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## Education

- **Massachusetts Institute of Technology**, Cambridge, MA
  - Ph.D., Electrical Engineering, October, 2003
  - “A System for Efficient Neural Stimulation with Energy Recovery”
  - Supervisor: John L. Wyatt
- **Massachusetts Institute of Technology**, Cambridge, MA
  - M.Eng., Electrical Engineering, June 1998
  - “A System for Electrical Retinal Stimulation for Human Trials”
  - Supervisor: John L. Wyatt
- **Massachusetts Institute of Technology**, Cambridge, MA
  - S.B., Electrical Engineering, June 1996
  - Minor in Biology; Minor in Biomedical Engineering; Supervisor: Steven Leeb
  - “A Marking and Identification System for Locating Faulty Assembly Line Parts”

## Primary Interests

- Medical device product design, development, and packaging
- Analog and mixed signal VLSI circuit design
- Retinal prostheses, implantable microelectronic medical devices
- Electrical tissue stimulation, neuromodulation, current source stimulation circuitry, stimulating electrode materials
- Wireless power/data telemetry, power management, micro-power management circuits

## Current Positions

### VA Pittsburgh Healthcare System:

**Research Biomedical Engineer** 2013 – Present

### Carnegie Mellon University:

**Senior Systems Scientist; Institute for Complex Engineered Systems** 2012 – Present

**Courtesy Faculty; Electrical and Computer Engineering** 2012 – Present

**Courtesy Faculty; Biomedical Engineering** 2013 – Present

I have been developing and testing a prototype implantable retinal prosthesis for the blind for over 16 years with the Boston Retinal Implant Project, a joint effort of the VA, MIT, and Massachusetts Eye and Ear Infirmary. Our group has successfully built three different generations of wirelessly-powered prostheses and implanted all three chronically in animals in preparation for clinical trials.

I am the lead electrical system architecture designer for the next generation implant, I design all of the inductively coupled power and data telemetry systems for the prosthesis, and I coordinate current generation implant component assembly by outside vendors. I previously led the electrical design and test group, consisting of 4 other engineers and a technician.

I developed a testing laboratory at MIT, where I designed and built test circuits and mechanical fixtures. I developed telemetry systems and circuits for early generations of the retinal prosthesis.

## Previous Experience

- **Shawn Kelly Consulting – Principal** 2006 – Present  
Consultant to four startup companies developing medical devices. Designed electrode test circuits, advised the design of telemetry systems, neurostimulators, and hermetic packages.

- **VA Boston Healthcare System – Research Health Scientist** 2003 – 2012
- **MIT – Visiting Scientist** 2003 – 2011
- **MIT Graduate Research Assistant – Ph.D.** 1999 – 2003  
Designed, laid out, and had fabricated a VLSI chip and power coupling system for low-power neural stimulation, which used 66% less power than the most efficient stimulator in use.
- **MIT Graduate Research Assistant – M.Eng.** 1997 – 1999  
Designed battery-powered retinal stimulator, used in 6 human surgical trials.
- **M/A-Com Microwave Test Engineer** 1996  
Designed 50 GHz test system; used skeleton system to test p-i-n diode parameters.
- **MIT Advanced Undergraduate Project** 1996  
Designed simple mechanical ink ejection system to mark faulty assembly line parts.
- **MIT Undergraduate Research** 1992 – 1995  
Determined cartilage mechanical properties under static and dynamic compression.
- **University of Pittsburgh Summer Research** 1995  
Developed circuitry to measure resistivity of brain tissue and cerebrospinal fluid; wrote Matlab models of current distributions near multiple resistivity boundaries.
- **University of Pittsburgh Summer Research** 1994  
Developed experimental hardware/software system for hydrostatic cartilage testing.

