Expert/Consultant Curriculum Vitae

Professor Zhi Ding

Ph.D. and Fellow of IEEE

Expertise

- Wireless Communication Systems
- Cellular Wireless (2G, 3G, 4G, 5G)
- Communication Network Protocols
- Multi-Antenna Technologies
- WLAN (WiFi, Bluetooth)
- xDSL Internet Services
- DOCSIS Modems
- Optical Networks

Professional Summary

- Professor of major US universities for over 30 years.
- *Consulted for multiple major technology companies*
- Worked as expert on multiple patent
- infringement cases.
- Conducted research works on Communications and Signal Processing for over 30 years.
- Supervised over 30 PhD students.
- Author of more than 200 journal papers and 2 books on communication technologies.

Dr. Zhi Ding has been a professor of electrical engineering at major US universities for 30 years. Since 1995, he has consulted for both engineering companies such as Nortel, Analog Devices, Intel, and worked as expert for major law firms from US, UK, China, and Canada including Kirkland & Ellis, WilmerHale, Quinn Emanuel, Fish & Richardson, Sheppard Mullin, Sidley Austin, Mayer Brown, Venable, and Finnegan, on multiple technical and patent infringement cases. He has been conducting research works on wireless communications and signal processing since 1984. He has supervised over 30 PhD students. He is an author of 200 journal papers and 2 technical books on communication technologies. He has taught classes that cover the fundamentals of signal detection, communications, and systems.

Dr. Ding currently holds the position of Distinguished Professor at the University of California, where he was appointed as the Child Family Professor of Engineering and Entrepreneurship in 2009-2014. He served as the steering committee chair of the IEEE Transactions on Wireless Communications. He was elevated to Fellow of IEEE in 2002 by the IEEE Signal Processing Society. He also served as the Technical Program Chair of the IEEE Globecom 2006 (the flagship conference of the IEEE Communications Society), Dr. Ding is an eminent scholar and expert of wireless technologies AND signal processing.

Intellectual Property Dispute Consulting:

Past Client	Past Engagement
Kirkland & Ellis LLP	2007-2015 (more than 10 engagements)
Wilmer Cutler Pickering Hale, and Dorr, LLP	2009-2020 (multiple engagements)
Fish and Richardson, LLP	2014-15, 2019-21 (multiple engagements including Samsung, Dish, Huawei, Quectel, LG, etc.)
Kaye Scholer LLP	2008-2009
Bridges and Mavrakakis, LLP	2011-2014 (multiple engagements including Apple)
Sterne, Kessler, Goldstein & Fox, LLC	2013-19 (multiple engagtements including Volkswagen)
Bramson, Plutzik, Mahler & Birkhaeuser	2013
Gibson, Dunn & Crutcher, LLP	2014
Quinn Emanuel	2014
Norton Rose Fulbright US LLP	2014
Sheppard, Mullin, Richter, and Hampton, LLP	2015-2021 (multiple engagements including Toyota, HTC, TCL, Continental)
Rothwell, Figg, Ernest, and Manbeck, P.C.	2016
Mayer Brown LLP	2015-17
Sidley Austin, LLP	2015-19
Irell & Manella, LLP	2016
Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P	2017
Venable, LLP	2017-18
Pillsbury LLP	2017-19
Alston, Bird, LLP	2018

Gibson, Dunn & Crutcher, LLP	*2018-19*
Jincheng Tongda & Neal (China)	2019-21
Desmaris, LLP	2019
Allen & Overy, LLP, UK	2019-20
Gowling WLG, Canada	2019
Erise IP	2019-20
Questel (China)	2020
Munger Tolles & Olson, LLP (Tesla)	2021
Saikrishna & Associates (India)	2021

Expert Testifying and Depositions (7 Trials and 10 Depositions)

