design," NSF and DARPA (as NSF Grant CCR-8908092), $523,837, 1989–93 (with S.R. Kosaraju (PI), S. Kasif, and G. Sullivan).
3. PI, "Parallel Computation and Computational Geometry," NSF (Grant CCR-9003299), $67,436, 1990–93.
4. co-PI, "A Facility for Experimental Validation," NSF (Grant CDA-9015667), $1,476,147, 1991–96 (with G. Masson (PI), J. Johnstone, S. Kasif, S.R. Kosaraju, S. Salzberg, S. Smith, G. Sullivan, L. Wolff, and A. Zwarico).
5. PI, "Parallel Network Algorithms for Cell Suppression," The Bureau of the Census (JSA 91-23), $14,998 1991–92.
6. PI, "A Geometric Framework for the Exploration & Analysis of Astrophysical Data," NSF (Grant IRI-9116843), $535,553, 1991–96 (with S. Salzberg and H. Ford (from Physics and Astronomy Dept.)).
7. PI, "Research Experiences for Undergraduates supplement to IRI-9116843," NSF, $4,000, 1993–94 (with S. Salzberg and H. Ford).
8. PI, "Constructing, Maintaining, and Searching Geometric Structures," NSF (Grant CCR-9300079), $134,976, 1993–96.
9. co-PI, "Robust and Applicable Geometric Computing," Army Research Office (ARO MURI Grant DAAH04-96-1-0013), $4,500,000, 1996–2000 (with F. Preparata (PI, Brown U.), R. Tamassia (Brown U.), S. Rao Kosaraju, J. Vitter (Duke U.), and P. Agarwal (Duke U.)). Subaward size: $1,466,640.
10. PI, "Application-Motivated Geometric Algorithm Design," NSF (Grant CCR-9625289), $107,389, 1996-98.
11. co-PI, "vBNS Connectivity for the Johns Hopkins University," NSF, $350,000, 1997–99 (with T.O. Poehler (PI), D.J. Binko, J.G. Neal, and A.S. Szalay).
12. co-PI, "Product Donation, Technology for Education Program," Intel Corporation, $480,071, 1997–2001 (with T.O. Poehler (PI), J.H. Anderson, A.S. Szalay, and M. Robbins).
13. co-PI, "A Networked Computing Environment for the Manipulation & Visualization of Geometric Data" (Research Infrastructure), NSF, $1,638,785, 1997–2003 (with L.B. Wolff (PI), Y. Amir, S.R. Kosaraju, S. Kumar, R. Tamassia (Brown U.), R.H. Taylor, and D. Yarowsky).
14. PI, "Geometric Algorithm Design and Implementation," NSF, Grant CCR-9732300, $224,982, 1998–2002.
15. PI, "Certification Management Infrastructure – Certificate Revocation," $52,023, 1998, NSA LUCITE grant.
16. PI, "Software Engineering Data Loading, Analysis, and Reporting," $41,614, 1998, NSA

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LUCITE grant.