## Teaching Experience

- CMU, Neural Technology, Sensing, and Stimulation Fall 2012
- Pitt, Guest Lecturer, Neurotechnology: Concepts, Patients, and Devices Spring 2012
- MIT Teaching Assistant, 6.111 – Digital Electronics Laboratory Fall 1996
- MIT Educational Studies Program, Physics Advisor for summer program 1996, 1997
- MIT Laboratory Assistant, 6.111 – Digital Electronics Laboratory Spring 1996
- MIT Experimental Studies Group, 5.11 – Chemistry Fall 1995
- MIT Computer Laboratory Assistant, 6.001 – Programming class Spring 1994

## Student Advising

- Ph.D. Thesis Supervisor, Carnegie Mellon University, ECE 2011 – Present
- Ph.D. Thesis Reader, U. of New South Wales, BME 2008
- M.S. Thesis Committee, Tufts U., ECE 2008
- Science advisor, MIT Sloan students developing business plans 2007, 2008
- Ph.D. Thesis Design Review Committee, Tufts U., ECE 2006
- Science Advisor, Boston College student business plan competition 2005, 2006
- Industry Advisor, Rhode Island School of Design 2005
- Science Advisor, MIT Sloan students, MIT 50K design competition 2004

## Leadership/Activities

- Board of Directors, MIT Enterprise Forum Pittsburgh 2012 – Present
- Advisory Board, CCNY-GaTech Man Machine Motor Control 2012 – Present
- Board of Directors, Science for the Public 2010 – Present
- Advisory Board (Co-chair), MIT Tech Catholic Community 2005 – 2011
- Volunteer math and science tutor for ESL adult education program 2003 – 2008
- Strategic Advisory Committee to the Chancellor, MIT 1999 – 2000
- Dormitory President, member of the MIT Dormitory Council 1995 – 1996

## Awards/Honors

- Best Paper Award, IEEE ISABEL conference 2009
- VA Career Development Award 2008 – 2011
- Catalyst Foundation Fellowship 1998 – 2003
- Richard P. Simmons '53 Scholarship 1992 – 1996
- Bell of Pennsylvania Scholarship 1992 – 1996
- United States Presidential Scholar 1992

## Memberships

- IEEE Member 2003 – Present
- Sigma Xi Scientific Research Society 2002 – Present
- Association for Research in Vision and Ophthalmology Member 2001 – Present
- Medical Development Group Member 2009 – 2011

## Selected Research Funding

- Pennsylvania Infrastructure Technology Alliance; PI 2013 – 2014  
 “Engineering Development of a Retinal Prosthesis for the Blind”
- VA Rehabilitation R&D; PI 2013 – 2017  
 “Power and Data Telemetry System for a 256-Channel Retinal Implant”
- NIH ARRA; Co-Investigator 2009 – 2011  
 “Advanced Engineering Development of a Chronic Retinal Implant”
- VA Rehabilitation R&D, Career Development Award; PI 2008 – 2011  
 “Improved Power and Data Telemetry System for Implanted Medical Devices”
- Department of Defense; Subcontract PI 2007 – 2009  
 “Optimization of Microelectronic Methods to Produce an Implantable Retinal Prosthesis to Treat Blindness”
- VA Rehabilitation R&D; Co-Investigator 2006 – 2010  
 “Center for Innovative Visual Rehabilitation” 2001 – 2006
- Catalyst Foundation; PhD Student Fellow 1998 – 2003  
 “Retinal Implant Chip for the Blind”

## Journal and Conference Reviewing

- IEEE Trans. on Biomed. Eng. IEEE Eng. in Med. and Bio. Conf.  
 IEEE Trans. on Biomed. Circ. and Sys. IEEE Biomed. Circ. and Sys. Conf.  
 IEEE Int'l Symposium on Circ. and Sys. IEEE Asian Solid-State Circ. Conf.  
 Investigative Ophth. and Vis. Sci. J. Neural Eng.  
 IEEE Int'l Symposium on Applied Sciences in Biomed. and Comm. Technologies

## US Patents

S.K. Kelly, J.L. Wyatt, J.F. Rizzo. “System for and Method of Power Efficient Electrical Tissue Stimulation.” United States Patent #7,295,872, November 2007.

## Selected Publications

A. Krishnan, S.K. Kelly. "On the Cause and Control of Residual Voltage Generated by Electrical Stimulation of Neural Tissue." IEEE Eng. in Medicine and Biology Conf., pp. 3899-3902, 2012.

S.K. Kelly, D.B. Shire, J. Chen, P. Doyle, M.D. Gingerich, S.F. Cogan, W. Drohan, S. Behan, L. Theogarajan, J.L. Wyatt, J.F. Rizzo. "A Hermetic Wireless Subretinal Neurostimulator for Vision Prostheses." IEEE Trans. on Biomedical Eng., Vol. 58, No. 11, pp. 3197-3205, 2011.