Clients	**Deposition/Testifying Experience**
Bramson, Plutzik, Mahler & Birkhaeuser LLP	2013: ***Deposition*** on Case No. CV 12-05240 PJH Nad Karim v. Hewlett Packard, Co. UNITED STATES NORTHERN DISTRICT COURT OF CALIFORNIA. Settlement ordered Jan. 18, 2017.
Fish and Richardson (Representing Marvell)	2015 (Feb): ***Deposition*** for Marvell. US PTAB *Inter Partes* Review IPR2014-00548 Marvell Semiconductor, Inc. v. Intellectual Ventures I LLC
	2015 (August): ***Depositios*** for Marvell. US PTAB *Inter Partes* Review IPR2014-00548 Marvell Semiconductor, Inc. v. Intellectual Ventures I LLC
Norton, Rose, Fulbright, US, LLP	2016 (April): ***Deposition*** for Qualcomm. US PTAB *Inter Partes* Review IPR2015-10577, IPR2015-10580, IPR2015-10581, IPR2015-10581. Qualcomm Inc. v Bandspeed Inc.
Sheppard, Mullin, Richter, and Hampton, LLP	2016 (May): ***Deposition*** for TCL in *TCL Communication Technology Holdings, LTD., et al. v. Ericsson, et al.,* Case No. 8:14-cv-341 (C. D. CA).
	2017 (Feb): **Testified at C.D. California** bench trial.

Sidley Austin, LLP	2016 (December): **Testified at** trial involving Huawei Technologies, Co. Ltd v. Samsung Regarding FRAND licensing disputes in Shenzhen Court, P.R. China.
	2018 (June): ***Deposition*** for N.D. CA on Huawei Technologies, Co. Ltd v. Samsung.
	2018 (December): **Testified at** trial involving Huawei Technologies, Co. Ltd v. Samsung regarding FRAND licensing disputes in Beijing Court of Intellectual Properties, P.R. China.
Mayer Brown LLP	2017 (January): **Testified during tribunal proceeding** for LG Electronics, Inc. in standard essential patent (SEP) licensing dispute of Nokia Technologies, Ltd. *v*. LG Electronics, Inc. During arbitration hearing in Paris, France.
Venable LLP	2017 (October): ***Deposition*** as expert witness for Verizon Services Corp. in Case No. 2:16-CV-588-WCB (E. D. TX) on US Patent disputes.
Pillsbury LLP	2018 (Feb): ***Deposition*** (Case No. 5:16-cv-00179-RWS)
	2018 (June): **Testified at E. D. Texas** (Texarkana) jury trial (Case No. 5:16-cv-00179-RWS).
Allen & Overy LLP UK	2019 (April) **Testified at** trial involving Huawei Technologies, Co. Ltd v. Conversant regarding FRAND licensing disputes in Nanjing Intermediate Court, P.R. China.
Sidley Austin LLP, US	2019 (Sept.) **Testified at** trial involving Huawei Technologies, Co. Ltd v. PanOptics, regarding FRAND licensing disputes in Shenzhen Intermediate Court, P.R. China.
Sheppard, Mullin, Richter, and Hampton, LLP	2019 (Dec. 3rd): ***Deposition*** for HTC and Apple in *HTC Corporation, HTC America, Inc., and Apple Inc. v. INVT SPE LLC,* Case Nos. IPR2018-01555 and IPR2018-01581.
Sterne, Kessler, Goldstein & Fox, LLC	2020 (Feb.): ***Deposition*** for Volkswagen Group of America, In. v. Carucel Investments, L.P. Case Nos. IPR2019-01573 and IPR2019-01101.
Jincheng Tongda & Neal, LLP	2021 (June) **Testified at** trial involving TCL. v. Ericsoon, regarding FRAND licensing disputes in Shenzhen Intermediate Court, P.R. China.
Orrick, Herrington, & Sutcliffe, LLP	2021 (October): ***Deposition*** for Canon, Inc, in Canon, v. WSOU Investments, LLC d/b/a/ Brazos Licensing, W.D. Texas, Case No. 6:20-cv-980.

Fish & Richardson, P.C.	2021 (November) ***Deposition*** for Quectel Wireless SOlutoins Co. Ltd in Quectel v. Koninklijke Philips N.V.
	2021 (December) ***Deposition*** for Quectel Wireless SOlutoins Co. Ltd in Quectel v. Koninklijke Philips N.V.