17. PI, "Establishing a LUCITE Collaboration Environment," $10,018, 1998, NSA LUCITE grant.
18. PI, "In Support of a Secure Multilingual Collabortive Computing Environment," $51,471, 1999-2000, NSA LUCITE grant.
19. PI, "Accessing Large Distributed Archives in Astronomy and Particle Physics," $199,981. subcontract to UCI from Johns Hopkins Univ. on NSF Grant PHY-9980044 (total budget, $2,500,000), 1999–2004.
20. PI, "Efficient and Scalable Infrastructure Support for Dynamic Coalitions," $1,495,000, DARPA Grant F30602-00-2-0509, 2000-2003 (with Robert Cohen and Roberto Tamassia), including $227,893 subaward to UCI (with Gene Tsudik).
21. PI, "Graph Visualization and Geometric Algorithm Design," $400,000, NSF Grant CCR-0098068, 2001-2004 (with Roberto Tamssia).
22. PI, "Collaborative Research: Teaching Data Structures to the Millennium Generation," $125,00, NSF Grant DUE-0231467, 2003–2005.
23. PI, "Collaborative Research: An Algorithmic Approach to Cyber-Security," $100,000, NSF Grant CCR-0311720, 2003–2006.
24. PI, "The OptIPuter," $900,000, subcontract from UCSD on NSF ITR grant CCR-0225642 (total budget, $13.5 million), 2002–2007 (with Padhraic Smyth and Kane Kim).
25. PI, "ITR: Algorithms for the Technology of Trust," $300,000, NSF Grant CCR-0312760, 2003–2009.
26. co-PI, "SDCI Data New: Trust Management for Open Collaborative Information Repositories: The CalSWIM Cyberinfrastructure," NSF grant OCI-0724806, $1,103,590, 2007–2012.
27. co-PI, "Support for Machine Learning Techniques for Cyber-Fraud Detection," Experian Corporation, $200,000 gift, 2008.
28. PI, "IPS: Collaborative Research: Privacy Management, Measurement, and Visualization in Distributed Environments," NSF Grant IIS-0713046, $224,851, 2007–2009.
29. PI, "Collaborative Research: Algorithms for Graphs on Surfaces," $400,000, NSF Grant CCR-0830403, 2008–2011.
30. PI, "ROA Supplement: IPS: Collaborative Research: Privacy Management, Measurement, and Visualization in Distributed Environments," NSF Grant IIS-0847968, $25,000, 2008–2009.
31. co-investigator, "Scalable Methods for the Analysis of Network-Based Data," Office of Naval Research: Multidisciplinary University Research Initiative (MURI) Award, number N00014-08-1-1015, $529,152, 2008–2014.
32. PI, "EAGER: Usable Location Privacy for Mobile Devices," NSF Grant 0953071, $300,000, 2009–2011.
33. PI, "TC:Large:Collaborative Research: Towards Trustworthy Interactions in the Cloud," NSF Grant 1011840, $500,000, 2010-2015.
34. PI, "TWC: Medium: Collaborative: Privacy-Preserving Distributed Storage and Computation," NSF Grant 1228639, $390,738, 2012-2018.
35. PI, "Support for Research on Geometric Motion Planning," 3M Corporation, $40,000 gift, 2014.
36. PI, "A4V: Automated Analysis of Algorithm Attack Vulnerabilities," subcontract 10036982-UCI from University of Utah for DARPA agreement no. AFRL FA8750-15-2-0092, $980,000, 2015–2019.
37. PI, "TWC: Small: Collaborative: Practical Security Protocols via Advanced Data Structures," NSF Grant 1526631, $166,638, 2015–2018.

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38. PI, "NSF-BSF: AF: Small: Geometric Realizations and Evolving Data," NSF Grant 1815073, $474,392, 2018–2022.
39. PI, "Collaborative Research: AF: Medium: Algorithms for Geometric Graphs," NSF Grant 2212129, $799,800, 2022–2026.

SELECTED INVITED TALKS (RECENT YEARS ONLY)

