UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GENERAL MOTORS LLC, et al.

Petitioner,

v.

NEO WIRELESS, LLC,

Patent Owner.

IPR2023-00962

DECLARATION OF DR. MATTHEW C. VALENTI IN SUPPORT OF PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 10,447,450

I. Engagement

1. I have been retained by General Motors LLC and Nissan North America, Inc. ("Petitioner" or "Petitioners") to provide this declaration concerning the technical subject matter relevant to a petition for inter partes review of U.S. Patent No. 10,447,450 ("'450 patent").

2. I am over 21 years of age and otherwise competent to make this Declaration. I make this Declaration based on facts and matters within my own knowledge and on information provided to me by others.

3. Specifically, I was asked to review the declaration of Dr. Todor Cooklev that was submitted by the petitioner in IPR2023-00763 as Exhibit 1003 ("the Cooklev Declaration") and form an opinion of whether I agreed with the facts, analysis, and conclusions in that declaration.

4. My compensation in this matter is not based on the substance of my opinions or the outcome of this matter. I have no financial interest in Petitioners.

5. In writing this declaration, I have considered my own knowledge and experience, including my work experience in the field of electrical and computer engineering and my experience working with others involved in this field.

II. Background and Qualifications

A. Educational Background

6. I received a Bachelor of Science degree in Electrical Engineering from the Virginia Polytechnic Institute & State University (Virginia Tech) in May 1992. I received a Master of Science degree in Electrical Engineering from Johns Hopkins University in May 1995 and a Ph.D. in Electrical Engineering from Virginia Tech in 1999.

B. Professional Experience

7. From 1992 to 1995 I served as an Electronics Engineer at the U.S. Naval Research Laboratory in Washington DC. During this time, I worked on signal processing systems, including systems that used adaptive antennas.

8. From 1995 to 1999, I was a Graduate Research Assistant and Instructor in the Bradley Department of Electrical and Computer Engineering at Virginia Tech. For my Ph.D. research while working as a research assistant, I conducted in-depth investigations into signal processing and error-control coding techniques specifically tailored for mobile radio systems including cellular networks.

9. From 1999 to present, I have been a faculty member at West Virginia University in Morgantown, West Virginia. I was initially appointed as an Assistant Professor, was promoted to Associate Professor with tenure in 2005, and then was promoted to Professor in 2010. At WVU, I regularly teach the senior undergraduate course on Wireless Networking (CPE 462), which covers key

concepts behind modern cellular networks, including orthogonal frequency division multiple access (OFDMA), multiple-input multiple-output (MIMO) antenna systems, and adaptive scheduling of transmissions. I also teach graduate courses on Coding Theory (EE 567) and Communication Theory (EE 561). In addition to my teaching, I run an active funded research program focused on wireless communications and signal processing. I have advised over 50 graduate students who worked in my lab, including 10 Ph.D. students, to degree completing.

10. I have authored numerous technical papers on various aspects of mobile and wireless communication systems that have been published in well-respected, peer-reviewed journals, such as the *IEEE Transactions on Communications, IEEE Transactions on Wireless Communications*, and the *International Journal on Wireless Information Networks*.

11. I have extensive experience in developing software for the simulation and implementation of various aspects of wireless communication systems, including error-control coding and adaptive modulation. My software is freely available to the public in a package called the Coded Modulation Library (CML)[1]. The software implements certain portions of several standardized systems including WiMAX, UMTS, HSDPA, and LTE. For instance, the software includes code that

[1] https://github.com/wvu-wcrl/CML

implements the error-control codes specified in IEEE 802.16e. This code has been incorporated into a commercial product – a scanning receiver for mobile WiMAX.

12. I have given several tutorials on commercial standards to industry and at various international conferences, including a tutorial entitled "Channel coding for IEEE 802.16e mobile WiMAX" presented at the 2009 *IEEE International Conference on Communications (ICC)* held in Dresden, Germany. This tutorial focused on key aspects of the mobile WiMAX system, as standardized by IEEE 802.16e.

13. Taken as a whole, my academic and practical experience have given me a substantial basis upon which to evaluate the technology that is in question in the claims of the '450 Patent. Based on my experience and education, and the acceptance of my publications and professional recognition by peers in my field, I believe that I am qualified to opine as to the knowledge and level of skill of one of ordinary skill in the art at the time of the alleged invention of the '450 patent (which I further describe below) and what such a person would have understood at that time, and the state of the art during that time.

14. A complete copy of my curriculum vitae, which includes a list of my publications and contains further details on my education, experience, publications, patents, and other qualifications to render an expert opinion, is attached as Appendix A.

III. Information Considered

15. In drafting this declaration and forming the opinions therein, I relied on my years of education, research, and industry and academic experience, including my direct experience and contribution in the area of design and analysis of wireless communication systems. I also relied on the materials listed in Appendix B.

16. I reserve the right to rely upon these materials and other materials to rebut arguments raised by the Patent Owner.

17. I reserve the right to supplement this declaration in response to additional evidence that may become known.

18. In connection with any testimony that I may be asked to give to the Patent Trial and Appeal Board, I may use as exhibits various documents that relate to matters set forth in this declaration.

IV. Opinions

19. After considering the Cooklev Declaration and the other materials listed in Appendix B, I agree with the facts, analysis, and conclusions in the Cooklev Declaration, and I adopt the testimony in sections II and V-XII of the Cooklev Declaration as my own for purposes of this proceeding with the exception that, for Section VII, I would substitute my biographical information for Dr. Cooklev's. More specifically, for Section VII, I note that, like Dr. Cooklev, I too was a POSA at the time based on my Ph.D. from Virginia Tech in 1999 and my at least five

years of experience with mobile wireless communications, and I adopt Dr. Cooklev's definition of a POSA.

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

Respectfully submitted,

Dated: June 5, 2023 By: Matthew C. Valenti

Matthew C. Valenti, Ph.D.

APPENDIX A

MATTHEW C. VALENTI, P.E.

IEEE Fellow
Professor
Lane Department of Computer Science and Electrical Engineering
West Virginia University

CONTACT

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Morgantown, WV 26505 USA
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EDUCATION

Ph.D. in Electrical Engineering
Virginia Polytechnic Institute & State University (Virginia Tech), Blacksburg, VA, August 1999

M.S. in Electrical Engineering
Johns Hopkins University, Baltimore, MD, May 1995

B.S. in Electrical Engineering
Virginia Polytechnic Institute & State University (Virginia Tech), Blacksburg, VA, May 1992

PROFESSIONAL EXPERIENCE

West Virginia University, Lane Department of Computer Science and Electrical Engineering
Professor – 2010 to present
Associate Professor – 2005 to 2010
Assistant Professor – August 1999 to 2005

Administrative Capacities:
Raymond J. Lane Department Chair – July 2020 to June 2021
Interim Chair – July 2019 to June 2020

Center for Identification Technology Research (CITeR), *an NSF I/UCRC*
Director, WVU Site – August 2014 to present.

Virginia Tech, Bradley Department of Electrical and Computer Engineering
Bradley Fellow, Graduate Research Assistant, and Instructor – August 1995 to July 1999

U.S. Naval Research Laboratory, Washington, DC
Electronics Engineer – Summer 1991, May 1992 to August 1995

LICENSES

Professional Engineer (P.E.)
Registered in the state of West Virginia since 2011

Amateur Radio License
Amateur Extra Class. Call sign KC8NHN. Licensed since 1999

TECHNICAL EXPERT EXPERIENCE

1. DLA Piper for Motorola
   Dates: 2023
   Venue: US. International Trade Commission (ITC)
   Case: Maxell, Ltd. v. Motorola Mobility LLC, Lenovo Group Ltd., and Lenovo (U.S.) Inc.
   In the Matter of Certain Mobile Electronic Devices
   US. International Trade Commission (ITC) Investigation No. 337-TA-1324
   Technology: LTE and 5G NR wireless technology. Dual connectivity operation.
   Activity: Expert Report (invalidity), rebuttal report (noninfringement, domestic industry practice). Deposition (Mar. 15, 2023). Prepared to give court testimony.
   Case settled on June 20, 2023, two days before the hearing was scheduled.

2. Sidley Austin for Lenovo
   Dates: 2022-2023
   Venue: United States District Court; District of Delaware
   Cases: Interdigital Technology Corporation v. Lenovo Holding Company, Inc.,
   Civil Action No. 19-1590-LPS
   Technology: Wireless technology including control signaling for LTE and HSPA.
   Activity: Expert Reports (invalidity and noninfringement). Deposition (Aug. 26, 2022).
   Case is ongoing with a pending trial.

3. Kirkland & Ellis for Samsung
   Dates: 2022-2023
   Venue: United States Patent and Trademark Office
   Cases: Petition for *Inter Partes* Review (IPR) of US Patent Nos. 7,116,710; 7,421,032; 7,916,781; and 8,284,833 (all owned by California Institute of Technology and petitioned by Samsung Electronics Co., Ltd)
   Technology: Forward error correction (FEC) coding including low density parity check (LDPC) codes and irregular repeat accumulate (IRA) codes.
   Activity: Expert Declarations (in support of IPR Petitions). *Case is ongoing.*

4. Fish & Richardson for Apple
   Dates: 2022
   Venue: United States District Court; Eastern District of Texas Marshall Division
   Cases: Ericsson, Inc. and Telefonaktiebolaget L.M. Ericsson v. Apple Inc.,
   Civil Action No. 2:21-cv-0036
   Technology: 5G NR wireless technology.
   Activity: Expert Reports (Patent portfolio technical evaluation and rebuttal). Deposition (Sept. 28, 2022). Prepared to give testimony before a jury.
   Case settled on December 8, 2022 after the fourth day of trial.

5. Fish & Richardson for Apple and its Brazilian entities
   Dates: 2022
   Venue: Brazil Courts: (1) 1st Business Court of the Capital District of Rio de Janeiro State (Case No. 0010664-19.2022.8.19.0001), and (2) Federal Court of Rio de Janeiro, 31st Court specialized in IP matters (Case No. 5016043-83.2022.4.02.5101)
   Cases: (1) Telefonaktiebolaget L.M. Ericsson vs. Allied Tecnologia S.A. and (2) Apple Computer Brasil Ltda. and Allied Tecnologia S.A. vs. Telefonaktiebolaget L.M. Ericsson
   Technology: Wireless technology including random access signaling for LTE.
   Activity: Expert Declarations (invalidity, noninfringement, and rebuttal).

6. Erise IP for Apple
   Dates: 2021-2022
   Venue: United States Patent and Trademark Office
   Cases: Petition for *Inter Partes* Review (IPR) of US Patent Nos. 8,023,990; 8,798,658; and 9,277,436 (all owned by Ericsson). IPR cases IPR2021-00459, IPR2022-00461, and IPR2022-00467 (petitioned by Apple Inc.). Request for Ex Parte Re-examination of US Patent No 10,476,722 (owned by Ericsson). Attorney Docket No. Apple.990
   Technology: Wireless technology including LTE-A minimization of drive testing (MDT) and 5G NR synchronization.
   Activity: Expert Declarations (in support of IPR Petitions and Ex Parte Re-examination). Deposition (Sept. 21, 2022 for the '658 patent).

