Harvard Medical School Curriculum Vitae

Date Prepared: March 25, 2017
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Research Statement
I am a neuroscientist/neuroengineer with basic science interests in how the brain works. I am also heavily engaged in translational research. The majority of my research is collaborative. Most of my research focuses on the vestibular system – partly because vestibular dysfunction is a large human health problem, partly because equilibrium is a crucial sense that is often overlooked (until something goes wrong), and partly because the vestibular system has characteristics that match my dynamic systems technical expertise. Other general areas of technical expertise include computational neuroscience, random variable analyses, human psychophysics, motion platform technologies, and neural stimulation.

Education

1982	B.S.M.E	Mechanical Engineering	University of Wisconsin-Madison
1985	M.S.E.	Mech.& Aero. Engineering	Princeton University
1990	Ph.D.	Biomedical Engineering	MIT

Postdoctoral Training

1990		L. Young Man-Vehicle Laboratory	MIT

Faculty Academic Appointments

1991-1995	Research Scientist	Man-Vehicle Laboratory	MIT
1995-1998	Assistant Scientist		Neurol. Sci. Institute
1995-1999	Adjunct Professor	Dept. of Phys. & Pharm.	OHSU
1996-1999	Faculty Member	Integrative Biomed. Sci. Program	OHSU
1997-1999	Faculty Member	Neuroscience Graduate Program	OHSU
1998-1999	Associate Scientist		Neurol. Sci. Institute
1999-2012	Assoc. Prof.	Otology and Laryngology	Harvard Medical School
2000-	Faculty Member	Speech Hearing Biosci. & Tech.	MIT
2000-	Affiliate Faculty	Division of Health Sci. & Tech.	Harvard/MIT
2007-	Faculty Member	Faculty of Arts & Sciences	Harvard
2012-	**Professor**	**Otology and Laryngology**	**Harvard Medical School**

Appointments at Hospitals/Affiliated Institutions

1995-1999	Scientific Systems Director	Neuro-otology Research	Legacy (Portland, OR)

Other Professional Positions

1984-1990	Research Assistant	Man-Vehicle Lab, MIT

1986	Scientist, Space Life Sciences Training Program	NASA Kennedy Space Center
1991	Visiting Scholar	Univ. of Sydney, Australia

Major Administrative Leadership Positions

Local

1992-1995	Acting PI	Directed efforts of an international team of neurovestibular scientists on Spacelab Life Sciences – 2
1996-1998	PR Director	Neurological Sciences Institute
1999-	**Director**	**Jenks Vestibular Physiology Laboratory (a multi-PI research lab)**
2002-2004	Organizer	Sensory-Neural Systems: Spatial Orientation from Vestibular End Organs to Behavior and Adaptation (16.430J/HST.514J),
2007-2011	Organizer	MEEI Vestibular Seminar Series

Committee Service

Local

2000	Department Search Committee for Otologist/Neurotologist	Member
2000	Faculty Promotion Committee for Computational Neuroscientist	Member
2004	Department Search Committee for Otoneurologist	Member
2005	Department Search Committee for Otologist/Neurotologist	Member
2006-2008	MEEI Research Committee	Member
2006	MEEI Vestibular Seminar Steering Committee	Chair
2009-2010	Department Search Committee for Otoneurologist	Member
2012-2016	MEEI Research Committee	Member

National

1990	Panel – Vestibular Research Facility as a National Laboratory, NASA	Member
1990	Human Responses to Accelerative Forces Panel, Naval Aerospace Medical Research Lab	Invited Participant
1992-1994	Health Care Engineering Policy Committee, Institute of Electrical and Electronics Engineers	Member
1995-1997	Vestibular Research Center Advisory Panel Northwestern/Neurological Science Institute (NIH/NASA)	Member
1999	Artificial Gravity Workshop NASA and National Space Biomedical Research Institute	Invited Participant
2003	Workshop of Neural Vestibular Prostheses NIH/NIDCD	Invited Participant
2012	NIDCD Workshop on Motion Perception and Balance Disorders	Invited Participant
2016	Committee to Review NASA's Evidence Reports on Human Health Risks	Invited Speaker
2016	DOD Spatial Orientation Modeling Expert Workgroup (SOMEW)	Participant/Speaker

International

1994	Neurolab Rotator Workshop, NASA and European Space Agency	Member
2010	Spatial Disorientation Workshop, Dutch Ministry of Defense	Member