Recent IPR Declarations or Outcomes	
	IPR2014-00548 Expert Declaration to the Patent Trial and Appeal Board, with link to Final PTAB Decision. IPR2015-00314 Expert Declaration to the Patent Trial and Appeal Board with link to Final PTAB Decision IPR2015-00315 Expert Declaration and Supplemental Expert Declaration to the Patent Trial and Appeal Board with link to PTAB Trial Decision. IPR2015-00531 Expert Declaration to the Patent Trial and Appeal Board with link to PTAB Trial Decision. IPR2015-01580 Expert Declaration to the Patent Trial and Appeal Board with link to PTAB Trial Decision. IPR2015-01582 Expert Declaration to the Patent Trial and Appeal Board and link to PTAB Decision on Institution of IPR and Grant of Motion for Joinder with ITR2015-00531. IPR2016-00620 Expert Declaration to the Patent Trial and Appeal Board with link to PTAB decision to institute and link to Final PTAB decision finding all but 2 dependent claims invalid . IPR2016-00623 Expert Declaration to the Patent Trial and Appeal Board with link to PTAB decision. IPR2018-01555 Expert Declaration to the Patent Trial and Appeal Board. Instituted (2019-03-07) IPR2018-01581 Expert Declaration to the Patent Trial and Appeal Board. Instituted (2019-0401) IPR2019-01573 Expert Declaration to the Patent Trial and Appeal Board. Instituted (2020-01-22)

	IPR2019-01101 Expert Declaration to the Patent Trial and Appeal Board. Instituted (2019-12-02)

Employment History

From: 2000 **University of California at Davis**
To: Present Davis, CA
Position: *Professor* (2000-2020) and *Distinguished Professor* (2020-), *Department of Electrical and Computer Engineering*

From: 01/1999 **University of Iowa**
To: 09/2000 Iowa City, IA
Position: *Assoc. Professor, Department of Electrical and Computer Engineering*

From: 01/1997 **Hong Kong University of Science and Technology**
To: 12/1997 Hong Kong
Position: *Visiting Associate Professor, Department of Electrical and Electronic Engineering*

From: 09/1995 **Auburn University**
To: 12/1998 Auburn, AL
Position: *09/1995-12/1998: Associate Professor, Department of Electrical and Computer Engineering*
09/1990-08/1995: Assistant Professor, Department of Electrical and Computer Engineering

From: 08/1993 **Australian National University**
To: 09/1993 Canberra, Australia
Position: *Visiting Research Fellow, Faculty of Information Technology and Engineering*

From: 06/1993 **US Air Force Wright Laboratory**
To: 08/1993 Eglin AFB, Florida
Position: *Faculty Research Associate, Armament Directorate*

From: 06/1992 **NASA Lewis Research Center**
To: 08/1992 Cleveland, OH
Position: *Visiting Faculty Research Fellow*

From:	08/1987	**Cornell University**
To:	08/1990	Ithaca, NY
	Position:	*Research Assistant*

From:	09/1984	**University of Toroto**
To:	08/1987	Toronto, Ontario, Canada
	Position:	*Research Assistant*

Technical Consulting

Consulted for multiple major technology companies: Analog Devices, Nortel, Intel, Futurewei, NEC.

Patents (Granted and/or Licensed)

Patent Number	Date Issued	Title
US 6,396,885	Mar.28, 2002	Co-channel interference reduction in wireless communications systems (Nortel)
US 6,463,099	Oct.8, 2002	Blind channel equalizers and methods of blind channel equalization (Licensed)
US 7,379,513	Mar. 20, 2008	Channel estimation in CDMA communications systems using both lower power pilot channel and higher power date channel
US 10,623,230	Apr. 14, 2020	Trans-layer robust header-compression technique

Education

1990	Cornell University, Ithaca, NY	Ph.D., Electrical Engineering
1987	University of Toronto, Toronto, Canada	MS, Electrical Engineering
1982	Nanjing Institute of Technology, Nanjing, China	BS, Wireless Engineering

Publications

Books & Book Chapters

[1] B. P. Lathi and Z. Ding, *Modern Digital and Analog Communication Systems,* 5th edition, Oxford University Press, 2018.