- "Probabilistic Packet Marking for Large-Scale IP Traceback," Purdue Univ., 2003
- "Algorithms for Data Authentication," Harvey Mudd College, 2003
- "Efficient Tree-Based Revocation in Groups of Low-State Devices," Univ. of Arizona, 2004
- "Leap-Frog Packet Linking and Diverse Key Distributions for Improved Integrity in Network Broadcasts," Southern California Security and Cryptography Workshop, 2005
- "Is Your Business Privacy Protected?," NEXT Connections, 2005
- "Distributed Peer-to-peer Data Structures," Harvard Univ., 2006
- "Balancing Life with an Academic Research Career," Grace Hopper Conference, 2006
- "Computer Security in the Large," Univ. Texas, San Antonio, 2006
- "Inspirations in Parallelism and Computational Geometry," Brown Univ., 2006
- "Efficiency and Security Issues for Distributed Data Structures," Computer Science Distinguished Lecture Series, Johns Hopkins Univ., 2006
- "Efficiency and Security Issues for Distributed Data Structures," UCLA, 2006
- "Efficiency and Security Issues for Distributed Data Structures," Edison Distinguished Lecturer Series, Univ. of Notre Dame, 2006
- "Efficiency and Security Issues for Distributed Data Structures," Computer Science Distinguished Lecturer Series, Texas A & M Univ., 2006
- "Algorithms for Secure Computing and Searching with Applications to Medical Informatics," Purdue Univ., 2006
- "Blood on the Computer: How Algorithms for Testing Blood Samples can be Used for DNA Sequencing, Wireless Broadcasting, and Network Security," Univ. of Southern California, 2007
- "Blood on the Computer: How Algorithms for Testing Blood Samples can be Used for DNA Sequencing, Wireless Broadcasting, and Network Security," Univ. California, San Diego, 2007
- "Blood on the Computer: How Algorithms for Testing Blood Samples can be Used for DNA Sequencing, Wireless Broadcasting, and Network Security," Univ. Minnesota, 2007
- "Blood on the Database: How Algorithms for Testing Blood Samples can be Used for Database Integrity," Invited Keynote, 21st Annual IFIP WG 11.3 Working Conference on Data and Applications Security (DBSec), 2007
- "Space-Efficient Straggler Identification," ALCOM Seminar, Univ. of Aarhus, 2007
- "Blood on the Computer: How Algorithms for Testing Blood Samples can be used in Modern Applications," ALCOM Seminar, Univ. of Aarhus, 2007
- "Studying Road Networks Through an Algorithmic Lens," ALCOM Seminar, Univ. of Aarhus, 2008
- "Studying Geometric Graph Properties of Road Networks Through an Algorithmic Lens," Int. Workshop on Computing: from Theory to Practice, 2009
- "Randomized Shellsort: A Simple Oblivious Sorting Algorithm," Distinguished Lecture Series, Department of Computer Science, Brown University, 2009
- "Simulating Parallel Algorithms in the MapReduce Framework with Applications to Parallel Computational Geometry," MASSIVE 2010

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- "Data Cloning Attacks for Nearest-Neighbor Searching based on Retroactive Data Structures," Department of Computer Science, UCSB, 2011
- "Turning Privacy Leaks into Floods: Surreptitious Discovery of Social Network Friendships and Other Sensitve Binary Attribute Vectors," Department of Computer Science Distinguished Lecturer Series, Univ. of Illinois, Chicago, 2011
- "Turning Privacy Leaks into Floods: Surreptitious Discovery of Social Network Friendships and Other Sensitve Binary Attribute Vectors," Department of Computer Science, Purdue Univ., 2011
- "Spin-the-bottle Sort and Annealing Sort: Oblivious Sorting via Round-robin Random Comparisons," Department of Computer Science, Brown Univ., 2012
- "Using Data-Oblivious Algorithms for Private Cloud Storage Access," Qatar University, 2013
- "Using Data-Oblivious Algorithms for Private Cloud Storage Access," Department of Computer Science and Engineering Distinguished Speaker Series, University of Buffalo, 2013
- "Force-Directed Graph Drawing Using Social Gravity and Scaling," invited talk, ICERM Workshop on Stochastic Graph Models, Providence, RI, 2014
- "Invertible Bloom Lookup Tables and Their Applications in Large-Scale Data Analysis," invited key-note speaker, Algorithms for Big Data, Frankfurt, Germany, 2014
- "Invertible Bloom Lookup Tables and Their Applications in Large-Scale Data Analysis," Brown University, Providence, RI, 2014
- "Studying Road Networks Through an Algorithmic Lens," Bold Aspirations Visitor and Lecture, University of Kansas, 2015
- "Learning Character Strings via Mastermind Queries, with Case Studies," Invited Lecture, Workshop on Pattern Matching, Data Structures and Compression, Bar-Ilan University, Tel Aviv, Israel, 2016
- "Invertible Bloom Lookup Tables and Their Applications in Data Analysis," University of Hawaii, 2016
- "Invertible Bloom Lookup Tables," Purdue University, 2016
- "Combinatorial Pair Testing: Distinguishing Workers from Slackers," Calvin Univ., 2016
- "Invertible Bloom Lookup Tables," University of California, Riverside, 2016
- "2-3 Cuckoo Filters for Faster Triangle Listing and Set Intersection," Technion, Israel Institute of Technology, Haifa, Israel, 2017
- "2-3 Cuckoo Filters for Faster Triangle Listing and Set Intersection," University of Arizona, 2017
- "Parallel Computational Geometry," First Hawaii Workshop on Parallel Algorithms and Data Structures, University of Hawaii, 2017
- "Fighting Gerrymandering with Algorithmic Fairness," Calvin University, 2019
- "Fighting Gerrymandering with Algorithmic Fairness," Carnegie Mellon University, 2019
- "Sorting Evolving Data in Parallel," Second Hawaii Workshop on Parallel Algorithms and Data Structures, University of Hawaii, 2019
- "Dealing with Big Data via External Memory Algorithms and Data Structures," Aarhus University, Denmark, 2021
- "Dealing with Big Data via External Memory Algorithms and Data Structures," Royal Danish Academy of Sciences and Letters, 2021
- "Augmenting Networks for Greedy Routing," Dept. of Electrical and Computer Engineering, Distinguished Lecturer Series, Iowa State University, Dec. 2023.
- "Augmenting Networks for Greedy Routing," Dept. of Computer Science, University of

