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EDUCATION

University	Degree	Field	Date
Massachusetts Institute of Technology	S.B.	Electrical Eng.	June, 1985
Massachusetts Institute of Technology	S.M.	Electrical Eng.	Sept., 1992
Massachusetts Institute of Technology	Electrical Engineer	Electrical Eng.	Sept., 1994
Massachusetts Institute of Technology	Ph.D.	Electrical Eng.	May, 1997

PROFESSIONAL PROFILE

Dr. Marc Thompson specializes in custom R/D, analysis, and failure investigations into multi-disciplinary electrical, magnetic, electromechanical and electronic systems at Thompson Consulting, Inc. (Harvard MA).

Dr. Thompson is also part-time Teaching Professor of Electrical and Computer Engineering at Worcester Polytechnic Institute. At W.P.I., Dr. Thompson teaches 2 different graduate design courses. The first, "Analog Circuits and Intuition" develops intuitive and "back of the envelope" methods for analog circuit, feedback control system, power electronics, magnetic, thermal and system analysis. Dr. Thompson also teaches "Power Electronics," focusing on intuitive methods for designing power electronics systems and magnetics. He also teaches graduate-level and undergraduate seminars in analog, power quality, power electronics, electromechanics, electric motors, rotating machinery, and power distribution for high-tech companies. He also teaches for University of Wisconsin-Madison, covering classes in electric motors, electromechanical systems, power electronics and magnetic design.

He was also Senior Managing Engineer at Exponent, an engineering consulting company, focusing on failure analysis of electronic components and systems. Dr. Thompson has held several engineering positions with companies including Polaroid Corporation and video manufacturer For-A Corporation.

Dr. Thompson is author of a textbook entitled *Intuitive Analog Circuit Design*, published in 2006 by Elsevier Science/Newnes. The 2nd edition of *Intuitive Analog Circuit Design* was published in 2013. Another text entitled *Power Quality in Electronic Systems*, co-authored with Dr. Alexander Kusko, was published by McGraw-Hill in 2007. Dr. Thompson has contributed 3 chapters to *Analog Circuits (World Class Designs)*, published by Elsevier in 2008, and 1 chapter to *Portable Electronics: World Class Designs*, Elsevier, 2009.

Dr. Thompson has 8 U.S. patents and was a Firefighter with the Harvard, Massachusetts Fire Department.

PROFESSIONAL EXPERIENCE

President, Thompson Consulting, Inc., 1995-present

Custom research and prototype development consulting firm specializing in advanced analog design, control systems, power electronics, switching power supplies, DC/DC converters, magnetic design, eddy-current brakes, motor and generator design, magnetic suspensions and Maglev. Failure investigations related to power systems, consumer electronics, and electronic equipment. Selected projects include:

- Development of a miniature, implantable, transcutaneous medical power supply using planar magnetics and variable airgap, including implantable lithium ion battery charger and motor driver
- Synchronous buck converter current source for driving semiconductor diode lasers for medical device application
- Control loop design for DC-AC inverter driven by photovoltaics
- Design of neodymium-iron-boron (NdFeB) permanent-magnet eddy-current brakes for roller coaster and other braking application
- Design and analysis of permanent magnet Halbach arrays for magnetic levitation
- Design, analysis and 2D and 3D finite-element analysis (FEA) of high frequency planar induction heating coils
- Design, analysis and FEA of microelectronic resonant actuator scanner (MEMS)
- Re-design of electromagnets for automated pick-and-place machines to reduce false picks
- Re-design for higher efficiency, noise reduction and cost reduction of multiple-output flyback switching power supplies
- Assessment of accuracy of magnetic sensing methods for robotic applications
- Contract monitoring consultant for U.S. Department of Transportation on electromagnetic aircraft launch (EMALS), Maglev and linear motor technologies. Work included magnetic analysis, and analysis of LSM position sensing methods
- Design of high-efficiency switching power supply for laser driving application
- Design of high-precision, low noise analog temperature control loop for optical switching application
- ESD audit and protection schemes for gallium arsenide semiconductor diode manufacturing facility
- Analysis and design of high-precision differential pressure sensor module
- Comparative study and analysis of electrodynamic (EDS) and electromagnetic (EMS) Maglev suspension technologies worldwide
- Analysis of magnetic catheter alignment system
- Design of 50 kVA inverter switch
- Mechanical and magnetic design for satellite levitated flywheel energy storage system
- Low-noise microphone amplifier design
- High frequency low noise oscillator design for driving amorphous magnetic fibers
- SBIR review panelist for National Science Foundation
- Assisted in design of low voltage power grid for electric power co-generation project
- Troubleshooting on thermal/overvoltage issues in high power medical pump device
- Design (analytical and finite element analysis) of magnetically-driven miniature compressor
- Failure analysis related to toy automobile motor driver overheating
- Risk analysis related to halogen light bulbs