S.K. Kelly, D.B. Shire, J. Chen, P. Doyle, M.D. Gingerich, S.F. Cogan, W. Drohan, L. Theogarajan, J.L. Wyatt, J.F. Rizzo. "Communication and Control System for a 15-Channel Hermetic Retinal Prosthesis." Biomed. Sig. Proc. and Control, Vol. 6, No. 4, pp. 356-363, 2011.

D.K. Freeman, J.S. Jeng, S.K. Kelly, E. Hartveit, S.I. Fried. "Calcium Channel Dynamics Limit Synaptic Release in Resonse to Prosthetic Stimulation with Sinusoidal Waveforms." Journal of Neural Engineering, Vol 8, pp. 046005-1 – 046005-19, 2011.

S.K. Kelly, J.L. Wyatt. "A Power-Efficient Neural Tissue Stimulator with Energy Recovery." IEEE Trans. on Biomedical Circuits and Systems, Vol. 5, No. 1, pp. 20-29, 2011.

J.F. Rizzo, D. Shire, S. Kelly, P. Troyk, M. Gingerich, B. McKee, A. Priplata, J. Chen, W. Drohan, P. Doyle, O. Mendoza, L. Theogarajan, S. Cogan, J. Wyatt. "Development of the Boston Retinal Prosthesis." Proc. IEE Eng. in Medicine and Biology Conf., pp. 3135-3138, 2011.

S.K. Kelly, P. Doyle, A. Priplata, O. Mendoza, J.L. Wyatt. "Optimal Primary Coil Size for Wireless Power Telemetry to Medical Implants." IEEE ISABEL conference, invited paper, 2010.

S.K. Kelly, D.B. Shire, J. Chen, P. Doyle, M.D. Gingerich, W.A. Drohan, L.S. Theogarajan, S.F. Cogan, J.L. Wyatt, J.F. Rizzo. "The Boston Retinal Prosthesis: A 15-Channel Hermetic Wireless Neural Stimulator." IEEE ISABEL conference, invited paper, 2009. Best Paper Award.

S.K. Kelly, D.B. Shire, J. Chen, P. Doyle, M. Gingerich, W. Drohan, L. Theogarajan, S. Cogan, J.L. Wyatt, J.F. Rizzo. "Realization of a 15-Channel, Hermetically-Encased Wireless Subretinal Prosthesis for the Blind." IEEE Eng. in Medicine and Biology Conf., pp. 200-203, 2009.

D.B. Shire, S.K. Kelly, J. Chen, P. Doyle, M.D. Gingerich, S.F. Cogan, W. Drohan, O. Mendoza, L. Theogarajan, J.L. Wyatt, J.F. Rizzo. "Development and Implantation of a Minimally-Invasive, Wireless Sub-Retinal Neurostimulator." IEEE Trans. on Biomedical Eng., Vol. 56, No. 10, pp. 2502-2511, 2009.

L. Theogarajan, J. Wyatt, J. Rizzo, B. Drohan, M. Markova, S. Kelly, G. Swider, M. Raj, D. Shire, M. Gingerich, J. Loewenstein, B. Yomtov. "Minimally Invasive Retinal Prosthesis." IEEE Int'l Solid-State Circuits Conf., paper 2.5, pp. 99-108, 2006.

S.K. Kelly, J. Wyatt. "A Power-Efficient Voltage-Based Neural Tissue Stimulator with Energy Recovery." IEEE Int'l Solid-State Circuits Conf., paper 12.6, pp. 228-524, Vol. 1, 2004.

J.F. Rizzo, J.L. Wyatt, J. Loewenstein, S.K. Kelly, D.B. Shire. "Methods and Perceptual Thresholds for Short-Term Electrical Stimulation of Human Retina with Microelectrode Arrays." Invest. Ophth. and Vis. Sci., Vol. 44, No. 12, pp. 5355-5361, 2003.

J.F. Rizzo, J.L. Wyatt, J. Loewenstein, S.K. Kelly, D.B. Shire. "Perceptual Efficacy of Electrical Stimulation of Human Retina with a Microelectrode Array During Short-Term Surgical Trials." Invest. Ophth. and Vis. Sci., Vol. 44, No. 12, pp. 5362-5369, 2003.