Professional Societies

1987-	Institute of Electrical and Electronic Engineers	Member
1987-1995	Aerospace Medical Association	Member

1990-	Society for Neuroscience	Member
1990-	Biomedical Engineering Society	Member
1993-	Barany Society	Member
1996-2008	Association for Research in Otolaryngology	Member
2012-	Institute of Electrical and Electronic Engineers	Senior Member
2012-	**American Institute for Medical and Biological Engineering**	**Fellow**

Grant Review Activities

1992	Postdoctoral Fellowship Review Panel, Office of Naval Technology	Member
1995	Grant Review Panel, National Science Foundation	Reviewer
1997	R03 Review Panel, NIH/NIDCD	Member
1998	R03 Review Panel, NIH/NIDCD	Member
1999-2003	Communications Disorders Review Committee (CDRC) NIH/NIDCD	Member
2000	Research Council for Earth and Life Sciences Netherlands Organization for Scientific Research	Reviewer
2001	Neurobiology Flight Grant Review Panel, NASA	Member
2001	Special Emphasis Review Panel, NIH/NIDCD	Member
2002	Special Emphasis Review Panel, NIH/NIDCD	Member
2004	Special Emphasis Review Panel, NIH/IFCN	Member
2005	Special Emphasis Review Panel, NIH/IFCN	Member
2004	Scientific Merit Review and Evaluation Advisory Committee Veteran Affairs Rehab R&D	Member
2006	Grant Review Panel, Medical Research Council (Great Britain)	Member
2007	Research Core Center (P30) Review Committee, NIH/NIDCD	Chairman
2007	Special Emphasis P50 Review Committee, NIH/NIDCD	Member
2008	NASA and NSBRI Sensory Adaptation Grant Review Panel, NASA	Member
2008	UK Engineering and Physical Sciences Research Council Review	Reviewer
2009-2011	Special Emphasis Panels, NIH/NIDCD	Member
2010	Meniere's Clinical Trial Panel, NIH/NIDCD	Member
2008-2011	Communications Disorders Review Committee (CDRC) NIH/NIDCD	Member
2011	National Science Foundation (NSF)	Reviewer
2011	Special Emphasis Panel (ETTN E12) Study Section (NIH)	Member
2012	Special Emphasis Panel (ZDC1 SRB Y53) Study Section (NIH/NIDCD)	Member
2012	UK Medical Research Council Review	Reviewer
2012-2018	**Sensorimotor Integration (SMI) Study Section NIH**	**Regular Member**

Editorial Activities

Ad hoc Reviewer

1994	Aviation, Space, and Environmental Medicine
1995	Annals of Biomedical Engineering
1995-2011	Experimental Brain Research
1995-2011	Journal of Neurophysiology
1996-1997	Brain Research Bulletin
1996-2011	Journal of Vestibular Research
1997	Brain Research Reviews
1997-2011	IEEE Transactions on Biomedical Engineering
1999	Nature Neuroscience
1999-	Journal of the Association for Research in Otolaryngology

2001	Vision Research
2003	Perception and Psychophysics
2003-	IEEE Transactions of Neural Networks
2004-	Science
2004-	Journal of Neural Engineering
2006-	Brain Research
2006	PLoS Biology
2008-2011	Journal of Physiology
2008	Journal of Vision
2007-2011	Journal of Neuroscience
2010	Attention, Perception, & Psychophysics
2010	PloS One
2010	Neuroscience
2010	Cerebral Cortex
2010-	Otology & Laryngology
2011	Neuroscience Methods
2011	Hearing Research
2011	Journal of Neural Engineering
2011	IEEE Transactions on Neural Systems and Rehabilitation Engineering
2011	Annals of Otology

Other Editorial Roles

1997-2001	Editorial Board member	Journal of Vestibular Research
2004-2005	Guest Editor	Journal of Neural Engineering
2011	Associate Editor	IEEE 2011 EMBC
2012-	Board of Co-Editors member	Experimental Brain Research
2014-	**Associate Editor**	**Journal of Neurophysiology**