- Study of "acoustic shriek" in portable telephone handset
- Study of failure phenomena and risk analysis for compact fluorescent electronic lamp ballasts
- Re-design of mass spectrometer high voltage RF power supply
- Design of battery-powered medium voltage power supply for piezoelectric application
- Design of low-noise current drivers for high power semiconductor diode lasers
- AC levitation coil design for induction separation
- Permanent magnet coupling design and analysis for implanted medical device
- Non-contact power supply for handheld medical device with rechargeable battery
- Permanent magnet rotary brake for low-gravity simulator device
- Non-contact power supply with very tight EMI requirements. 2D and 3D FEA of same.
- Design of eddy current brakes for next-generation aircraft carrier
- Magnetic and thermal design of rotary eddy current brake for industrial application
- Design and analysis of permanent magnet arrays for linear synchronous motor (LSM)
- Design and analysis of axial permanent magnet generator and magnetic bearing for tidal-powered generation
- Analysis and design of magnetic shield for high frequency inductive power transfer system
- Patent reviews for major worldwide analog/power electronics integrated circuit manufacturers
- Fire investigation related to consumer appliances
- Magnetic and shielding design for novel variable reluctance motor
- Investigation into non-contact broken rail detection for railroad applications
- Investigation into non-contact train detection for collision avoidance
- High frequency amplifier design for power cable degradation testing
- Investigation into premature powdered-iron inductor failures
- EMI investigation on 480V, 3-phase X-ray equipment
- Magnetic analysis of novel position sensing scheme for down-hole drilling equipment
- Analysis and troubleshooting of Class-E amplifier high frequency induction heating equipment
- Technology assessment of Maglev technology for Florida Department of Transportation
- Magnetic field estimation and finite-element analysis on down-hole magnetometer
- Technical assessment of delta vs. Y connected power transformer for adjustable speed drive
- Thermal analysis and design of high-efficiency RF cell tower base station
- PC board layout and switching speed analysis of tiny footprint GaN MOSFET RF modulator
- Analysis of eddy current effects in AMR sensors for automotive applications
- Rotordynamics, motor analysis and control system analysis for miniature blood pump
- Analysis, design and PC board layout of miniature, high power density switched capacitor power converter
- Non-contact power supply and magnetic analysis for non-contact speaker charging

Adjunct Associate Professor of Electrical Engineering, Worcester Polytechnic Institute, 1998-2011

Teaching Professor of Electrical Engineering, Worcester W.P.I., 2011-present

In charge of EE523, *Power Electronics*, a graduate subject covering power electronics, switching power supplies, rectifiers and inverters, power devices, high frequency DC/DC converters, thermal and magnetic design; and EE529, *Analog Circuits and Intuition*, a graduate subject covering intuitive methods in analog circuit design including CMOS and bipolar transistor amplifiers and transistor switching circuits, feedback systems, operational amplifier analysis, analog building blocks including

current mirrors, bandgap voltage references, phase-locked loops, and mechanical and thermal circuit analogies. Also in charge of graduate-level *Electromechanics* (covering magnetics, transformer design, electromechanical energy conversion, and motor/generator design) and graduate-level *Power Distribution* covering elements of industrial and residential power distribution systems.