[2] Zhi Ding and Ye Li, *Blind Equalization and Identification*, Marcel Dekker, New York, 2001.

[3] Z. Ding, "Chapter 7: Linear Predictive Algorithms for Blind Multichannel Identification," in *Signal Processing Advances in Wireless and Mobile Communications*, Vol. I: Trends in Channel Estimation and Equalization, G. B. Giannakis, Y. Hua, P. Stoica, and L. Tong (Editors), Prentice Hall, 2000.

[4] Z. Ding, "Blind Channel Identification and Equalization using Spectral Correlation Measurements: Frequency Domain Analysis," in *Cyclostationarity in Communications and Signal Processing*, William A. Gardner, Ed., pp.417-436, IEEE Press, 1993.

[5] Z. Ding, C. R. Johnson, Jr., and R. A. Kennedy, "Chapter 3: Global Convergence Issues with Linear Blind Adaptive Equalizers," in *Blind Deconvolution*, Simon Haykin, Ed., pp.60-120, Prentice-Hall, 1994.

[6] Z. Ding, "Adaptive Filters for Blind Equalization," in *IEEE DSP Handbook*, Douglas B. Williams, Ed., pp.24.1-24.17, IEEE Press, 1998.

Journal Papers

[1] A. Jalali and Z. Ding, ``Joint Detection and Decoding of Polar Coded 5G Control Channels", *IEEE Transactions on Wireless Communications,* 19(3), pp. 2066-2078, Mar. 2020.

[2] Yang, Kai, Yuanming Shi, Wei Yu, and Zhi Ding, ``Energy-efficient processing and robust wireless cooperative transmission for edge inference," *IEEE Internet of Things Journal*, accepted, 2020. DOI: 10.1109/JIOT.2020.2979523

[3] J. Dong, Y. Shi, and Z. Ding, ``Blind Over-the-Air Computation and Data Fusion via Provable Wirtinger Flow", *IEEE Transactions on Signal Processing* vol. 68, pp. 1136-1151, 2020. DOI: 10.1109/TSP.2020.2970338.

[4] Y. Ma, Z. Quan, D. Li, S. Zhang, X. Li, Z. Feng, and Z. Ding, Optimal Linear Cooperation for Signal Classification via M-ary Hypothesis Testing in Cognitive Communication Networks, *IEEE Transactions on Wireless Communications,* 19(5), pp. 3144-3155, May 2020.

[5] S. Zhang, Z. Ding and S. Cui, ``Introducing Hypergraph Signal Processing: Theoretical Foundation and Practical Applications," *IEEE Internet of Things Journal,* , vol.7, no.1, pp. 639-660, Jan. 2020. doi: 10.1109/JIOT.2019.2950213

[6] Z. Jiang, X. Shen, H. Wang and Z. Ding, ``Joint PSK Data Detection and Channel Estimation under Frequency Selective Sparse Multipath Channels," in *IEEE Transactions on Communications*, doi: 10.1109/TCOMM.2020.2975172.

[7] R. Liu, Q. Chen, G. Yu, G. Y. Li and Z. Ding, ``Resource Management in LTE-U Systems: Past, Present, and Future," *IEEE Open Journal of Vehicular Technology,* vol. 1, pp. 1-17, 2020 DOI: 10.1109/OJVT.2019.2949020

[8] Li, Pei-Rong, Zhi Ding, and Kai-Ten Feng, ``Enhanced Receiver Based on FEC Code Constraints for Uplink NOMA With Imperfect CSI." *IEEE Transactions on Wireless Communications* vol. 18, no. 10, pp. 4790-4802, 2019.