S.B. Baumann, D.R. Wozny, S.K. Kelly, F.M. Meno. "The Electrical Conductivity of Human Cerebrospinal Fluid at Body Temperature." IEEE Trans. on Biomedical Engineering, Vol. 44, No. 3, pp. 220-223, 1997.

## Selected Conference Abstracts

S.K. Kelly. "Advancements in the Development of a Retinal Prosthesis for the Blind." Vision Restoration: Regenerative Medicine in Ophthalmology, 2012.

S.K. Kelly, W.F. Ellersick, A.A. Priplata, D.B. Shire, J.L. Wyatt, J.F. Rizzo. "Power and Data Telemetry Developments for a Retinal Implant." Invest. Ophthalmol. Vis. Sci., Vol. 53: 5516, 2012.

S.K. Kelly, W.F. Ellersick, P. Doyle, A.A. Priplata, D.B. Shire, J.L. Wyatt, J.F. Rizzo. "Current Driver Circuits and Safety Features for a Retinal Prosthesis." Invest. Ophthalmol. Vis. Sci., Vol. 52: 4941, 2011.

J. Chen, P. Doyle, J. Dumser, A. Marvasti, O. Mendoza, S.K. Kelly, D.B. Shire, J.F. Rizzo. "Surgical Implantation of Newly Designed Subretinal Implant in Minipig Eyes." Invest. Ophthalmol. Vis. Sci., Vol. 52: 4929, 2011.

S.K. Kelly, W.F. Ellersick, P. Doyle, S.F. Cogan, W.A. Drohan, D.B. Shire, J.L. Wyatt, J.F. Rizzo. "Electrical System and Circuit Considerations for a Chronic Retinal Prosthesis." Invest. Ophthalmol. Vis. Sci., Vol. 51: 3025, 2010.

S.K. Kelly. "The Boston Retinal Implant Project: Progress on the Development and Testing of a Hermetic Retinal Prosthesis." German Retina Implant Foundation International Symposium on Artificial Vision, Bonn, 2009.

S.K. Kelly, P. Doyle, O. Mendoza, W.A. Drohan, G.W. Swider, D.B. Shire, J.L. Wyatt, J.F. Rizzo, III. "Improved Class A Based Transmitter System for Wireless Retinal Implant Data Telemetry." Invest. Ophthalmol. Vis. Sci., Vol. 50: 4578, 2009.

S.K. Kelly, G.W. Swider, W.A. Drohan, J.L. Wyatt, J.F. Rizzo. "Exploration of Optimal Coil Designs for Retinal Implant Power and Data Telemetry." Invest. Ophthalmol. Vis. Sci., Vol. 48: 674, 2007.

S.K. Kelly, M. Markova, L. Theogarajan, W.A. Drohan, G.W. Swider, B. Yomtov, J.L. Wyatt, J.F. Rizzo. "Development of a Telemetry System for the Boston Retinal Implant." Invest. Ophthalmol. Vis. Sci., Vol. 47: 3168, 2006.

S.K. Kelly, J.L. Wyatt. "Low-Power Neural Stimulator for a Retinal Prosthesis." Invest. Ophthalmol. Vis. Sci., Vol. 45: 4174, 2004.

S.K. Kelly, J.L. Wyatt. "Low-Power Techniques for a Retinal Prosthesis." Invest. Ophthalmol. Vis. Sci., Vol. 44: 5064, 2003.

## Invited Seminar Lectures

"Advancements in the Development of a Retinal Prosthesis for the Blind." CCNY/GA Tech Joint Workshop on Man, Machine, and Motor Control for the Blind, 2012.

"Being Bionic: The New Prosthetics." Science for the Public, community television, 2011.

"Development of a Retinal Prosthesis for the Blind." Carnegie Mellon University Institute for Complex Engineered Systems Seminar Series, 2010.

"Functional Vision for the Blind: The Boston Retinal Implant." Boston Chapter of the IEEE Society on Social Implications of Technology, 2008.

"The Boston Retinal Implant Project: Overview and Current VLSI Research." Tufts University Department of Electrical and Computer Engineering Seminar Series, 2006.