ENGINEERING SOFTWARE EXPERTISE

- FEMM (2D magnetic, electric and thermal finite-element analysis)
- Ansoft Maxwell 3D (3D magnetic finite-element analysis)
- Radia 3D (3D magnetic finite-element analysis)
- FastHenry (3D inductance and resistance matrix extraction tool)
- LISA (3D structural, thermal, modal analysis, electrostatic FEA)
- MATLAB/Simulink
- PSPICE, LTSpice
- PSIM power electronics simulator
- SwitcherCAD

RESEARCH EXPERIENCE

Doctoral Research, Massachusetts Institute of Technology, 1993-1997

- Research areas: Magnetic levitation using superconducting magnets (Maglev); Maglev control systems; electromechanical actuator design; induction heating; properties of ferrofluids; scaling laws for magnetic design.
- Ph.D. thesis: *High Temperature Superconducting Magnetic Suspension for Maglev*, supervised by Prof. Richard D. Thornton at the Laboratory for Electromagnetic and Electronic Systems. Work includes mechanical and electrical design and analysis of a superconducting magnetic suspension with active magnetic secondary suspension for ride-quality control. Designed and built active vertical control system. Built 2-meter diameter, 1000 RPM composite test wheel and one degree-of-freedom air bearing for vertical Maglev dynamics studies.

Master's Research, Massachusetts Institute of Technology, 1990-1992

- M.S. Thesis: *High Power Laser Diode Driver with Plural Feedback Loops*, supervised by Prof. Martin Schlecht at the Laboratory for Electromagnetic and Electronic Systems. 1.2 Watt, 2 Ampere, 20 nanosecond laser driver based on power converter technology with microstrip laser cable. Research funded by Polaroid Corporation, received patent based on system concept.

PRIOR WORK EXPERIENCE

Senior Managing Engineer, Exponent, Inc., 2003-2006

Part-time consultant at Exponent, a failure-analysis, scientific and engineering consulting company.

Teaching Assistant, Research Assistant, Massachusetts Institute of Technology, 1993-1997

Research Assistant in the Laboratory for Electromagnetic and Electronic Systems, focusing on magnetic design and Maglev. Teaching Assistant for course number 6.101, *Introductory Analog Systems Laboratory*. In 6.101 was responsible for generating homework assignments and solutions, supervising laboratory work, and giving bi-weekly lectures.

Consultant, Polaroid Corporation, 1993-2001**Senior Engineer, Polaroid Corporation, 1990-1993****Advanced Engineer, Polaroid Corporation, 1987-1990**

Designed electronics systems including motor drivers, video frame stores, phase-locked loops, high-speed amplifiers, and high-speed, high current pulsed laser diode drivers. Received several patents based on laser diode driver work.

R/D Engineer, For-A Corporation of America, 1985-1987

Designed professional broadcast video equipment including NTSC and PAL encoders and decoders and PAL frame stores, analog signal processing and analog filtering with group delay correction.

LEGAL/EXPERT WITNESS WORK

Have done work on IP, insurance and product liability cases. Have written expert witness reports, given depositions and testified at trial.