Honors and Prizes

1990	Sigma XI-National Scientific Honorary Fraternity
1990	Fellow, Winter Conference on Brain Research
1990	Payload Specialist Semi-Finalist, Spacelab mission "SLS-1"
1991	Visiting Scholar, University of Sydney
1995	Payload Specialist Semi-Finalist, Spacelab mission "SLS-2"
1995	**Biomedical Engineering Society's "Whitaker Young Investigator"**
2004	Invited Participant, NIDCD Workshop on Electrical Stimulation of Vestibular Nerve
2012-	Senior Member, Institute for Electrical and Electronics Engineering (IEEE)
2012-	**Fellow, American Institute of Medical and Biological Engineering (AIMBE)**
2014	**Inaugural Vestibular Disorders Association "Champion of Vestibular Medicine"**

Report of Funded and Unfunded Projects

Funding Information

Past

1986-1989	NASA Fellowship, Vestibulo-Ocular Responses during Centrifugation	PI
1991-1992	NASA, Vestibular Experiments in Spacelab Life Sciences – 1	Co-I
1992-1995	NASA, Vestibular Experiments in Spacelab Life Sciences – 2	Co-I

1993-1996	NASA,Visual-Vestibular Interactions	Co-PI
1994-1997	NASA, Mechanisms of Sensorimotor Adaptation to Centrifugation	Co-I
1995-1998	NASA, Otolith and Vertical Canal Contributions to Dynamic Postural Control	Co-I
1995-1999	NIH/NIDCD R01, Otolithic Control of Human Postural Sway Trajectories	Co-I
1996-1998	Medical Research Foundation of Oregon, Efficacy and Side-effects of Electrical Stimulation of Peripheral Vestibular Nerves	PI
1996-2001	NIH/NIDCD R01, Vestibular-ocular Responses during Combined Linear And Angular Stimuli	PI
1997-2001	Whitaker Foundation, Adaptive Responses of the Vestibulo-ocular Reflexes to Electrical Stimulation	PI
2000-2006	NASA, Influence of Sensory Integration on the Neural Processing of Gravito-inertial Cues	PI
2001-2004	NASA, neural Processing of Ambiguous Gravito-Inertial Cues	Co-I
2001-2006	NIH/NIDCD R01, Adaptation to Controlled Vestibular Stimulation	PI
2004-2006	NASA, The Influence of Rotational Cues on Human Tilt and Translation Responses	Co-I
2007-2008	NASA, The Influence of rotational Cues on Human Tilt and Translation Responses	PI
2006-2009	NIH/NIDCD R01, Vestibular influences on spatial orientation in monkey	Co-I
2007-2010	NIH/NIDCD R01, Development of semicircular canal prostheses for studies of vestibular plasticity	PI
2009-2012	European Commission, Closed loop neural prosthesis for vestibular disorders	Co-I
2012-2013	NIH R56, Innovative methodologies for measuring behavioral vestibular thresholds	PI
2009-2014	NIH/NIDCD R01, Vestibular prosthesis tested in a vestibulopathic model	Co-I
1999-2015	NIH/NIDCD R01, Vestibular thresholds, including psychophysical response dynamics	PI
Present		
2011-2017	MedEl, Supplementary Investigations to Support the Development of a Vestibular Implant Targeting Bilateral Vestibular Hypofunction	PI
2012-2017	NIH/NIDCD R01, Vestibular migraine investigated with psychophysical and oculomotor tests	Co-I
2013-2018	NIH/NIDCD R01, Vestibular contributions to estimated head motion and orientation	Co-I
2015-2020	NIH/NIDCD R01, Employing Vestibular Thresholds to Improve Patient Diagnosis	PI
2016-2018	NIH/NIDCD R21, Employing Magnetic Vestibular Stimulation (MVS) during Functional Imaging	PI
2016-2018	DOD SBIR, Assessment and Diagnosis of Vestibular Indicators of Soldier Operational Readiness	Consult.
2017-2019	DOD SBIR, Mathematical Model of Spatial Orientation	Co-I

Report of Local Teaching and Training

Teaching of Students in Courses

Undergraduate and Graduate course teaching:

Massachusetts Institute of Technology and HMS Whitaker College of Health, Science and Technology

1985-1993	HST Quantitative Physiology: Sensory and Motor Systems (6.032J/2.793J/16.351J/HST543J. Vestibular and eye movement laboratories
1987	HST Quantitative Physiology: Sensory and Motor Systems (6.032J/2.793J/16.351J/HST543J, Teaching Assistant