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California, Riverside, June 2024.

TECHNICAL EXPERT CONSULTING SUMMARY
(LAST FIVE YEARS)

Michael T. Goodrich, PhD

Dept. of Computer Science
Bren School of Info. & Computer Sciences
University of California, Irvine
Irvine, CA 92697-3435

http://www.ics.uci.edu/~goodrich/
E-mail: mike.t.goodrich (at) gmail.com

TECHNICAL EXPERT CONSULTING

The following is a listing of prior and current expert consulting since 2019, where I have testified as an expert, but it may not include confidential information, as per written agreements.

1. Apr. 2016 to Sep. 2024, Technical expert and deponent, retained through Kramer Levin LLP on behalf of Acceleration Bay LLC, in IPR proceedings and patent litigation, Acceleration Bay LLC v. Activision Bizzard, Inc., Electronic Arts Inc., Take-Two Interactive Software, Inc., Rockstar Games, Inc., and 2K Sports, Inc. Civil Actions No. 1:16-cv-00453-RGA, No. 1:16-cv-00454-RGA, No. 1:16-cv-00455-RGA (D. Del.), IPR2015-01951, IPR2015-01953, IPR2015-01964, IPR2015-01970, IPR2015-01972, IPR2015-01996, IPR2016-00724, and IPR2016-00747 (PTAB).

2. May 2016 to Apr. 2023, Technical expert and deponent, retained through Kramer Levin LLP (transferred to Fish & Richardson) on behalf of Finjan, Inc., in PTO proceedings and patent litigations, Finjan, Inc. v. Blue Coat, Finjan, Inc. v. ESET, LLC, Finjan, Inc. v. Juniper Networks, Inc., Finjan, Inc. v. Cisco Systems, Inc., Finjan, Inc. v. Qualys, Inc., Finjan, Inc. v. Rapid7, Inc., and Finjan, Inc. v. SonicWall, Inc., IPR2015-01974, IPR2015-01979, IPR2016-00478, IPR2016-00159 (PTAB), 5:15-cv-03295-BLF-PSG (N.D. Cal.), 3:17-cv-05659-WHA (N.D. Cal.), 3:17-cv-0183-CAB-BGS (S.D. Cal.), 17-cv-0072-BLF-SVK (N.D. Cal.), 4:18-cv-07229-YGR (N.D. Cal.), 1:18cv-01519-MN (Del.), and 5:17-cv-04467-BLF (N.D. Cal.).

3. Jan. 2017 to Jan. 2021, Technical expert and deponent, retained by Fitzpatrick, Cella, Harper & Scinto, Venable LLP, on behalf of Koninklijke Philips N.V. and U.S. Philips Corp., in patent litigation, Philips v. Acer Inc., ASUSTeK Computer, Double Power Tech., HTC, Southern Telecom, Visual Land, Zowee Marketing Co., Ltd., Shenzen Zowee Technology Co., Ltd., YiFang USA, Inc. d/b/a EFun, Inc., and Intervenor/Counterclaim Defendant Microsoft Corporation. Civil Actions No. 15-1125-GMS, No. 15-1126-GMS, No. 15-1127-GMS, No. 15-1128-GMS, No. 15-1130-GMS, No. 15-1131-GMS, No. 15-1170-GMS (D. Del.), and 4:18-cv-01885-HSG (N.D. Cal., Oakland Div.).