PATENTS

- [1] B. Santarelli and M. Thompson, **U.S. Patent #5,123,023**, "Laser Driver with Plural Feedback Loops," issued June 16, 1992
- [2] M. Thompson, **U.S. Patent #5,444,728**, "Laser Driver Circuit," issued August 22, 1995
- [3] W. T. Plummer, M. Thompson, D. S. Goodman and P. P. Clark, **U.S. Patent #6,061,372**, "Two-Level Semiconductor Laser Driver," issued May 9, 2000
- [4] E. M. Pribonic and M. Thompson, **U.S. Patent #6,523,650**, "Permanent Magnet Eddy Brake with Flux-Steering Poles," issued February 25, 2003
- [5] E. M. Pribonic and M. Thompson, **U.S. Patent # 6,533,083**, "Eddy Current Braking Apparatus," issued March 18, 2003
- [6] E. M. Pribonic and M. Thompson, **U.S. Patent # 6,918,469**, "Curvilinear Eddy Current Braking Apparatus," issued July 19, 2005
- [7] M. Thompson, **U.S. Patent # 7,076,304**, "Transcutaneous Power Supply," issued July 11, 2006
- [8] P. Golden and M. Thompson, **U.S. Patent # 7,952,428**, "Dynamically adjustable low noise, low power instrumentation amplifier," issued May 31, 2011

SELECTED INDUSTRY ENGINEERING COURSES

- "Seminar on Analog Circuit Design," Polaroid Corporation, 1999
- "Analog Circuits and Intuitive Design Methods," Allegro Microsystems, 2004
- "Power Electronics," Allegro Microsystems, 2004
- "Power Quality in Electronic Systems," IEEE Boston, 2005 (with Alexander Kusko)
- "Electromechanics," NSTAR, 2005
- "Power Distribution," NSTAR, 2006
- "Electromechanical Basics," Naval Air Engineering Station, Lakehurst N.J., June 2006; September 2006; June 2008
- "Power Distribution," Northeast Utilities, 2007
- "Introduction to Power Electronics," National Grid, 2008

- “Power Electronics,” Naval Air Engineering Station, Lakehurst N.J., September 2008; February 2009
- “Electromechanics,” Northeast Utilities, 2009
- “Introduction to Power Electronics,” University of Wisconsin-Madison, April 2010; April 2011; April 2012; April 2013; April 2014
- “Introduction to Power Electronics,” General Motors, September 2010; October 2011
- “Electromechanical Energy Conversion,” Public Service of New Hampshire, Spring 2011
- “Introduction to Power Electronics,” United States Navy (Philadelphia), June 2011
- “Introduction to Power Electronics,” Aerojet (Redmond WA), June 2012
- “Seminar on Power Systems, Power Quality, and Instrumentation,” Analog Devices, March 2013
- “Power Electronics,” Electric Boat, New London CT, Spring 2014
- “Power Electronics,” online (via W.P.I.), Fall 2014

PUBLICATIONS

Textbooks

- [1] *Intuitive Analog Circuit Design*, Newnes Publishing (Elsevier), 2006. ISBN: 0750677864
- [2] *Power Quality in Electronic Systems*, (with Dr. Alexander Kusko), McGraw-Hill, 2008. ISBN: 0071470759
- [3] *Analog Circuits (World Class Designs)*, contributor of 3 chapters, edited by Bob Pease, Elsevier, 2008. ISBN: 0750686278
- [4] *Portable Electronics: World Class Designs*, contributor of 1 chapter, edited by Bob Donovan, Elsevier, 2009. ISBN: 185617624X
- [5] *Intuitive Analog Circuit Design*, 2nd edition, Newnes Publishing (Elsevier), December 2013. ISBN: 0124058663