7. Foley Hoag for Rideshare Displays, Inc.
   Dates: 2021-2022
   Venue: United States Patent and Trademark Office
   Cases: Patent owner's response to *Inter Partes* Review (IPR) of US Patent Nos. 9,892,637; 10,169,987; 10,395,525; 10,559,199; and 10,748,417 (all owned by Rideshare Displays, Inc.). IPR cases IPR2021-01598 to IPR2021-01602 (petitioned by Lyft, Inc.)
   Technology: Vehicle identification technology.
   Activity: Expert Declarations (in support of Patent Owner's responses to IPR Petitions, responses to Board's decision to institute, and motions to amend claims). Deposition (Sept. 9, 2022).

8. Fish & Richardson for LG Electronics, Inc., LG Electronics USA, Inc., Dell Inc., and Dell Technologies, Inc.
   Dates: 2021-2022
   Venue: United States Patent and Trademark Office
   Cases: Petition for *Inter Partes* Review (IPR) of US Patent Nos. 8,467,366 and 10,833,908 (owned by Neo Wireless LLC). IPR cases IPR2021-01480 and IPR2022-00277 (petitioned by Dell Inc.)
   Technology: Wireless technology including OFDM transmissions, random access, and ranging signals.
   Activity: Expert Declarations (in support of IPR Petitions).

9. Kirkland & Ellis for Lenovo
   Dates: 2020-2021
   Venue: UK High Court
   Cases: InterDigital Technology Corporation and others v Lenovo Group Limited and others (Claim No. HP-2019 000032)
   Technology: Wireless technology including control signaling for LTE.
   Activity: Expert Report (invalidity, non-essentiality, two rebuttal reports). Court Testimony (UK bench trial): Mar. 5-9, 2021.

10. Fish & Richardson for LG Electronics, Inc.
    Dates: 2019-2020
    Venue: United States Patent and Trademark Office
    Cases: Petition for *Inter Partes* Review (IPR) of US Patent No. 7,039,435 (owned by Bell Northern Research). IPR case IPR2020-00319 (petitioned by LG Electronics, Inc.)
    Technology: Wireless technology including power control of wireless transmissions.
    Activity: Expert Declaration (in support of IPR Petition).

11. Fish & Richardson for Apple
    Dates: 2017-2019
    Venue: United States District Court; Southern District of California
    Cases: Apple Inc. v. Qualcomm Inc., Civil Action No. 3:17-cv-00108
    Technology: LTE wireless technology.
    Activity: Expert Report (Patent portfolio technical evaluation). Deposition (Oct. 17, 2018). *Testimony before jury was scheduled for April 22, 2019, but case settled after opening arguments.*

12. Quinn Emanuel Urquhart & Sullivan for Samsung
    Dates: 2017-2018
    Venue: United States District Court; Northern District of California (San Francisco Division) and United States Patent and Trademark Office
    Cases: Samsung Electronics Co., LTD, et al. (counterclaim-plaintiffs) v. Huawei Technologies Co., LTD., et al. (counterclaim-defendants), Case No. 16-cv-02787-WHO
    Huawei Technologies Co., LTD vs. Samsung Electronics Co., LTD, Case IPR2017-01974 (US Patent 8,457,588)
    Huawei Technologies Co., LTD vs. Samsung Electronics Co., LTD, Case IPR2017-01982 (US Patent 8,228,827)
    Technology: LTE wireless technology.
    Activity: Declarations (Claim Construction, 2 Patent Owner's Responses to Petition for IPR); Expert Report (Infringement); Rebuttal Report (Validity). Depositions (June 20, 2018, Aug. 10, 2018, Aug. 11, 2018).

13. Baker Botts for AT&T; Gibson, Dunn & Crutcher for T-Mobile
    Dates: 2016-2017
    Venue: United States District Court; District of Delaware
    Cases: (a) Intellectual Ventures I LLC v. AT&T Mobility LLC et al., Civil Action No. 12-CV-193-LPS (D. Del.); Intellectual Ventures I LLC v. AT&T Mobility LLC et al., Civil Action No. 1:15-CV-00799-LPS.
    (b) Intellectual Ventures I LLC v. T-Mobile USA Inc. et al. D. Del. Case No. 1:13-cv-1632-LPS.
    Technology: HSDPA wireless technology.
    Activity: Expert Report; Declaration; Sur-Reply Report. Deposition (Mar. 23, 2017).

14. Rothwell Figg for LG; Paul Hastings for Samsung; Mayer Brown for Motorola Mobility
    Dates: 2016
    Venue: United States District Court; Southern District of California
    Cases: (a) Odyssey Wireless Inc. v. LG Electronics USA, Inc. et al., Civil Action No. 3:15-cv-01746-H-RBB (S.D. Cal.).
    (b) Odyssey Wireless Inc. v. Samsung Electronics Co. et al., Civil Action No. 3:15-cv-01738-H-RBB (S.D. Cal.).
    (c) Odyssey Wireless Inc. v. Motorola Mobility, Civil Action No. 3:15-cv-01741-H-RBB (S.D. Cal.).
    Technology: LTE wireless technology.
    Activity: Expert Report (noninfringement). Deposition (Aug. 24, 2016).

15. Sheppard Mullin for Samsung; Gibson Dunn and Wilmer Hale for Intel; Boies Schiller for Apple
    Dates: 2016
    Case: Various regulatory agencies' investigations of Qualcomm Incorporated ("Qualcomm"), including the Korean Fair Trade Commission (the "KFTC") and the United States Federal Trade Commission (the "FTC").
    Technology: LTE wireless technology.
    Activity: Declaration (technical analysis of patent portfolio).

16. Boies, Schiller & Flexner for Apple; Sheppard, Mullin, Richter & Hampton for HTC; Kilpatrick Townsend & Stockton for Lenovo and Motorola Mobility; Quinn Emanuel Urquhart & Sullivan for Samsung; McDermott Will & Emery for ZTE; Sidley Austin for Microsoft
    Dates: 2016
    Venue: United States District Court; District of Delaware
    Cases: (a) Evolved Wireless, LCC, v. Apple Inc., Civil Action No. 1:15-cv-00542-SLR. (b) Evolved Wireless, LCC, v. HTC Corporation and HTC America, Inc., Civil Action No. 1:15-cv-00543-SLR. (c) Evolved Wireless, LCC, v. Lenovo Group Ltd., Lenovo (United States) Inc., and Motorola Mobility, Civil Action No. 1:15-cv-00544-SLR. (d) Evolved Wireless, LCC v. Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc., Civil Action No. 1:15-cv-00545-SLR. (e) Evolved Wireless, LCC v. ZTE Corporation, ZTE (USA) Inc., and ZTE Solutions Inc., Civil Action No. 1:15-cv-00546-SLR. (f) Evolved Wireless, LCC v. Microsoft Corporation, Microsoft Mobile OY and Nokia Inc., Civil Action No. 1:15-cv-00547-SLR.
    Technology: LTE wireless technology.
    Activity: Declaration (claim construction).

17. Williams & Connolly
    Dates: 2015
    Case: Confidential Parties (Leading Global Wireless Communication Companies) Consolidated Arbitrations Under the International Chamber of Commerce Rules.
    Technology: LTE wireless technology.
    Activity: Expert Report (patent portfolio technical evaluation).

18. Kirkland & Ellis for Samsung
    Dates: 2013
    Case: Samsung Electronics and Samsung Telecommunications America v. Ericsson Inc. In the Matter of Certain Wireless Communications Equipment and Articles Therein US. International Trade Commission (ITC) Investigation No. 337-TA-866
    Technology: LTE wireless technology.
    Activity: Expert Report (infringement, domestic industry practice), rebuttal report (validity). Court testimony (ITC bench trial): direct (Oct. 23, 2013) and rebuttal (Oct. 30, 2013).

19. Quinn Emanuel Urquhart & Sullivan, LLP for Samsung
    Dates: 2013
    Case: Samsung Electronics GmbH v. Apple Inc. German Patent Court, Case Number 5 Ni 49/11
    Technology: Turbo codes; LTE wireless technology.
    Activity: Declaration (validity).

20. Kirkland & Ellis for DIRECTV
    Dates: 2009
    Case: Rembrandt Data Technologies v. DIRECTV, Inc. et al. Eastern District of Virginia, Case No. 1:08cv1009
    Technology: Telephone modems; set-top boxes.
    Activity: Rebuttal Expert Report (non-infringement). Deposition (May 20, 2009).

21. Kirkland & Ellis for Samsung
    Dates: 2006
    Case: Samsung Electronics and Samsung Telecommunications America v. Ericsson Inc. In the Matter of Certain Wireless Communications Equipment, Articles Therein, and Products Containing the Same ITC Investigation No. 377-TA-577
    Technology: WCDMA/UMTS wireless technology; mobile phone handsets.
    Activity: Declaration (domestic industry practice). Deposition (Nov. 17, 2006).

OTHER RECENT TECHNICAL CONSULTING

1. 4D Tech Solutions, Morgantown, WV
   Nonorthogonal Frequency Division Multiplexing
   July 2017 to December 2018.
2. WPL, Manhattan Beach, CA
   Survivable, Secure and Dependable Wireless Communications
   August 2016 to February 2017.

HONORS AND AWARDS

IEEE Communications Society, Communication Theory Technical Committee Outstanding Service Award (2021)
Career award for service to the communication theory community

IEEE MILCOM Award for Sustained Technical Achievement (2019)
Career award for contributions to military communications

Fellow, Institute of Electrical and Electronics Engineers (IEEE)
Elevated to Fellow in 2018 for contributions to cooperative diversity and the development of distributed turbo codes

WVU Foundation Outstanding Teaching Award (2013)
Highest teaching award at West Virginia University

Outstanding Teacher (2012, 2009, 2006, 2003, and 2001)
Outstanding Advisor (2012, 2004)
Outstanding Researcher (2008, 2001, and 2000)
West Virginia University, Statler College of Engineering & Mineral Resources (College-level awards)

Bradley Fellow, August 1995-May 1998
Virginia Tech, Bradley Department of Electrical Engineering (highest departmental fellowship)

PUBLICATIONS

Refereed Journal Articles

1. P. Das, R. Plesh, V. Talreja, N. Schmid, **M.C. Valenti**, J. Skufca, and S. Schuckers, "Empirical assessment of end-to-end iris recognition system capacity," *IEEE Transactions on Biometrics, Behavior, and Identity Science*, vol. 5, no. 2, pp. 154-169, April 2023.
2. F. Taherkhani, V. Talreja, J. Dawson, **M.C. Valenti**, and N.M. Nasrabadi "Profile to frontal face recognition in the wild using coupled conditional generative adversarial network," *IET Biometrics,* vol. 11, no. 3, pp. 260-272, May 2022.
3. T. Ketseoglou, **M.C. Valenti**, and E. Ayanoglu "Millimeter wave massive MIMO downlink per-group communications with hybrid linear precoding," *IEEE Transactions on Vehicular Technology,* vol. 70, no. 7, pp. 6841-6854, July 2021.
4. V. Talreja, **M.C. Valenti** and N. M. Nasrabadi, "Deep hashing for secure multimodal biometrics," *IEEE Transactions on Information Forensics and Security*, vol. 16, pp. 1306-1321, 2021.
5. F. Taherkhani, V. Talreja, **M.C. Valenti**, and N.M. Nasrabadi "Error-corrected margin-based deep cross-modal hashing for facial image retrieval," *IEEE Transactions on Biometrics, Behavior, and Identity Science,* vol. 2, no. 3, pp. 279-293, July 2020.
6. E. Hriba and **M.C. Valenti**, "Correlated blocking in mmwave cellular networks: Macrodiversity, outage, and interference," *Electronics (Special Issue on Millimeter-Wave (mmWave) Communications),* vol. 8, no. 10, article number 1187, Oct. 2019.
7. T. Ferrett and **M.C. Valenti**, "Noncoherent LDPC-coded physical-layer network coding using multitone FSK," *IEEE Transactions on Communications*, vol. 66, no. 6, pp. 2384-2395, June 2018.