4. Jun. 2018 to present, Technical expert, declarant, deponent, and testifying trial expert witness, retained through Kramer Levin LLP on behalf of Centripetal Networks, Inc., in IPRs

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and patent litigation, Centripetal Networks, Inc. v. Keysight Technologies, Inc., Ixia, and Cisco. Civil Actions No. 2:17-cv-00383/HCM-LRL and 2:18-cv-00094-HCM-LRL (E.D. Virginia), 2:22-cv-00002 (E.D. Virginia), IPR2018-01386, IPR2018-01443, IPR2018-01444, IPR2018-01512, IPR2018-01513, IPR2022-01525, IPR2023-00445, IPR2023-00446, IPR2023-00448 (PTAB), and Inv. No. 337-TA-1314 (ITC).

5. Feb. 2019 to present, Technical expert, declarant, deponent, and testifying trial expert witness, retained through Reichman Jorgensen LLP on behalf of Kove IO, Inc., in patent litigation, Kove IO, Inc. v. Amazon Web Services, Inc., Civil Action No. 1:18-cv-08175 (N.D. Illinois, Eastern Div.).

6. Apr. 2019 to Sep. 2020, Technical expert, declarant, and deponent, retained by McKool Smith on behalf of SEVEN Networks LLC in patent litigation, SEVEN Networks LLC v. Apple, Inc. Civil Action No. 2:19-cv-115 (E.D. Texas).

7. Jun. 2019 to Jun. 2023, Technical expert, declarant, and deponent, retained through Kramer Levin LLP on behalf of CUPP Cybersecurity LLC, in patent litigation, CUPP Cybersecurity LLC, et al., v. Trend Micro, Inc. IPR2021-00813, IPR2021-01236, IPR2021-01237 (PTAB), Civil Action no. 3:18-cv-01251-M, 3:20-cv-03206-M (N.D. Texas).

8. Jul. 2020 to Feb. 2021, Technical expert and declarant, retained through Goodwin Procter LLP on behalf of MobileIron, Inc., in patent litigation, MobileIron, Inc. v. BlackBerry Corp. IPR2020-01741 (PTAB).

9. Aug. 2020 to present, Technical expert and declarant, retained through Thompson & Knight LLP (now Holland & Knight) on behalf of Broadcom Corp., in patent litigation, Broadcom Corp. and Avago Technologies International Sales PTE. Limited v. Netflix, Inc. Civil actions no. 8:20-cv-529 (C.D. Cal.), 3:20-cv-04677-JD (N.D. Cal.).

10. Nov. 2020 to Dec. 2021, Technical expert and deponent, retained through Kramer Levin LLP on behalf of Midwest Athletics and Sports Alliance LLC (MASA), in patent litigation, Midwest Athletics and Sports Alliance LLC v. RICOH USA, Inc., and Midwest Athletics and Sports Alliance LLC v. Xerox Corp. Civil Action Nos. 19-CV-00514 (E.D. Penn.) and 6:19-CV-06036-EAW-JFW (W.D. New York).

11. Mar. 2021 to Feb. 2024, Technical expert, declarant, and deponent, retained through Nix Patterson LLP on behalf of Ikorongo Technology LLC, in patent litigation, Ikorongo v. Samsung, LG, Lyft, Uber, and Bumble Trading, Civil Action Nos. 6:20-cv-00256-ADA, 6:20-cv-00257-ADA, 6:20-cv-00258-ADA, 6:20-cv-00259-ADA, 6:20-cv-00843-ADA (W.D. Texas, Waco), and IPR2021-00204 (PTAB).

12. May 2021 to Aug. 2024, Technical expert, declarant, and deponent, retained by McKool Smith on behalf of SEVEN Networks LLC in patent litigation, SEVEN Networks, LLC v. Motorola Mobility LLC. Civil Action Nos. 2:21-cv-88 (E.D. Texas) and 3:21-cv-1036 (N.D. Texas).

13. Aug. 2021 to present, Technical expert, declarant, and deponent, retained through Holland & Knight LLP on behalf of CA, Inc., in patent litigation, CA, Inc. and Avago Technologies International Sales PTE. Limited v. Netflix, Inc. Civil action no. 2:21-cv-00080-JRG-RSP (E.D. Texas).