Refereed journals

- [1] Marc T. Thompson and Martin F. Schlecht, “Laser Diode Driver Based on Power Converter Technology,” *IEEE Transactions on Power Electronics*, vol. 12, no. 1, Jan. 1997, pp. 46-52
- [2] “Simple Models and Measurements of Magnetically-Induced Heating Effects in Ferromagnetic Fluids,” *IEEE Transactions on Magnetics*, vol. 34, no. 5, September 1998
- [3] Marc T. Thompson, Richard D. Thornton and Anthony Kondoleon, “Scale Model Flux-Canceling EDS Maglev Suspension --- Part I: Design and Modeling,” *IEEE Transactions on Magnetics*, vol. 35, no. 3, May 1999, pp. 1956-1963
- [4] Marc T. Thompson and Richard D. Thornton, “Scale Model Flux-Canceling EDS Maglev Suspension --- Part II: Test Results and Scaling Laws,” *IEEE Transactions on Magnetics*, vol. 35, no. 3, May 1999, pp. 1964-1975
- [5] “Eddy Current Magnetic Levitation --- Models and Experiments,” *IEEE Potentials*, vol. 19, no. 1, Feb./March 2000, pp. 40-44
- [6] “Electrodynamic Magnetic Suspension --- Models, Scaling Laws and Experimental Results,” *IEEE Transactions on Education*, vol. 43, no. 3, August 2000, pp. 336-342
- [7] T. Sakamoto, K. Yamada and M. Thompson, “Numerical Calculations of Flux-Canceling Maglev with DC and AC Excited SCMs,” *T. IEEE Japan*, vol. 121-D, no. 11, 2001

- [8] "Practical Issues in the Use of NdFeB Permanent Magnets in Maglev, Motors, Bearings and Eddy Current Brakes," *Proceedings of the IEEE*, vol. 97, no. 11, November 2009 special issue "Linear Motor Power Transportation: Present Status and Future Possibilities"
- [9] R. Thornton, M. Thompson, B. Perreault and J. Fang, "Linear Motor Powered Transportation," *Proceedings of the IEEE*, vol. 97, no. 11, November 2009 special issue "Linear Motor Power Transportation: Present Status and Future Possibilities"

Technical articles

- [1] "Designing Video Circuits, Part 1 of 3," *Electronic System Design Magazine*, October, 1988, pp. 67-74
- [2] "Designing Video Circuits, Part 2," *Electronic System Design Magazine*, November, 1988, pp. 75-79
- [3] "Designing Video Circuits, Part 3," *Electronic System Design Magazine*, December, 1988, pp. 47-51
- [4] "Design Linear Circuits Using OCTC Calculations," *Electronic Design (Special Analog Issue)*, June 24, 1993, pp. 41-47
- [5] "SCTC Analysis Estimates Low-Frequency -3-dB Point," *Electronic Design*, October 1, 1993, pp. 65-68
- [6] "Network Tricks Aid in OCTC," *Electronic Design*, December 16, 1993, pp. 67-70
- [7] "Tips for Designing High-Gain Amplifiers," *Electronic Design*, May 16, 1994, pp. 83-90
- [8] "Guesstimating Inductance of Wire Loops," *Newsletter of the IEEE Power Electronics Society*, Volume 11, Number 2, April 1999, pp. 3
- [9] "Sizing the MOSFET Gate Damping Resistor," *Newsletter of the IEEE Power Electronics Society*, Volume 11, No. 4, October 1999, pp. 2
- [10] "Inductance Calculation Techniques --- Part I: Classical Methods," *Power Control and Intelligent Motion*, vol. 25, no. 12, December 1999, pp. 40-45
- [11] "Inductance Calculation Techniques --- Part II: Approximations and Handbook Methods," *Power Control and Intelligent Motion*, website <http://www.pcim.com>, 1999
- [12] Edward Pribonic and Marc Thompson, "Frictionless Non-Powered Emergency Arrestors for Mine Hoisting Systems," *International Journal of Transport and Logistics*, September 2005, pp. 16-35
- [13] Edward Pribonic and Marc Thompson, "A 21st Century Advancement for Mine Hoisting Systems: Frictionless Non-Powered Emergency Arrestors," *CIM Bulletin*, vol. 101, no. 1107, March/April 2008, pp. 1-8