8. D. Torrieri, S. Talarico, and **M.C. Valenti**, "Analysis of a frequency-hopping millimeter-wave cellular uplink," *IEEE Transactions on Wireless Communications*, vol. 15, no. 10, pp. 7089-7098, Oct. 2016.
9. K. Venugopal, **M.C. Valenti**, and R. W. Heath, Jr., "Device-to-device millimeter wave communications: Interference, coverage, rate, and finite topologies," *IEEE Transactions on Wireless Communications*, vol. 15, no. 9, pp. 6175-6188, Sept. 2016.
10. D. Torrieri, S. Talarico, and **M.C. Valenti**, "Performance comparisons of geographic routing protocols in mobile ad hoc networks," *IEEE Transactions on Communications,* vol. 63, no. 11, pp. 4276-4286, Nov. 2015.
11. P. Rost, S. Talarico, and **M.C. Valenti**, "The complexity-rate tradeoff of centralized radio access networks," *IEEE Transactions on Wireless Communications,* vol. 14, no. 11, pp. 6164-6176, Nov. 2015.
12. **M.C. Valenti**, D. Torrieri, and S. Talarico, "A direct approach to computing spatially averaged outage probability," *IEEE Communications Letters,* vol. 18, no. 7, pp. 1103-1106, July 2014.
13. S. Talarico, N.A. Schmid, M. Alkhweldi, and **M.C. Valenti**, "Distributed estimation of a parametric field: Algorithms and performance analysis," *IEEE Transactions on Signal Processing,* vol. 62, no. 5, pp. 1041-1053, Mar 1, 2014.
14. D. Torrieri, **M.C. Valenti**, and S. Talarico, "An analysis of the DS-CDMA cellular uplink for arbitrary and constrained topologies," *IEEE Transactions on Communications,* vol. 61, no. 8, pp. 3318-3326, Aug. 2013.
15. D. Torrieri and **M.C. Valenti**, "Exclusion and guard zones in DS-CDMA ad hoc networks," *IEEE Transactions on Communications,* vol. 61, no. 6, pp. 2468-2476, June 2013.
16. D. Torrieri and **M.C. Valenti**, "The outage probability of a finite ad hoc network in Nakagami fading," *IEEE Transactions on Communications*, vol. 60, pp. 3509-3518, Nov. 2012.
17. **M.C. Valenti** and X. Xiang, "Constellation shaping for bit-interleaved LDPC coded APSK," *IEEE Transactions on Communications*, vol. 60, pp. 2960-2970, Oct. 2012.
18. **M.C. Valenti**, D. Torrieri, and T. Ferrett, "Noncoherent physical-layer network coding with FSK modulation: Relay receiver design issues," *IEEE Transactions on Communications,* vol. 59, no. 9, pp. 2595-2604, Sept. 2011.
19. D. Torrieri and **M.C. Valenti**, "Rapidly-converging series representations of a mutual-information integral," *ISRN Communications and Networking*, vol. 2011, Article ID 546205, 6 pages, 2011.
20. **M.C. Valenti**, S. Cheng, and D. Torrieri "Iterative multisymbol noncoherent reception of coded CPFSK," *IEEE Transactions on Communications*, vol. 58, no. 7, pp. 2046-2054, July 2010.
21. D. Torrieri and **M.C. Valenti**, "Efficiently decoded full-rate space-time block codes," *IEEE Transactions on Communications*, vol. 58, no. 2, pp. 480-488, Feb. 2010.
22. S. Cheng, **M.C. Valenti**, and D. Torrieri, "Coherent continuous-phase frequency-shift keying: Parameter optimization and code design," *IEEE Transactions on Wireless Communications,* vol. 8, no. 4, pp. 1792-1802, Apr. 2009.
23. D. Torrieri and **M.C. Valenti**, "Constellation labeling maps for low error floors," *IEEE Transactions on Wireless Communications,* vol. 7, no. 12, pp. 5401-5407, Dec. 2008.
24. D. Torrieri, S. Cheng, and **M.C. Valenti**, "Robust frequency hopping for interference and fading channels," *IEEE Transactions on Communications,* vol. 56, no. 8, pp. 1343-1351, Aug. 2008.
25. K. Vardhe, D. Reynolds, and **M.C. Valenti**, "The performance of multi-user cooperative diversity in an asynchronous CDMA uplink," *IEEE Transactions on Wireless Communications*, vol. 7, no. 5, pp. 1930-1940, May 2008.

26. R. Iyer Seshadri and **M.C. Valenti**, "Capacity-based parameter optimization of bit-interleaved coded CPM with differential detection," *IEEE Transactions on Vehicular Technology*, vol. 57, no. 1, pp. 345-353, Jan. 2008
27. S. Cheng, **M.C. Valenti**, and D. Torrieri, "Robust iterative noncoherent reception of coded FSK over block fading channels," *IEEE Transactions on Wireless Communications,* vol. 6, no. 9, pp. 3142-3147, Sept. 2007.
28. S. Wei, D.L. Goeckel, and **M.C. Valenti**, "Asynchronous cooperative diversity," *IEEE Transactions on Wireless Communications*, vol. 5, no. 6, pp. 1547-1557, June 2006.
29. B. Zhao and **M.C. Valenti**, "Position-based relaying with hybrid-ARQ for efficient ad hoc networking," *EURASIP Journal on Wireless Communications and Networking*, vol. 5, no. 5, pp. 610-624, Dec. 2005.
30. **M.C. Valenti** and S. Cheng, "Iterative demodulation and decoding of turbo coded M-ary noncoherent orthogonal modulation," *IEEE Journal on Selected Areas in Communications,* vol. 23, no. 9, pp. 1738-1747, Sept. 2005.
31. J. Sun and **M.C. Valenti**, "Joint synchronization and SNR estimation for turbo codes in AWGN channels," *IEEE Transactions on Communications*, vol. 53, no. 7, pp. 1136-1144, July 2005.
32. B. Zhao and **M.C. Valenti**, "Practical relay networks: A generalization of hybrid-ARQ," *IEEE Journal on Selected Areas in Communications,* vol. 23, no. 1, pp. 7-18, Jan. 2005.
33. B. Zhao and **M.C. Valenti**, "Distributed turbo coded diversity for the relay channel," *IEE Electronics Letters*, vol. 39, no. 10, pp. 786-787, May 15, 2003.
34. **M.C. Valenti** and J. Sun, "The UMTS turbo code and an efficient decoder implementation suitable for software defined radios," *International Journal on Wireless Information Networks,* vol. 8, no. 4, pp. 203-216, Oct. 2001.
35. **M.C. Valenti** and B.D. Woerner, "Pilot symbol assisted detection of turbo codes over flat-fading channels," *IEEE Journal on Selected Areas in Communications*, vol. 19, pp. 1697-1705, Sept. 2001.
36. **M.C. Valenti** and B.D. Woerner, "Iterative multiuser detection, macrodiversity combining and decoding for the TDMA cellular uplink", *IEEE Journal on Selected Areas in Communications*, vol. 19, pp. 1570-1583, Aug. 2001.
37. **M.C. Valenti** and B.D. Woerner, "Distributed multiuser detection for the TDMA cellular uplink," *IEE Electronics Letters*, vol. 35, no. 21, pp. 1803-1804, Oct. 21, 1999.
38. **M.C. Valenti** and B.D. Woerner, "Refined channel estimation for coherent detection of turbo codes over flat-fading channels," *IEE Electronics Letters*, vol. 34, no. 17, pp. 1648-1649, Aug. 20, 1998.

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Other Conference Papers

108. S. Talarico, **M.C. Valenti**, and D. Torrieri, "Analysis and optimization of a frequency hopping ad hoc network in Rayleigh fading," in *Proc. Virginia Tech Symp. on Wireless Personal Commun.*, (Blacksburg, VA), May 2012.

109. M. Fanaei, **M.C. Valenti**, and N. Schmid, "Distributed parameter estimation in wireless sensor networks using fused local observations," in *Proc. SPIE Wireless Sensing, Localization, and Processing VII*, (Baltimore, MD), Apr. 2012.

110. M. Fanaei, **M.C. Valenti**, N. Schmid and V. Kulathumani, "Channel-aware distributed classification using binary local decisions," in *Proc. SPIE Signal Processing, Sensor Fusion, and Target Recognition XX*, (Orlando, FL), Apr. 2011.

111. X. Chen, S. Gong, N.A. Schmid, and **M.C. Valenti**, "UAV based distributed ATR under realistic simulated environmental effects," in *Proc. SPIE Signal Processing, Sensor Fusion, and Target Recognition XVI*, (Orlando, FL), Apr. 2007.

112. R. Iyer Seshadri and **M.C. Valenti**, "A capacity-based search for energy and bandwidth efficient bit-interleaved coded noncoherent GFSK," in *Proceedings of the Virginia Tech Symp. on Wireless Personal Commun.*, (Blacksburg, VA), June 2006.

113. B. Zhao and **M.C. Valenti**, "Cooperative diversity using distributed turbo codes," in *Proc. Virginia Tech Symp. on Wireless Personal Commun.*, (Blacksburg, VA), June 2003, pp.143-152.

114. N. Chandran and **M.C. Valenti**, "Bridging the gap between parallel and serial concatenated codes," in *Proc. Virginia Tech Symp. on Wireless Personal Commun.*, (Blacksburg, VA), June 2002, pp. 145-154.

115. B. Zhao and **M.C. Valenti**, "Iterative demodulation and decoding of DPSK modulated turbo codes over Rayleigh fading channels," in *Proc. Virginia Tech Symposium on Wireless Personal Communications*, (Blacksburg, VA), June 2001, pp. 259-270.

116. D. Baker and **M.C. Valenti**, "The impact of channel estimation errors on space time block codes," in *Proc. Virginia Tech Symposium on Wireless Personal Communications*, (Blacksburg, VA), June 2001, pp. 175-186.

117. **M.C. Valenti**, "Turbo codes and iterative processing," in *Proc. IEEE New Zealand Wireless Commun. Symp.*, (Auckland, New Zealand), Nov. 1998.

PRESENTATIONS

Invited Research Seminars and Tutorial Presentations

1. "Air-assisted broadband communications," invited seminar, *Hughes Network Systems* (Germantown, MD), August 4, 2022.

2. "Unlocking the promise of 5G," invited seminar, *University of South Carolina* (Columbia, SC), April 1, 2022.