14. Aug. 2021 to present, Technical expert, declarant, deponent, and testifying trial expert witness, retained through Kramer Levin LLP on behalf of Centripetal Networks, Inc., in patent litigation and IPRs, Centripetal Networks, Inc. v. Palo Alto Networks, Inc. Civil Action No. 2:21-cv-00137 (E.D. Virginia, Norfolk Div.), IPR2021-01149, IPR2021-01150, IPR2021-01152, IPR2021-01157, IPR2022-00182 (PTAB).

15. Jul. 2022 to May 2024, Technical expert, deponant, and declarant, retained through McKool Smith on behalf of the State of Texas, in litigation State of Texas v. Meta Platforms, Inc., Cause No. 22-0121.

16. Aug. 2022 to present, Technical expert and declarant, retained through Stamoulis & Weinblatt LLC on behalf of Ameranth, Inc., in a patent-related matter.

17. Sep. 2022 to present, Technical expert, deponent, and declarant, retained through Reichman Jorgensen Lehman & Feldberg LLP on behalf of VideoLabs, Inc., in patent-related matters, VideoLabs v. Netflix, and Starz Entertainment, LLC, et al. v. VL Collective IP, LLC and VideoLabs, Inc., Civil Action No. 21-cv-1448-JLH (D. Del.), IPR2022-01086, IPR2023-00628, IPR2023-00630, IPR2023-00891.

18. Nov. 2022 to Jun. 2023, Technical expert and declarant, retained through McKool Smith on behalf of American Airlines, Inc., in a patent-related litigation, R2 Solutions LLC v. American Airlines, Inc., Civil Action No.4:22-cv-00353 (E.D. Tex.).

19. Feb. 2023 to Nov. 2023, Technical expert and declarant, retained through Kirkland and Ellis LLP on behalf of Forcepoint LLC in a patent-related litigation, Webroot, Inc. et al. v. Forcepoint LLC, Case No. 6:22-cv-00341-ADA (W.D. Tex.).

20. Feb. 2023 to Dec. 2023, Technical expert and declarant, retained through Holland & Knight LLP on behalf of MDSave Shared Services, Inc., in a patent-related litigation.

21. Aug. 2023 to Sep. 2024, Technical expert, declarant, and deponent, retained though Kramer Levin LLP on behalf of Acceleration Bay LLC in patent-related litigation, Acceleration Bay LLC v. Amazon Web Services, Inc., Case No. 1:22-cv-904 (D. Del.).

22. Feb. 2024 to May 2024, Technical expert and declarant, retained through McKool Smith on behalf of AlphaSense, Inc., in patent litigation, AlphaSense, Oy and AlphaSense, Inc. v. Tegus, Inc. and Bamsec, LLC, Case No. cv-23-1030-MN (D. Del.).

23. May 2024 to present, Technical expert and declarant, retained through Reichman Jorgensen Lehman & Feldberg LLP on behalf of Kove IO, Inc., in patent litigation, Kove IO, Inc. v. Google, LLC, No. 1:23-cv-04244 (N.D. Ill.).

24. July 2024 to present, Technical expert and declarant, retained through McKool Smith on behalf of Carbyne Biometrics, LLC, in patent litigation, Apple, Inc., Petitioner v. Carbyne Biometrics, LLC, Patent Owner in Case: (1) IPR2024-00329, U.S. Patent No. 9,972,010; (2) IPR2024-00330, U.S. Patent No. 10,713,656; (3) IPR2024-00331, U.S. Patent No. 11,526,886; (4) IPR2024-00332, U.S. Patent No. 10,929,512; (5) IPR2024-00333, U.S. Patent No. 11,475,105; (6) IPR2024-00334, U.S. Patent No. 11,514,138; and (7) IPR2024-00507, U.S. Patent No. 11,475,105.

25. October 2024 to present, Technical expert, retained through Kramer Levin LLP on behalf of Cyandia, Inc., in patent litigation Cyandia, Inc. v. SAP America, Inc., and SAP SE, Case No. 2:22-cv-00096-JRG.