Conference and other publications

- [1] Anthony Kondoleon, Donald Seltzer, Richard D. Thornton, and Marc T. Thompson, "Development of a Large Scale High Speed Wheel Test Facility," *Proceedings of the Third International Symposium on Magnetic Suspension Technology*, NASA Conference Publication 3336, part 2, pp. 523-534, Dec. 13-15, 1995
- [2] Marc T. Thompson and Richard D. Thornton, "Modeling of HTSC-Based Iron Core Flux-Canceling Electrodynamics Suspension for Maglev," *Proceedings of the 4th International Symposium on Magnetic Suspension Technology*, NASA Conference Publication, 1997

- [3] Marc T. Thompson and Anthony Kondoleon, "Test Results from a Large Scale, High Speed EDS Maglev Wheel Test Facility," *Proceedings of the 4th International Symposium on Magnetic Suspension Technology*, NASA Conference Publication, 1997
- [4] Richard D. Thornton and Marc T. Thompson, "Magnetically Based Ride Quality Control for an Electrodynamic Maglev Suspension," *Proceedings of the 4th International Symposium on Magnetic Suspension Technology*, NASA Conference Publication, 1997
- [5] "Inductance Calculation Techniques --- Tutorial on Approximations, Handbook Methods and Scaling Laws," *Proceedings of PCIM 2000*, August 3-5, 2000, Boston
- [6] "Permanent Magnet Electrodynamic Brakes --- Design Principles and Scaling Laws," *Online Symposium on Electrical Engineering*, www.techonline.com, July 2001
- [7] "Inductance Calculation Techniques --- Approximations and Handbook Methods," *Online Symposium on Electrical Engineering*, www.techonline.com, July 2001
- [8] N. Medora, A. Kusko and M. Thompson, "Impact of Line Voltage Sag on Switch Mode Power Supply Operation," *2008 3rd IEEE Conference on Industrial Electronics and Applications*, June 3-5, 2008, Singapore
- [9] R. Hoopengardner and M. Thompson, "FTA Low-Speed Urban Maglev Research Program: Updated Lessons Learned," *Federal Transit Administration Report No. 0026*, November 2012

Technical presentations

- [1] "Archival Storage of Digital Television Images," *Electronic Imaging*, Boston, November 1987
- [2] "Psychophysics and Future Television Technology," *Electronic Imaging*, Boston, October, 1988
- [3] "System Design via Intuitive Methods and Back-of-the-Envelope Calculations," *Worcester Polytechnic Institute*, October 22, 1997
- [4] "Modeling and Control of HTSC Flux-Canceling Electrodynamic Maglev Suspension," *IEEE Control System Society*, March 10, 1998
- [5] T. Clark, A. Kondoleon, M. Thompson and R. Thornton, "Shaftless, Magnetically Levitated Flywheel Energy Storage System," *Aerospace Flywheel Workshop*, Albuquerque NM, October 7-8, 1998
- [6] "Issues in Low Speed Maglev," *United States Department of Transportation Seminar*, Volpe Center, Cambridge MA, August 17, 1999
- [7] "EMALS Enabling Technologies Overview," *United States Department of Transportation*, September 13, 1999
- [8] "Magnetic Levitation and Control," *Boston University Student IEEE*, October 3, 2002
- [9] "Maglev Comparative Study," *Lockheed Martin, Inc.*, January 20, 2003
- [10] "Permanent Magnet Brakes --- An Application Where Eddy Currents are Useful," *IEEE Magnetics Society*, Boston section, September 24, 2003

OTHER

- Manuscript reviewer for *IEEE Transactions on Education*
- Manuscript reviewer for *IEEE Spectrum*
- Manuscript reviewer for *IEEE Power Electronics Letters*

- Guest editor for *IEEE Proceedings* Nov. 2009 special issue "Linear Motor Power Transportation: Present Status and Future Possibilities"

ORGANIZATION MEMBERSHIP

- Member of Institute of Electrical and Electronic Engineers (IEEE)
- Firefighter, Harvard Massachusetts Fire Department, 2003-2014