3. "Cloud radio access networks for 5G communications," invited seminar, *Hughes Network Systems* (Germantown, MD), June 8, 2018.
4. "Cloud radio access networks for 5G communications," invited seminar, *Michigan Technological University* (Houghton, MI), April 13, 2018.
5. "Centralized radio access networks: Moving baseband to the Cloud," a half-day tutorial presented at the *IEEE International Conference on Communications* (Kuala Lumpur, Malaysia), May 27, 2016.
6. "The computational requirements of centralized RAN," invited presentation, *Communication Theory Workshop* (Nafplio, Greece), May 16, 2016.
7. "Research challenges in biometrics", invited seminar, *Biometrics Institute meeting* (Australian Embassy, Washington, DC), Sep. 15, 2015.
8. "Computational outage: A new KPI for C-RAN," invited seminar, *University of Southampton* (Southampton, UK), June 12, 2015.
9. "Centralized radio access networks: Moving baseband to the Cloud," a half-day tutorial presented at the *Virginia Tech Symposium on Wireless Personal Communications and Annual Wireless Summer School*, (Blacksburg, VA), May 28, 2015.
10. "Coverage and rate in finite-sized device-to-device millimeter wave networks," invited seminar, *McGill University* (Montreal, Quebec), Mar. 23, 2015.
11. "Centralized radio access networks: The case for baseband in the cloud," invited seminar, *University of Toronto* (Toronto, ON), Nov. 12, 2014.
12. "Centralized radio access networks: The case for baseband in the cloud," invited seminar, *University of New Mexico* (Albuquerque, NM), Oct. 31, 2014.
13. "Mobile biometrics in the cloud," invited presentation, *Smart Card Alliance Government Conference* (Washington, DC), Oct. 30, 2014.
14. "Computational communication theory: A modern tool for engineering future wireless networks," invited seminar, *Motorola Labs* (Plantation, FL), May 23, 2014.
15. "Interference and spatial modeling in wireless networks," invited seminar, *University at Buffalo, The State University of New York* (Buffalo, NY), May 15, 2014.
16. "Interference and spatial modeling in wireless networks," invited seminar, *University of Pisa* (Pisa, Italy), May 5, 2014.
17. "A day in the life of an LTE handset," a half-day tutorial presented at the *Virginia Tech Symposium on Wireless Personal Communications and Annual Wireless Summer School*, (Blacksburg, VA), May 30, 2013.
18. "Interference and spatial modeling in wireless networks," invited seminar, *Clemson University*, May 28, 2013
19. "Constellation shaping for LDPC-coded APSK," invited seminar, *Hughes Network Systems* (Germantown, MD), Mar. 14, 2013.
20. "The LTE physical layer," a half-day tutorial presented at the *Virginia Tech Symposium on Wireless Personal Communications*, (Blacksburg, VA), June 1, 2012.
21. "A high-performance computing approach to wireless network optimisation," invited seminar, *University of Auckland* (Auckland, New Zealand), Feb. 3, 2012.
22. "Communication theory in the cloud: The transformative power of cheap utility computing," plenary, *Australian Communication Theory Workshop* (Wellington, New Zealand), Jan. 30, 2012.
23. "Modern digital satellite television: How it works," invited seminar, *United States Naval Academy*, Nov. 7, 2011.

24. "Modern digital satellite television: How it works," invited seminar, *Georgia Institute of Technology,* Nov. 1, 2011.
25. "The transmission capacity of frequency-hopping ad hoc networks," invited seminar, *Osaka University*, June 13, 2011.
26. "LDPC codes: Achieving the capacity of the binary erasure channel," invited talk, *Math/CS Colloquium* (West Virginia University, Morgantown, WV), Nov. 30, 2009.
27. "Communication theory in the cloud," invited seminar*, University of Toronto*, Oct. 30, 2009.
28. "Channel coding for IEEE 802.16e mobile WiMAX," a half-day tutorial presented at the *IEEE International Conference on Communications* (Dresden, Germany), June 18, 2009.
29. "Channel coding for IEEE 802.16e mobile WiMAX," a half-day tutorial presented at the *Virginia Tech Symposium on Wireless Personal Communications* (Blacksburg, VA), June 4, 2009.
30. "Mutual information as a tool for the design, analysis, and testing of modern communication systems," invited seminar presented to *Hughes Network Systems*, (Germantown, MD), June 8, 2007.
31. "Turbo and LDPC codes: Implementation, simulation, and standardization," a half-day tutorial presented at the *16th Virginia Tech/MPRG Symposium on Wireless Personal Communications and 2nd Annual Wireless Summer School*, (Blacksburg, VA), June 2006.
32. "Distributed Simulation of Modern Communication Systems Using the Global Grid Exchange," invited presentation, *Teaming to Win Conference*, Stonewall Jackson Resort (Walkersville, WV), June 1, 2006.
33. "Distributed Simulation of Modern Communication Systems Using the Global Grid Exchange," invited presentation, *West Virginia University Computing & Technology Symp.*, Apr. 12, 2006.
34. "Modern wireless network design based on constrained capacity," invited seminar, *Pittsburgh Signal Processing Society Seminar*, University of Pittsburgh, April 20, 2005.
35. "Coded-protocols for implementing cooperative diversity," invited research colloquium, *Motorola Corporate Research Labs*, (Schaumburg, IL), June 30, 2004.
36. "Bluetooth: Throughput analysis and tricks to improve performance," invited seminar, *Ohio University*, (Athens, OH), May 15, 2002.
37. "Bluetooth: Link and physical layer," invited research colloquium, *Motorola Florida Research Labs,* (Plantation, FL), Mar. 25, 2002.
38. "Turbo codes and iterative processing," invited research colloquium, *Motorola Florida Research Labs,* (Plantation, FL), Mar. 22, 2002.
39. "Emerging wireless standards," invited presentation, *Second YAS Broadband Venture Seminar,* West Virginia University, (Morgantown, WV), Sept. 7, 2001.
40. "Wireless communications research at West Virginia University," invited research colloquium, *National Radio Astronomy Observatory (NRAO),* (Green Bank, WV), June 13, 2000.

Oral Conference Presentations

1. "Learning to authenticate with deep multibiometric hashing and neural network decoding," *IEEE International Conference on Communications (ICC)*, (Shanghai, China), May 21, 2019.
2. "The impact of correlated blocking on millimeter-wave personal networks," *IEEE Military Commun. Conf. (MILCOM)*, (Los Angeles, CA), Oct. 29, 2018.
3. "Outage correlation in finite and clustered wireless networks," *IEEE Int. Symp. on Personal, Indoor, & Mobile Radio Commun. (PIMRC)*, (Bologna, Italy), Sept. 12, 2018.
4. "Accurately accounting for random blockage in device-to-device mmwave networks," *IEEE Global Commun. Conf. (GLOBECOM)*, (Singapore), Dec. 5, 2017.

5. "Controlled barrage regions: Stochastic modeling, analysis, and optimization," *IEEE Military Commun. Conf. (MILCOM)*, (Baltimore, MD), Nov. 2016.
6. "Frequency hopping on a 5G millimeter uplink," *Asilomar Conf. on Signals, Sys., & Computers*, (Pacific Grove, CA), Nov. 2015
7. "Optimization of an adaptive frequency-hopping networks," *IEEE Military Commun. Conf. (MILCOM)*, (Tampa, FL), Oct. 2015.
8. "Effects of spatial randomness on locating a point source with distributed sensors," *IEEE Int. Conf. on Commun. (ICC) Workshop on Advances in Network Localization and Navigation (ANLN)*, (Sydney), June 2014.
9. "An iterative noncoherent relay receiver for the two-way relay channel," *IEEE Int. Conf. on Commun. (ICC),* (Budapest, Hungary), June 2013.
10. "Closing the gap to the capacity of APSK: Constellation shaping and degree distributions," *Int. Conf. on Computing, Networking, and Commun. (ICNC),* (San Diego, CA), Jan. 2013.
11. "Analysis and optimization of a frequency hopping ad hoc network in Rayleigh fading," *Virginia Tech Symp. on Wireless Personal Commun.*, (Blacksburg, VA), May 30, 2012.
12. "Iterative multisymbol noncoherent reception of coded CPFSK," presented at the *IEEE Military Communications Conference (MILCOM)*, (Boston, MA), Oct. 19, 2009.
13. "Robust frequency-hopping system for channels with interference and frequency-selective fading," *IEEE Int. Conf. on Commun. (ICC)*, (Glasgow, Scotland), June 2007.
14. "The impact of an antenna array in a relay network," *IEEE Int. Conf. on Commun. (ICC)*, (Glasgow, Scotland), June 2007.
15. "Macrodiversity packet combining for the IEEE 802.11a uplink," *IEEE Wireless Commun. & Networking Conf. (WCNC)*, (New Orleans, LA), Mar. 2005.
16. "Bit-interleaved turbo-coded noncoherent orthogonal modulation with iterative demodulation and decoding: Capacity limits and convergence analysis," *Asilomar Conference on Signals, Systems, and Computers*, (Pacific Grove, CA), Nov. 2004.
17. "Hybrid-ARQ based intra-cluster geographic relaying," *IEEE Military Commun. Conf. (MILCOM)*, (Monterey, CA), Nov. 2004, invited presentation.
18. "Towards the capacity of noncoherent orthogonal modulation: BICM-ID for turbo coded NFSK," *IEEE Military Commun. Conf. (MILCOM)*, (Monterey, CA), Nov. 2004.
19. "Some new adaptive protocols for the wireless relay channel," *Allerton Conf. on Commun., Control, and Comp.*, Monticello, IL, Oct. 3, 2003.
20. "Cooperative diversity using distributed turbo codes," *Virginia Tech Symp. on Wireless Personal Commun.*, Blacksburg, VA, June 6, 2003.
21. "Exploiting Macrodiversity in Dense Multihop Networks and Relay Channels," *IEEE Wireless Commun. & Networking Conf. (WCNC)*, New Orleans, LA, Mar. 20, 2003.
22. "Improving uplink performance by macrodiversity combining packets from adjacent access points," *IEEE Wireless Commun. & Networking Conf. (WCNC)*, New Orleans, LA, Mar. 19, 2003.
23. "Improving the QoS of Bluetooth Through Turbo Coding," *IEEE Military Commun. Conf. (MILCOM)*, Los Angeles, CA, Oct. 8, 2002.
24. "Custom coding, adaptive rate control, and distributed detection for Bluetooth," *IEEE Vehicular Tech. Conf. (VTC)*, Vancouver, BC, Sept. 26, 2002.
25. "An analog turbo decoder for an (8,4) product code," *IEEE Midwest Symp. on Circuits & Sys. (MWSCAS)*, Tulsa, OK, Aug. 7, 2002.

26. "Bridging the gap between parallel and serial concatenated codes," *Virginia Tech Symp. on Wireless Personal Commun.*, Blacksburg, VA, June 7, 2002.
27. "On the throughput of Bluetooth data transmissions," *IEEE Wireless Commun. & Networking Conf. (WCNC)*, (Orlando, FL), Mar. 18, 2002.
28. "Per-survivor based detection of DPSK modulated high rate turbo codes over Rayleigh fading channels," *Asilomar Conference on Signals, Systems, and Computers*, Pacific Grove, CA, Nov. 2001, invited presentation.
29. "An efficient software radio implementation of the UMTS turbo codec," *IEEE International Symp. on Personal, Indoor, and Mobile Radio Communications (PIMRC),* San Diego, CA, Oct. 2001.
30. "The impact of channel estimation errors on space time block codes," *Virginia Tech Symposium on Wireless Personal Communications*, Blacksburg, VA, June 2001.
31. "Coded transmit macrodiversity: Block space-time codes over distributed antennas," *IEEE Vehicular Technology Conference (VTC)*, Rhodes, Greece, May 2001.
32. "Hybrid ARQ using Serial Concatenated Convolutional Codes over Fading Channels" *IEEE Vehicular Technology Conference (VTC)*, Rhodes, Greece, May 2001.
33. "Inserting turbo code technology in the DVB satellite broadcasting system," *Military Communications International Symposium (MILCOM)*, Los Angeles, CA, Nov. 2000.
34. "Iterative channel estimation and decoding of turbo codes over flat-fading channels," *Wireless Communications and Networking Conference (WCNC),* Chicago, IL, Sept. 2000, invited presentation.
35. "An optimal soft-output multiuser detection algorithm and its applications," *Second International Symposium of Turbo Codes and Related Topics*, Brest, France, Sept. 2000.
36. "An ARQ technique using related parallel and serial concatenated convolutional codes," *Int. Conf. on Commun. (ICC)*, New Orleans, LA, June 2000.
37. "A bandwidth efficient pilot symbol technique for coherent detection of turbo codes over fading channels," *Military Communications International Symp. (MILCOM)*, Atlantic City, NJ, Nov. 1999.