[9] Z. Liu, L. Zhang, and Z. Ding, ``Exploiting Bi-Directional Channel Reciprocity in Deep Learning for Low Rate Massive MIMO CSI Feedback", *IEEE Wireless Communications Letters*, Feb. 2019. doi:10.1109/LWC.2019.2898662

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[12] S. Bi, J. Lyu, Z. Ding, and R. Zhang, R., ``Engineering Radio Maps for Wireless Resource Management," *IEEE Wireless Communications,* 26(2), pp.133-141, Feb. 2019. doi:10.1109/MWC.2019.1800146

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[23] Y. Wu, C. Xiao, Z. Ding, X. Gao, and S. Jin A Survey on MIMO Transmission With Finite Input Signals: Technical Challenges, Advances, and Future Trends," Proceedings of the IEEE, vol. 106, No. 10, 1779-1833, October, 2018.

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[26] Q. Ji, Z. Ding, N. Wang, M. Pan and G. Song, ``A Novel Waveform Optimization Scheme for Piezoelectric Sensors Wire-Free Charging in the Tightly Insulated Environment,"> IEEE Internet of Things Journal, vol. 5, no. 3, pp. 1936-1946, June 2018. doi: 10.1109/JIOT.2018.2817601

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[28] C. Jiang, W. Wu, and Z. Ding, ``LTE Multimedia Broadcast Multicast Service Provisioning Based on Robust Header Compression," *IEEE Transactions on Wireless Communications,* vol. 17, no. 2, pp. 1161-1172, Feb. 2018. doi: 10.1109/TWC.2017.2776906

[29] X. Ling, J. Wang, X. Liang, Z. Ding, C. Zhao, and X. Gao ``Biased Multi-LED Beamforming for Multicarrier Visible Light Communications," IEEE Journal on Selected Areas in Communications, vol. 36, no. 1, pp.106-120, Jan. 2018. doi: 10.1109/JSAC.2017.2774539

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[37] Hesham Elmaghraby and Zhi Ding, ``Scheduling and Power Allocation for Hybrid Access Cognitive Femtocells," *IEEE Transactions on Wireless Communications* vol.16, No.4, pp. 2520-2533, April 2017.

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[39] Dongrun Qin and Zhi Ding, ``Transport capacity analysis of wireless in-band full duplex ad hoc networks." *IEEE Transactions on Communications,* vol. 65, no. 3, pp.1303-18, March 2017. doi: 10.1109/TCOMM.2016.2640278

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[56] Kun Wang, Hong Shen, Wenhao Wu, and Zhi Ding, Joint Detection and Decoding in LDPC-Based Space-Time Coded MIMO-OFDM Systems via Linear Programming" IEEE Transactions on Signal Processing, 63. 3411-3424. 2015. doi: 10.1109/TSP.2015.2422681

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Professional Services and Achievements

- Steering Committee Chairman, *IEEE Transactions on Wireless Communications,* 1.2008-1-2010
- Canadian National Science and Engineering Research Council Panelist, 2009-2012
- Fellow of IEEE
- Steering Committee Member, *IEEE Transactions on Wireless Communications,* 1.2006-1-2008
- General Chair, IEEE 2016 International Conference on Acoustics, Speech, and Signal Processing, Shanghai, China.
- Technical Program Chair, *IEEE 2006 Globecom*, San Francisco, CA.
- Editorial Board Member, *IEEE Signal Processing Magazine*, 1/2003-1/2007.
- Associate Editor, *IEEE Signal Processing Letters*, 1.2002-1.2005.
- Associate Editor, IEEE Transactions on Signal Processing, 1.2001-1.2004.
- Editor, Special Issue on Multiuser Detection and Blind Estimation, *EURASIP Journal on Applied Signal Processing*, Dec. 2002.
- Member, IEEE Statistical Signal and Array Processing Technical Committee, 1993-1998.
- Member, IEEE Signal Processing for Communications Technical Committee, 1998-2004.
- Associate Editor, IEEE Transactions on Signal Processing, 1994-1997.
- Technical Program Committee Member, 3rd IEEE Workshop on Signal Processing Advances in Wireless Communications, Taiwan, March 2001.
- Organization Committee Member, 1st IEEE Workshop on Signal Processing Advances in Wireless Communications, Paris, France, April 1997.
- Review Panelist, National Science Foundation, 1997, 2003, 2004, 2005, 2007, 2008, 2010, 2014, 2015, 2016.