Poster Presentations

1. "Multibiometric secure system based on deep learning," *poster presentation*, *IEEE Global Conf. on Signal and Information Processing (GlobalSIP)*, (Montreal, Canada), Nov. 2017.
2. "Interference correlation in fixed and finite networks," *poster presentation*, *2015 Communication Theory Workshop*, (Laguna Beach, CA), May 11, 2015.
3. "The role of computational outage in dense cloud-based centralized radio access networks," *poster presentation, IEEE Global Commun. Conf. (GLOBECOM)*, (Austin, TX), Dec. 2014
4. "A direct approach to spatial averaging: Revisiting Baccelli's Result," *poster presentation*, *2014 IEEE Communication Theory Workshop*, (Curacao), May 26, 2014.
5. "An information-theoretic approach to accelerated simulation of hybrid-ARQ systems," *poster presentation*, *IEEE Int. Conf. on Commun. (ICC)*, (Kyoto, Japan), June 2011.
6. "Optimum frame synchronization for preamble-less packet transmission of turbo codes," *poster presentation*, *Asilomar Conference on Signals, Systems, and Computers*, (Pacific Grove, CA), Nov. 2004.
7. "Scaling cooperative diversity to large networks," *poster presentation*, *NATO Workshop on Cross-Layer Issues in the Design of Tactical Mobile Ad Hoc Wireless Networks*, (US Naval Research Laboratory, Washington, DC), June 2-3, 2004.
8. "Iterative demodulation and decoding of DPSK modulated turbo codes over Rayleigh fading channels," *poster presentation*, *Virginia Tech Symposium on Wireless Personal Communications*, (Virginia Tech, Blacksburg, VA), June 2001.

GRANTS AND CONTRACTS

Awards Made by the Center for Identification Technology Research
Description: These are funds secured from the NSF and the CITeR Industrial Affiliates. The funds are used to operate the center and to fund research projects selected by the Affiliates.

Research Title	Granting Agency	Dates of Award	Agency Funding	Role
I/UCRC Phase II: I/UCRC for Identification Technology Research	National Science Foundation (and Federal Affiliate Members)	3/15/2017 to 2/28/2024	$4,018,327	PI
CITeR Affiliation Membership: Athena Sciences Corporation	Athena Sciences Corporation	11/1/2019 to 2/28/2024	$32,500	PI
CITeR Affiliation Membership: InCadence Membership	InCadence Strategic Solutions Corporation	6/1/2017 to 2/28/2024	$50,000	PI
CITeR Affiliation Membership: FBI Membership	US Department of Justice: FBI	3/15/2017 to 2/28/2024	$410,000	PI
CITeR Affiliation Membership: Northrop Grumman Corporation	Northrop Grumman Corporation	6/1/2017 to 2/28/2024	$170,000	PI
CITeR Affiliation Membership: MorphoTrak	MorphoTrak (Idemia)	6/1/2017 to 8/15/2014	$40,000	PI
CITeR Affiliation Membership: Stereovision Imaging, Inc.	Stereovision Imaging, Inc.	1/1/2019 to 2/28/2024	$50,000	PI
Collaborative Research: I/UCRC for Identification Technology (CITeR)	National Science Foundation (and Affiliate Members)	3/15/2011 to 2/28/2018	$3,363,384	PI
I/UCRC FRP: Collaborative Research: Enabling Biometrics Research in the Cloud: Design and Demonstration	National Science Foundation	8/1/2013 to 7/31/2014	$65,000	Co-PI

Awards Made by the Center for Identification Technology Research
Description: These are research projects that were selected by the CITeR Industrial Affiliates Board to fund projects for which I was named as the PI (i.e., I was materially involved in the research).

Research Title	Granting Agency	Dates of Award	Agency Funding	Role
Uniqueness and Permanence of Iris	Center for Identification Technology Research	8/14/2019 to 12/31/2020	$25,000	Co-PI
Deep Virtual Line-Up Using Soft Biometrics	Center for Identification Technology Research	1/1/2019 to 12/31/2019	$35,000	PI
Deep Hashing for Secure Multimodal Biometrics	Center for Identification Technology Research	1/1/2018 to 12/31/2018	$50,000	PI
A Forensic Approach to Iris Analysis	Center for Identification Technology Research	8/16/2015 to 8/15/2016	$20,000	PI
A Cloud-based Biometric Service Model for Iris and Ocular Recognition Using a Smartphone	Center for Identification Technology Research	1/2/2015 to 1/1/2016	$29,000	PI
Cloud-Empowered Mobile Biometrics	Center for Identification Technology Research	4/15/2013 to 5/15/2014	$34,400	PI

Other Research Awards

Description: These are awards made outside of the context of CITeR.

Research Title	Granting Agency	Dates of Award	Agency Funding	Role
2022 DoD Cybersecurity Scholarship Program	US DoD/NSA	9/7/2022 to 9/7/2024	$131,568	PI
Strengthening Investigative Tools and Technology	WV DMAPS State Police	10/1/2023 to 9/30/2024	$138,253	PI
Strengthening Investigative Tools and Technology	WV DMAPS State Police	10/1/2021 to 9/30/2022	$99,999	PI
Survivable, Secure, and Dependable Wireless Communications	WPL, Inc. (Subcontract of phase II SBIR award from AFRL)	1/1/2018 to 12/31/2019	$124,650	PI (Sole)
Iris Liveness Detection	MorphoTrak	9/1/2016 to 8/31/2017	$50,000	PI
Intelligent Camera Networks for the Recognition of Human Activities in Urban Environments	Office of Naval Research	9/3/2009 to 9/2/2013	$604,505	Co-PI
CRI: CRD: A Web-Accessible Grid-Computing Resource for the Telecommunications Research Community	National Science Foundation	5/01/2008 to 4/30/2013	$578,351	PI (Sole)
Advanced Communications for Wireless Sensor Networks	US Army Research Laboratory	9/29/2010 to 12/31/2012	$2,720,000	Co-PI
Radiation Hardened Interceptor Communications, Phase II.	Welkin Sciences, LLC (Subcontract of phase II STTR from MDA)	6/15/2009 to 5/31/2011	$225,000	PI (Sole)
Initiatives in Computational-Based Discovery	WVU Research Corp. (PSCoR)	1/7/2009 to 12/31/2009	$28,784	PI
Evolutionary Design of Near-Optimal Space Links	Parabon Computation (Subcontract of a NASA award)	2/12/2007 to 2/28/2008	$59,177	PI (Sole)
Phase II of Development of a Concept for Swarmed mini-UAVs for Automatic Target Recognition	Augusta Systems (Subcontract of phase II STTR from US Navy)	9/1/2005 to 8/31/2007	$277,498	PI
Retrieval and Reconstruction of Magnetic Data Using Scanning Probe Microscopy	Federal Government (classified agency)	8/31/2004 to 8/30/2007	$683,168	Co-PI
Multiterminal Relaying Strategies	Welkin Sciences, LLC (Subcontract of phase I STTR award – MDA)	10/1/2007 to 3/28/2007	$30,000	PI (Sole)
Proximity Based Protocols for Highly Mobile Large Scale Ad Hoc Networks	Augusta Systems (Subcontract of US Navy award)	2/1/2006 to 12/31/2006	$75,000	PI
Improved Code and Receiver Design for IFICS	Xenotran (Subcontract of phase II SBIR award from MDA)	4/15/2005 to 8/15/2006	$87,585	PI (Sole)
Efficient & Reusable Framework for Deep Space Mission Communication Applications	NASA	7/1/2005 to 6/30/2006	$20,000	PI (Sole)

Development of a Concept for Swarmed mini-UAVs for Automatic Target Recognition	Augusta Systems (Subcontract of phase I STTR award from ONR)	7/1/2004 to 9/15/2005	$42,000	PI
Software Radio Architectures for Deep Space Communications	NASA	7/1/2004 to 6/30/2005	$20,000	PI (Sole)
Advanced Packet-Based Communications: Turbo Coding, Synchronization, and Automatic Repeat Request	Office of Naval Research	4/1/2000 to 6/30/2004	$345,000	PI (Sole)
Macrodiversity-Reception for the Wireless LAN Uplink: Feasibility Study and Application to IEEE 802.11a	Cisco Systems (University Research Program via WVU Foundation)	1/1/2003 to 12/31/2003	$39,900	PI (Sole)
Integrated Computing, Communication and Distributed Control of Deregulated Electric Power Systems	Department of Energy (DOE EPSCoR)	10/1/2000 to 9/30/2003	$900,000	Co-PI
Development of Modules for VisSim/Comm	Eritek, Inc.	5/15/2001 to 12/31/2001	$9,216	PI (Sole)
Turbo Space-Time Codes for High Data Rate Wireless Communications	NASA	5/15/2000 to 5/14/2001	$13,333	PI (Sole)
Turbo Code Consulting	Coleman Research Corporation (now L3)	2/1/2000 to 7/31/2000	$14,475	PI (Sole)

PROFESSIONAL SERVICE

Professional Membership

Fellow, Institute of Electrical and Electronics Engineers
Student Member 1992, Member 1999, Senior Member 2007, Fellow 2018

Member, American Society for Engineering Education (ASEE) – 2015-2016, 2021-2022

Member, Electrical and Computer Engineering Department Head Association (ECEDHA) – 2019-2021

Member, Radio Club of America – 1999-present

Member, Phi Kappa Phi – 1991-present

Member, Eta Kappa Nu – 1990-present

Professional Committees, Councils, and Boards

Member, IEEE Communication Theory Technical Committee (IEEE Comm. Society) – 2007-present
Chair, 2015-2016
Vice Chair, 2013-2014

Member, IEEE Communications Society Publication Misconduct Review Committee – 2022-2023

Member, IEEE Communications Society Ad Hoc Committee on Diversity – 2021-2022

Member, IEEE Communications Society Governance Committee – 2019-2021

Member, IEEE Communications Society Conference Council – 2018-2021

Member, IEEE Communications Society Online Content Board – 2018-2021

Member, IEEE Communications Society Technical Committees Board – 2015-2016 and 2018-2021

Journal Editorships and Leadership

Member, Steering Committee, *IEEE Trans. on Wireless Commun.* – 2021-2024 (Chair 2023-2024)

Editor-in-Chief, *IEEE Communications Society Best Readings* – 2015-2022
Best Readings is an online repository of curated content. It publishes four issues per year, with each issue devoted to a particular technology. Examples include *Massive MIMO, Nanoscale Communication Networks, Cloud Communications and Networking,* and *Device-to-Device Communications.*

Member, *ECEDHA Source Editorial Committee* – 2020-2022
Shaped content in *the Source*, the newsletter for ECE department heads.

Member, Executive Editorial Committee, *IEEE Transactions on Wireless Communications,*
Member: 2014-2017. Chair: 2016-2017.
This committee assists the Editor-in-Chief with the screening of submissions, providing early reject decisions and assignment to Area Editors.

Editor, *IEEE Transactions on Communications* – 2013-2017

Associate Editor, *IEEE Wireless Communications Letters* – 2011-2014

Associate Editor, *IEEE Transactions on Wireless Communications* – 2007-2011

Associate Editor, *IEEE Transactions on Vehicular Technology* – 2003-2007

Conference Organization and Leadership

IEEE Communications Society's GLOBECOM/ICC Technical Content (GITC) Committee
Chair – 2018-2021
Vice Chair – 2016-2017
Member – 2015-2019
GITC is the (technical) steering committee for GLOBECOM and ICC, the flagship conferences on communication technology sponsored by the IEEE Communications Society.

IEEE Communications Society's GLOBECOM/ICC Management & Strategy (GIMS) Committee
Member – 2018-2021
This is the (non-technical) steering committee for GLOBECOM and ICC, the flagship conferences on communication technology sponsored by the IEEE Communications Society.

IEEE Military Communications Conference (MILCOM) Board
Member (non-voting) – 2014-2020
This is the steering committee for MILCOM, the flagship IEEE/AFCEA conference on military conference.

Technical Program Chair, *IEEE International Conference on Communications (ICC) 2024*, Denver, Colorado, June 2024

Technical Program Co-Chair, *IEEE International Conference on Communications (ICC) 2021*, Montreal, Canada, June 2021 (due to COVID-19, the conference was held online)

Technical Program Chair, *IEEE Military Communications Conference (MILCOM) 2017*, Baltimore, MD, Oct. 2017

Unclassified Technical Program Chair, *IEEE Military Communications Conference (MILCOM) 2016*, Baltimore, MD, Oct. 2016

Technical Program Vice Chair, *IEEE Military Communications Conference (MILCOM) 2015*, Tampa, FL, Oct. 2015

Technical Program Vice Chair, *IEEE Global Communications Conference (GLOBECOM) 2013*, Atlanta, GA, Dec. 2013

Workshops Co-Chair, *IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC) 2023,* Toronto, ON, Sept. 2023

Awards Chair, *IEEE International Conference on Communications (ICC) 2022*, Seoul, Korea, May 2022

Workshop Co-Chair, *4th International Workshop on 5G Architecture, 2017 International Conference on Communications (ICC) Workshops*, Paris, France, May 2017

Track Co-Chair, Waveforms and Signal Processing Track, *IEEE Military Communications Conference (MILCOM) 2021*, San Diego, CA, Nov. 2021

Symposium Co-Chair, Communication Theory Symposium, *IEEE International Conference on Communications (ICC) 2019,* Shanghai, China, June 2019

Symposium Co-Chair, Wireless Communications Symposium, *IEEE Global Communications Conference (GLOBECOM) 2015*, San Diego, CA, Dec. 2015

Track Co-Chair, Waveforms and Signal Processing Track, *IEEE Military Communications Conference (MILCOM) 2014*, San Diego, CA, Oct. 2014

Track Co-Chair, Waveforms and Signal Processing Track, *IEEE Military Communications Conference (MILCOM) 2012*, Orlando, FL, Oct./Nov. 2012

Symposium Co-Chair, Communication Theory Symposium, *IEEE International Conference on Communications (ICC) 2011,* Kyoto, Japan, June 2011

Track Co-Chair, Waveforms and Signal Processing Track, *IEEE Military Communications Conference (MILCOM) 2010*, San Jose, California, Oct./Nov. 2010

Symposium Co-Chair, Wireless Communications Symposium, *IEEE International Conference on Communications (ICC) 2009,* Dresden, Germany, May 2009

Track Co-Chair, Transmission Technologies, *IEEE Vehicular Technology Conference (VTC) Fall-2007*, Baltimore, MD, Oct. 2007

Member, Technical Program Committee, *IEEE Global Telecommunications Conference (GLOBECOM),* 2005-2022

Member, Technical Program Committee, *IEEE International Conference on Communications (ICC),* 2005, 2007-2009, 2012-2022

Member, Technical Program Committee, *IEEE International Conference on Computer Communications (INFOCOM) 2018,* Honolulu, HI, Apr. 2018. Distinguished TPC Member

Member, Technical Program Committee, *IEEE Wireless Communications & Networking Conference (WCNC),* 2006-2010, 2014, 2017, 2018

Member, Technical Program Committee, *IEEE Vehicular Technology Conference (VTC)*, 2012-2014

Member, Technical Program Committee, *IEEE Military Communications Conference (MILCOM),* 2004, 2005, 2010-2017, 2021

Member, Technical Program Committee, *Wireless Telecommunications Symposium (WTS), 2015*

Member, Technical Program Committee, *7th International Symposium on Turbo Codes & Iterative Processing,* 2012

Member, Technical Program Committee, *European Wireless Conference, 2008*

Member of Technical Program Committee, Symposium on Cooperative Networks, *IEEE WirelessCom*, 2005

Workshop Co-chair, "Infrastructure and Applications for the Mobile Internet," *IEEE Int. Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises (WETICE)*, Cambridge, MA, June 2001

Session Chair or Session Organizer

Session Chair, "Energy Management Strategies," *IEEE Int. Symp. on Personal, Indoor, & Mobile Radio Commun. (PIMRC)*, (Bologna, Italy), Sept. 10, 2018.

Session Organizer and Chair, "5G Cellular Networks," *Asilomar Conference on Signals, Systems, and Computers*, (Pacific Grove, CA), Nov. 2015.

Session Chair, "Cooperative Communications," *IEEE Global Communications Conference (GLOBECOM)*, Austin, TX, Dec. 11, 2014.

Session Chair, "Cooperative Communications (session 1)," *IEEE Military Communications Conference (MILCOM),* (San Diego, CA), Nov. 18, 2013.

Session Chair, "Relay Channels II (session CT-11)," *IEEE International Conference on Communications (ICC*), (Budapest, Hungary), June 12, 2013.

Session Chair, "Cooperative Networks (session WSP-20)," *IEEE Military Communications Conference (MILCOM),* (San Jose, CA), Nov. 3, 2010.

Session Chair and Organizer, "Interference and Fading I (session U116)," *IEEE Military Communications Conference (MILCOM),* (Boston, MA), Oct. 20, 2009.

Session Chair, "CDMA (session WCS-19)," *IEEE International Conference on Communications (ICC*), (Dresden, Germany), June 16, 2009.

Session Chair, "Topics in Networking (session FA2)," *Conf. on Info. Sci. and Sys. (CISS)*, (Baltimore, MD), Mar. 2007.

Session Chair, "Modulation and Coding (session 4C)," *IEEE Vehicular Tech. Conf. (VTC)*, (Baltimore, MD), Oct. 2, 2007.

Session Chair, "Space-time Communication (session MCS-10)", *IEEE Military Communications Symposium (MILCOM*), (Orlando, FL), Oct. 31 2007.

Session Organizer, "Coding and Modulation for Noncoherent Channels," *IEEE Military Communications Symposium (MILCOM*), (Atlantic City, NJ), Nov. 2005.

Session Chair, "Phy 22: Space Time Codes I," *IEEE Wireless Communications & Networking Conference (WCNC) 2005,* (New Orleans, LA), Mar. 2005.

Session Chair, "Phy 23: Space Time Codes II," *IEEE Wireless Communications & Networking Conference (WCNC) 2005,* (New Orleans, LA), Mar. 2005.

Session Organizer, "Advanced Coding Techniques," *IEEE Military Communications Symposium (MILCOM*), (Monterey, CA), Nov. 2004.

Session Chair and Organizer, "FEC," *Asilomar Conference on Signals, Systems, and Computers*, (Pacific Grove, CA), Nov. 2004.

Session Chair: "Performance Analysis 8," *IEEE Vehicular Tech. Conf. (VTC)*, (Vancouver, BC), Sept. 2002.

Session Chair and Organizer: "High Data Rate Modulation and Coding Techniques," *IEEE Midwest Symposium on Circuits and Systems (MWSCAS)*, (Tulsa, OK), Aug. 2002.

Reviewer/Panelist: Funding Agencies

National Research Foundation, *Panelist and Reviewer for Enhanced Access to the Radio Spectrum (EARS) Program (2016), BigData Program (2015), CyberSEES Program (2014), Communications Research Program* (2002 and 2005), *Integrative, Hybrid and Complex Systems (IHCS) Program* (2007), *Communications and Information Foundations (CIF) Program* (2010 and 2012), *Accelerating Innovation Research (AIR) Program* (2011)*, Industry & University Cooperative Research Program (I/UCRC) Program* (2012, 2016, and 2018), *Spectrum Energy Efficiency, and Security (SpecEES) Program (2017),* and *CISE Community Research Infrastructure (CCRI)* (2021)

Air Force Office of Scientific Research, *Proposal reviewer for Dynamics & Controls Program, 2007*

Army Research Office, *Proposal reviewer for Wireless Communications and Networks program*, 2004, 2005, 2008, 2011, 2013, 2014, and 2017

Tennessee EPSCoR State Committee, *Reviewed Pre-Proposal for DoD EPSCoR Competition*, 2004

Louisiana Board of Regents, *Reviewed proposal for Pilot Funding for New Research Program*, 2016

Reviewer: Publications

Journal Reviewer (IEEE Journals): *IEEE Trans. on Aerospace and Electronic Systems, IEEE Communications Letters, IEEE Journal on Selected Areas of Communications, IEEE Signal Processing Letters, IEEE Trans. on Broadcasting, IEEE Trans. on Circuits and Systems, IEEE Trans. on Communications, IEEE Trans. on Education, IEEE Trans. on Information Theory, IEEE Trans. on Networking, IEEE Trans. on Mobile Computing, IEEE Trans. on Signal Processing, IEEE Trans. on Vehicular Tech., IEEE Trans. on Wireless Communications, IEEE Vehicular Technology Magazine, IEEE Wireless Communications Magazine*

Journal Reviewer (non-IEEE): *ACM Mobile Communications Review, Arabian Journal of Science and Engineering, Applied Mathematics E-Notes, EURASIP Journal on Applied Signal Processing, IASTED International Journal of Computers and Applications (IASTED), IEE Electronics Letters, IEE Communications, Wireless Communications & Mobile Computing (Wiley)*

Conference Reviewer: *IEEE Global Communications Conference (GLOBECOM), IEEE Int. Conf. on Communications (ICC), IEEE Int. Symp. on Information Theory (ISIT), IEEE Int. Symp. on Information Theory and its Applications (ISITA), IEEE Int. Symp. on Personal, Indoor and Mobile Radio Communications (PIMRC), IEEE Int. Symp. on Spread Spectrum Techniques and Applications (ISSSTA), IEEE Int. Symp. on Wireless Communication Systems (ISWCS), IEEE Int. Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP), IEEE Int. Workshop on Signal Processing Advances in Wireless Communications (SPAWC), IEEE Military Communications Conf. (MILCOM), IEEE Vehicular Tech. Conf. (VTC), IEEE Wireless Commun. & Networking Conf. (WCNC), Int. Conf. on Commun. Systems (ICCS), Int. Symp. on Turbo Codes & Iterative Processing, Int. Symp. on Modeling & Optimization in Mobile, Ad Hoc, and Wireless Network.*

Book and Book Proposal Reviewer: *Cambridge University Press, Springer, Wiley & Sons,* and *Kluwer*

INSTITUTIONAL SERVICE

Service to the University

Member, WVU Board of Governors – 2017-2019

Member, WVU Faculty Senate – 2006-2009; 2012-2019; 2022-2025
Secretary – 2018-2019
Chair – 2017-2018
Chair-elect – 2016-2017

Member, WVU Faculty Senate Executive Committee – 2015-2019
Chair – 2017-2018

Member, Faculty Senate Curriculum Committee – 2012-2017
Chair – 2015-2017
Chair-elect – 2014-2015

Member, Faculty Senate Student Recruitment and Retention Committee– 2023-2024

Member, Faculty Senate Service Committee – 2022-2024

Member, Faculty Senate Committee on Committees – 2016-2019

Member, Faculty Senate Faculty Welfare Committee – 2016-2018

Member, Faculty Senate General Education Committee – 2016-2017

Member, Presidential Search Committee – 2014

Member, Faculty Senate Library Committee – 2005-2008
Chair – 2007-2008

Member, WVU Graduate Mentoring Awards Committee, 2022

Member, WVU Educational Responsibility Roundtable – 2012-2014
Roundtable charged with developing a plan for meeting Goal 1 of WVU's Strategic Plan: "Engage undergraduate, graduate, and professional students in a challenging academic environment" and resulting in the development of the General Education Foundations (GEF)

Member, Heebink Award Selection Committee – 2014-2016
Award for distinguished service to the state of West Virginia

Member, Committee to Conduct 5-year Review of the Dean of Libraries – 2008-2009

Member, Wireless Task Force – 2001-2002
Charged to study the impact and implementation of a campus-wide wireless network

Associate Member, Mountain Honorary – 2004-present

Faculty Co-Advisor, WVU Amateur Radio Club – 1999-present

Service to the College

Member, Statler College Research Council – 2021-2023

Member, Statler Promotion and Tenure Committee – 2015-2019 and 2021-2024
Chair – 2017-2018 and 2022-2023

Member, Undergraduate Academic Affairs Committee, Statler College – 2010-2019
Chair – 2011-2014

Member, ABET Leadership Team, Statler College of Eng. & Mineral Res. – 2012-2015; 2018-2021
Committee charged with preparing for 2015 and 2021 ABET visits.

Member, Freshman Engineering Faculty Promotion Committee – 2013

Member, Outstanding Advisor Selection Committee, College of Eng. & Mineral Res. – 2010 and 2012

Member, Library Committee, College of Engineering and Mineral Resources – 2004-2008
Chair – 2006-2007

Member, Teaching Award Committee, College of Engineering and Mineral Resources – 2008 and 2022

Service to the Department

Faculty Advisor, WVU chapter of Eta Kappa Nu (HKN), the EE honor society – 2002-2017

Member, CSEE Promotion and Tenure Committee – 2000-2002, 2005-2007, 2010-2012, and 2013-2015
Chair – 2014-2015

Member, CSEE Faculty Search Committee – 2001-2002, 2002-2003, and 2014-2015
Chair – 2014-2015

Member, EE Curriculum Committee – 1999-2023
Chair – 2010-2019

Member, CSEE Graduate Affairs Committee – 2010-2015

Chair, EE Graduate Curriculum Committee – 2007-2010

Member, CSEE Computer Systems Committee – 2004-2015
Chair – 2004-2006

Chair, Lane Fellowship Committee – 2000-2003

STUDENTS ADVISED

Completed Ph.D. Students (Doctoral Committee Chair)

1. **Shi Cheng**, *Coded Continuous-phase FSK: Information Theoretic Limits and Receiver Design,* Nov. 12, 2007.
2. **Mohammad Fanaei**, *Distributed Detection and Estimation in Wireless Sensor Networks*, July 22, 2016.
3. ***Terry Ferrett**, Receiver Design for Physical-Layer Network Coding in the Two-Way Relay Channel,* July 21, 2017.
4. **Enass Hriba,** *Analysis of Millimeter-Wave Networks: Blockage, Antenna Directivity, Macrodiversity, and Interference,* Oct. 14, 2021.
5. **Rohit Iyer Seshadri,** *Capacity-Based Parameter Optimization of Bandwidth Constrained CPM*, Aug. 31, 2007.
6. **Jian Sun**, *Synchronization for Capacity-Approaching Coded Systems*, Oct. 25, 2004.
7. **Salvatore Talarico**, *Role of Interference and Computational Complexity in Modern Wireless Networks: Analysis, Optimization and Design*, Sept. 10, 2015.
8. ***Veeru Talreja,** Integration of Deep Hashing and Channel Coding for Biometric Security and Biometric Retrieval, July 16, 2021.*
9. **Xingyu Xiang**, *Optimization of a Coded-Modulation System with Shaped Constellation*, Apr. 12, 2013.
10. **Bin Zhao**, *Multiterminal Relay Networks: Performance Bounds, Protocol Design, and Channel Coding Strategies*, Apr. 19, 2004.

Completed M.S. Students (Thesis or Problem Report – Committee Chair)

1. **Syed Amaar Ahmad,** *A Robust Hybrid-ARQ Protocol for Relay Networks*, Apr. 4, 2007.
2. **Naga Gopi Krishna Alapati,** *Green Cellular Networks: When Should a Base Station Be Turned Off?,* Dec. 2, 2015.
3. **Raneem Alghawi**, *Network Slicing in 5G: Admission, Scheduling, and Security*, July 20, 2022.
4. **Shaikha Alkandari**, *Air-Assisted Communications Using Line-of-Sight Links*, July 20, 2022.
5. **Deepthi Ancha**, *Implementation of Tail-Biting Convolutional Codes*, Nov. 7, 2008.
6. **Rahul Annareddy,** *Incentive Analysis of Blockchain Technology*, Nov. 18, 2022.
7. **Geetanjalee Athavale,** *Enabling Wireless Data Applications on Mobile Devices*, Oct. 28, 2002.
8. **Dirk Baker**, *Space-Time Block Coding with Imperfect Channel Estimates*, Apr. 10, 2001.
9. **Sri Lakshmi Balineni**, *Stochastic Geometry Analysis of a Class of Cooperative Relaying Protocols*, Apr. 18, 2017.
10. **Anupama Battula**, *Implementation of Extrinsic Information Transfer Charts*, Oct. 24, 2008.
11. **Aruna Sri Bommagani,** *Distributed Monte Carlo Simulation,* Nov. 3, 2011.
12. **David Buckingham**, *Information Outage Analysis of Finite-Length Codes*, Apr. 7, 2008.
13. **Anthony Carrola**, *Synthesizing Realistic Substitute Data for a Law Enforcement Database Using a Python Library*, April 15, 2022.
14. **Naveen Chandran**, *Hybrid ARQ with Parallel and Serial Concatenated Convolutional Codes for Next Generation Wireless Communications*, June 19, 2001.

15. **Sheetu Dasari**, *Implementation & Analysis of a Hybrid-ARQ Based Cooperative Diversity Protocol Using Reed-Solomon Codes*, Nov. 14, 2005.
16. **John Deal**, *Fractal Analysis of Fingerprints,* Nov. 12, 2007.
17. **Raghu Doppalapudi**, *Optimization of Bit Interleaved Coded Modulation Using Genetic Algorithms*, Oct. 20, 2008.
18. **Terry Ferrett**, *Data Recovery from Magnetic Media Using Magnetic Force Microscopy*, Apr. 25, 2008.
19. **Ramesh Gali,** *A Tool for the Statistical Analysis and Post-Processing of Distributed Sensor Network Data*, Mar. 31, 2003.
20. **Anusha Gangadi**, *Object-Oriented Implementation of LTE Turbo Codes*, Nov. 5, 2010.
21. **Timothy Gerkin,** *Implementation of LDPC Codes Using the IEEE 802.16e Standard*, Apr. 9, 2008.
22. **Tarik Ghanim**, *Analysis of Hybrid-ARQ Based Relaying Protocols under Modulation Constraints*, Apr. 26, 2006.
23. **Ruthika Gunda,** *Simulation of the Physical Link Layer of GSM,* July 8, 2004.
24. **Sai Deepthi Katragunta,** *Simulation of the Performance of IEEE 802.16-2004 Fixed Broadband Wireless Access Technology,* Jan. 17, 2007.
25. **Raja Katuri**, *Efficient Simulation of Communication Systems on a Desktop Grid*, Aug. 25, 2006.
26. **Haranath Madineni,** *A Diagnostic Tool for Performance Assessment of Bluetooth Data Transmissions*, Dec. 4, 2003.
27. **Sushma Mamidipaka**, *Implementation of Block Turbo Codes from IEEE 802.16 Standard*, Oct. 27, 2008.
28. **Gopal Manchikanti**, *A Framework for Developing Wireless Applications*, May 1, 2001.
29. **Mamatha Mannava**, *Simulation of the Performance of IEEE 802.16-2004 Wireless MAN-OFDM PHY Layer*, Apr. 11, 2008.
30. **Sundara Ram Matta**, *Visualizing Outage Performance in Wireless Networks in the Presence of Rayleigh Fading,* Dec. 4, 2015.
31. **Brianna Maze**, *Analysis of Hamming and Bernard's Patent and the Bluetooth Standard,* Apr. 25, 2016.
32. **John Mazzie**, *Relay Communications Over Frequency-Selective Fading Channels*, Apr. 11, 2008.
33. **Lokesh Merupula,** *Simulation of IEEE 802.11a PHY Layer*, Sept. 9, 2004.
34. **Biju Naduvathuparambil**, *Telecommunications for a Deregulated Power Industry*, July 12, 2002.
35. **Chandana Nannapaneni**, *Constellation Shaping for Communication Channels with Quantized Outputs*, Nov. 11, 2010.
36. **Nisha Narasimhan,** *Data Synchronization for Bluetooth Networks*, Dec. 4, 2003.
37. **Senthil Ramamurthy,** *Multiple Quantum Filtered Localized Spectroscopy at 3T*, Apr. 14, 2004.
38. **Vasavi Rangammagari**, *Optical-Based ATR Algorithms for Applications in Swarmed UAVs*, Aug. 4, 2006.
39. **Guillaume Raux,** *Telecommunication of Stabilizing Signals in Power Systems*, Apr. 18, 2003.
40. **Sumit Sharma**, *Optimization of an iDEN Cellular Network*, Feb. 18, 2005.
41. **Yipeng Tang**, *DSP Implementation of Trellis Coded Modulation and Distributed Space Time Coding*, Jan. 25, 2001.
42. **Sujay Telang**, *Wireless Streaming Multimedia Applications,* Oct. 2, 2000.

43. **Srinivas Vemury**, *Comparison of Decoding Algorithms for LDPC Codes*, April 16, 2004.
44. **Kyle Whetzel**, *Complexity Aware C-RAN Scheduling for LDPC Codes over BEC,* Dec. 21, 2016.

External Dissertation Examiner

Served as an external examiner or committee member for the following Ph.D. students:

1. **Tiaza Thasthakeer,** University of Auckland (New Zealand), *Stochastic Geometry Approach on Modelling Finite Millimetre Wave Outdoor Cellular Networks*, July 19, 2021.
2. **Nadhiya Mohd Kamal**, University of Auckland (New Zealand), *Throughput Performance of Wireless Networks,* June 12, 2018.
3. **Kiran Venugopal**, University of Texas (Austin, TX), *Millimeter Wave Wearable Communication Networks*, May 11, 2017.
4. **Jing Guo**, Australian National University (Australia), *Stochastic Geometry for Modeling, Analysis and Design of Future Wireless Networks*, May 4, 2016.
5. **Saeed Khosravirad**, McGill University (Canada), *Performance Limits for Incremental Redundancy Hybrid Automatic Repeat Request (HARQ) over Fading Channel*, Mar. 23, 2015.
6. **Yicheng Lin,** University of Toronto (Canada), *Performance Analysis and Optimization of Wireless Heterogeneous Networks*, Nov. 12, 2014.
7. **L. Pujji**, University of Auckland (New Zealand), *Optimisation of Base Station Placement for Indoor Wireless Communications*, Dec. 2011.
8. **J.P.K. Chu**, University of Toronto (Canada), *Design and Analysis of Coded Cooperation in Relay Networks*, Oct. 30, 2009.
9. **J.K.L. Wong**, University of Auckland (New Zealand), *Automatic Planning and Optimization of In-Building CDMA Systems*, Oct. 2006.
10. **M. Flanagan**, University College, Dublin (Ireland), *Combined Equalization and Coding for Dispersive Communication Channels*, Apr. 4, 2005.

Undergraduate Students

Faculty advisor for 15 completed senior design projects.

Supervised and supported undergrad researchers during summers of 2002, 2003, 2006, 2010, and 2013, including through the WVU Summer Undergraduate Research Experience (SURE) program.

Until 2018, was academic advisor to approximately 25 EE, CPE, and dual (CPE/EE and CPE/BIOM) majors per semester, including honors students (after that, advising became a College-level function).

INSTRUCTION

Course Development

Developed the following courses (Submitted new course proposals and shepherded through approval by the WVU Faculty Senate – permanent course numbers indicated):
Wireless Networking (CPE 462)
Wireless Communication Systems (EE 562)
Coding Theory (EE 567)

Course Materials and Workbooks

- M.C. Valenti, The Wireless Networking Workbook, 2013; revised 2018.
  A 33-page companion for CPE 462 (Wireless Networking) initially used during the Fall 2013 semester.
- M.C. Valenti, The Coding Theory Workbook, 2012; revised 2016.
  A 56-page companion for EE 567 (Coding Theory) initially used during the Spring 2012 semester.

- M.C. Valenti, The DSP Workbook, 2011.
  A 113-page companion text for EE 463 used by Prof. Brian Woerner during the Spring 2011 semester and Prof. Reynolds during the Spring 2012 and 2013 semesters. An "instructor edition" was also created, which contains worked out exercises (which are blank in the student edition).
- M.C. Valenti, Solutions Manual for the DSP Workbook, 2011.
  A 63-page solutions manual for the end-of-chapter exercises.
- M.C. Valenti, The Signals and Systems Workbook, 2002, revised 2005.
  A 75-page companion text for EE 329 developed during the Spring 2002 semester and used since then by other faculty at WVU and by Prof. Anderson at the United States Naval Academy
- M.C. Valenti, Solutions Manual for the Signals and Systems Workbook, 2002, revised 2005.
  A 75-page solutions manual for the end-of-chapter exercises.

Independent Study

Led undergraduate and graduate students in the following asynchronous learning experiences:
DSP Implementation of Communication Systems
Wireless Application Protocol
Wireless Networking
Wireless Communication Systems

Undergraduate Courses Taught

Course Number	Title	Semester	Number of Students
BIOM 426	Biometric Systems	Fall 2021	11 (team taught – 10%)
		Fall 2020	11 (team taught – 10%)
CSEE 380	Engineering Professionalism Seminar	Spring 2023	80
		Fall 2022	74
		Spring 2022	121
		Fall 2021	58
		Spring 2021	83
EE 329	Signals & Systems II	Spring 2005	43
		Spring 2004	63
		Spring 2002	38
EE 461	Introduction to Communication Systems	Fall 2002	44
		Fall 2001	36
		Fall 2000	14
		Fall 1999	16
EE 463	Digital Signal Processing Fundamentals	Spring 2010	25
		Spring 2009	34
		Spring 2008	35
		Spring 2007	44
		Spring 2006	36
CPE 462	Wireless Networking	Fall 2022	15
		Fall 2021	11
		Fall 2020	12
		Fall 2019	14
		Fall 2018	14
		Fall 2017	6
		Fall 2016	13
		Fall 2015	10
		Fall 2013	24
		Fall 2012	30
		Fall 2010	15
		Fall 2008	22
		Fall 2005	30
		Fall 2004	43
		Fall 2003	34
		Spring 2003	4

Graduate Courses Taught

Course Number	Title	Semester	Number of Students
EE 513	Stochastic Systems Theory	Fall 2014	33
		Fall 2011	27
		Fall 2009	35
		Fall 2006	63
		Fall 2004	51
		Fall 2002	39
		Fall 2001	27
EE 561	Communication Theory	Spring 2022	6
		Spring 2019	4
		Spring 2017	11
		Spring 2015	24
		Spring 2013	18
		Spring 2011	25
		Spring 2009	27
		Spring 2007	38
		Spring 2003	27
		Spring 2001	14
		Spring 2000	9
EE 562	Wireless Communication Systems	Fall 2007	8
		Fall 2000	14
EE 567	Coding Theory	Spring 2023	6
		Spring 2018	4
		Spring 2016	19
		Spring 2014	28
		Spring 2012	16
		Spring 2010	29
		Spring 2008	24
		Spring 2006	19
		Spring 2004	27
CS/EE/CPE 796	Graduate Seminar (1 credit hour)	Fall 2016	44
		Spring 2016	37
		Fall 2015	65
		Spring 2015	43
		Fall 2014	59
		Spring 2014	56
		Fall 2013	60
		Spring 2013	58
		Fall 2012	73
		Spring 2012	51
		Fall 2011	65
		Spring 2011	45
		Fall 2010	46
		Spring 2010	39
		Fall 2009	64
		Spring 2009	48
		Fall 2008	57
		Spring 2008	38
		Fall 2007	40
		Spring 2007	66
		Fall 2006	67
		Spring 2006	52
		Fall 2005	50
		Spring 2004	86
		Fall 2003	50
		Spring 2003	80

APPENDIX B

Materials Reviewed

Petition for IPR filed in IPR2023-00763.

All exhibits filed by Petitioner in IPR2023-00763.

Ex.	Description
GM-1001	U.S. Patent No. 10,447,450 ("'450 Patent")
GM-1002	File History for U.S. Patent No. 10,447,450 ("'450 FH")
GM-1003	Declaration of Dr. Todor Cooklev ("Cooklev Decl.")
GM-1004	*Curriculum Vitae* of Dr. Todor Cooklev
GM-1005	U.S. Patent Application Publication No. 2006/0039274 A1 ("Park")
GM-1006	IEEE, *IEEE Standard for Local and Metropolitan Area Networks, Part 16: Air Interface for Fixed Broadband Wireless Access Systems*, IEEE STANDARDS 802.16 (Oct. 2004) ("802.16-2004")
GM-1007	Declaration of David Ringle (Mar. 1, 2023) ("Ringle Decl. (802.16-2004)")
GM-1008	Certified Translation of Korean Patent Application No. 65099/2004 ("Park Translation")
GM-1009	Opinion and Order Granting in Part and Denying in Part Defendants' Motion to Reduce Number of Asserted Claims (ECF No. 96), *In re Neo Wireless, LLC Patent Litig.*, No. 2:22-md-03034 (E.D. Mich. Nov. 18, 2022), ECF No. 99 ("*In re Neo* Reduction of Asserted Claims Op. (ECF 99)")
GM-1010	Opinion and Order on Further Prior Art and Claim Narrowing, *In re Neo Wireless, LLC Patent Litig.*, No. 2:22-md-03034 (E.D. Mich. Dec. 9, 2022), ECF No. 102 ("*In re Neo* Claim Narrowing Op. (ECF 102)")
GM-1011	Joint Claim Construction Statement, *In re Neo Wireless, LLC Patent Litig.*, No. 2:22-md-03034 (E.D. Mich. Jan. 18, 2023), ECF No. 114 ("Joint Claim Construction Statement")

GM-1012	United States District Courts – National Judicial Caseload Profile (Sept. 30, 2017–Sept. 30, 2022)
GM-1013	Transfer Order, *In re Neo Wireless, LLC Patent Litig.* MDL No. 3034 (J.P.M.L. June 14, 2022), ECF No. 50 ("MDL Transfer Order")
GM-1014	IEEE, *IEEE Standard for Local and Metropolitan Area Networks, Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems – Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1*, IEEE STANDARDS 802.16e (Dec. 2005) ("802.16e-2005")
GM-1015	Declaration of David Ringle (Mar. 16, 2023) ("Ringle Decl. (802.16e-2005)")
GM-1016	IEEE, *IEEE 802.16 Published Standards and Drafts*, https://www.ieee802.org/16/published.html (last visited Mar. 14, 2023, 2:43 PM)
GM-1017	IEEE, *IEEE Standard 802.16-2004: Publication History (Updated 2004-04-04)*, https://www.ieee802.org/16/pubs/80216-2004.html (last visited Mar. 15, 2023, 8:34 AM)
GM-1018	Patent Owner's Preliminary Response, *Volkswagen Grp. of Am., Inc. v. Neo Wireless, LLC*, IPR2022-01567 (Patent 10,447,450), Paper 7 (P.T.A.B. Feb. 8, 2023) ("IPR2022-01567, Paper 7 (POPR)")
GM-1019	Plaintiff Neo Wireless, LLC's Opening Claim Construction Brief, *In re Neo Wireless, LLC Patent Litig.*, No. 2:22-md-03034 (E.D. Mich. Feb. 16, 2023), ECF No. 127 ("Neo Opening Claim Construction Brief")
GM-1020	Declaration of William Alberth in Support of Neo Wireless's Opening Claim Construction Brief, *In re Neo Wireless, LLC Patent Litig.*, No. 2:22-md-03034 (E.D. Mich. Feb. 16, 2023), ECF No. 127-3 ("*In re Neo* (ECF 127-3)")

GM-1021	Patent Owner's Preliminary Response, *Dell, Inc. v. Neo Wireless, LLC*, IPR2021-01486 (Patent 10,447,450), Paper 7 (P.T.A.B. Dec. 20, 2021) ("IPR2022-01486, Paper 7 (POPR)")
GM-1022	Roger Marks, Presentation: *IEEE 802.16 WirelessMAN® Standard: Myths and Facts*, 2006 Wireless Communications Conference, Wash., D.C. (Doc. No. IEEE C802.16-06/007r1) (June 29, 2006) ("Marks")
GM-1023	Soon Young Yoon, Presentation: *Introduction to WiBro Technology*, Telecom R&D Center, Samsung Electronics Co., Ltd. (Sept. 10, 2004) ("Yoon")
GM-1024	Kim Tong-hyung, *Seoul Chooses Standard for Wireless Broadband Access*, THE KOREA HERALD (July 29, 2004)
GM-1025	IEEE, *IEEE Standards Wireless Networks Series: WirelessMan®, Inside the IEEE 802.16™ Standard for Wireless Metropolitan Networks* (2006) ("Eklund")
GM-1026	*Wireless Internet Operators to Be Picked*, KOREA TIMES (July 30, 2004)
GM-1027	Sorour Falahati et al., *Adaptive Modulation Systems for Predicted Wireless Channels*, 52 IEEE TRANSACTIONS COMMC'NS 307 (Feb. 2004) ("Falahati")
GM-1028	Exhibit C to Defendants' Joint Motion to Reduce the Number of Asserted Claims, Plaintiff's Infringement Contentions to Ford, *In re Neo Wireless, LLC Patent Litig.*, No. 2:22-md-03034 (E.D. Mich. Oct. 21, 2022), ECF No. 96-4 (excerpts)