1992-1995	MIT Bioengineering Journal Article Seminar, Lecturer and Organizer
1994	HST Quantitative Physiology: Sensory and Motor Systems (6.032J/2.793J/16.351J/HST543J). Lecturer, Eye Movement Module
2000-2003	HST Space Biomedical Engineering & Life Support (16.423J/HST.515J). Lecturer, Central Neural Processing of Vestibular Cues
2002	HST Special Topics in Sensory-Neural Systems: Spatial Orientation form vestibular End Organs to Behavior and Adaptation (16.499J/HST.587J), Course Organizer and Lecturer
2004	HST Sensory-Neural Systems: Spatial Orientation from Vestibular End Organs to Behavior and Adaptation (16.430J/HST.514J), Course Organizer and Lecturer
2006-2012	HST Sensory-Neural Systems: Spatial Orientation from Vestibular End Organs to Behavior and Adaptation (16.430J/HST.514J), Lecturer
2014	**Sensory-Neural Systems: Spatial Orientation from Vestibular End Organs to Behavior and Adaptation (16.430J/HST.514J), Course Organizer and Lecturer**

Harvard School of Engineering and Applied Sciences

2007-2011	Introduction to Systems Analysis with Physiological Applications (ES 145/HST 545), Course Organizer and Lecturer
2012-2015	**Introduction to Systems Analysis with Physiological Applications (BE 110/HST 545), Course Organizer and Lecturer**
2015	**Bioelectromagnetics (BE 153 / ENG-SCI 253), Course Organizer and Lecturer**

Harvard College

2008	Perception, Lecturer, Vestibular System

Harvard/MIT Speech and Hearing Biosciences Technology Program

2016-2017	Lecturer, Vestibular System

Formally Supervised Trainees

1996-2000	Post-doctoral fellow supervisor, Dr. Lionel Zupan Presently: Associate Director for Research Technology at Tufts University Example paper: Merfeld D, Zupan L, Peterka R. Humans use internal models to estimate gravity and linear acceleration. Nature. 1999;398:615-8.
2002	Post-doctoral fellow research co-supervisor (with Dr. Kosslyn), Dr. Fred Mast Presently: Professor Ordinarius (full Professor) and Dean of Faculty at Bern University Example paper: Mast FW, Merfeld DM, Kosslyn SM. Visual mental imagery during caloric vestibular stimulation. Neuropsychologia. 2006;44(1):101-9.
2002-2003	Post-doctoral fellow supervisor, Dr. Sukyung Park Presently: Associate Prof., Korea Advanced Institute of Science and Technology Example paper: Park S, Gianna-Poulin C, Black FO, Wood S, Merfeld DM. Roll rotation cues influence roll tilt perception assayed using a somatosensory technique. Journal of neurophysiology. 2006;96(1):486-91.
2005-2006	Ph.D. thesis committee member, Jocelyn Songer, Speech and Hearing

2007	Post-doctoral fellow co-supervisor (with Dr. Eatock), Jocelyn Songer, Ph.D. Presently: Instructor, Harvard Medical School
2005-2009	Ph.D. thesis committee member, Hector Penagos, HMS/MIT HST
2008-2009	Ph.D. thesis co-supervisor, Andrew Rader, Ph.D., MIT Aero/Astro Example paper: Rader AA, Oman CM, Merfeld DM. Motion perception during variable-radius swing motion in darkness. Journal of neurophysiology. 2009;102(4):2232-44.
2004-2009	Ph.D. thesis supervisor, Michael Saginaw, Ph.D., MIT EECS Presently: Mathworks Example paper: Saginaw M, Gong W, Haburcakova C, Merfeld D. Attenuation of Eye Movements Evoked by a Vestibular Implant at the Frequency of the Baseline Pulse Rate. IEEE transactions on bio-medical engineering. 2010.
2007-2010	Research fellowship supervisor, Keyvan Nicoucar, M.D. Presently: Chief Otorhinolaryngology Resident, University Hospitals of Geneva Example paper: Grabherr L, Nicoucar K, Mast FW, Merfeld DM. Vestibular thresholds for yaw rotation about an earth-vertical axis as a function of frequency. Experimental brain research Experimentelle Hirnforschung. 2008, 186(4):677-81.
2007-2012	Post-doctoral fellow supervisor, Faisal Karmali, Ph.D. Presently: Assistant Professor, Harvard Medical School Example paper: Karmali, F, Merfeld DM. A distributed, dynamic, parallel computational model: the role of noise in velocity storage. Journal of neurophysiology, 2012.
2011-2013	Ph.D. thesis committee member, Lara Thompson, Speech and Hearing
2011-2012	Post-doctoral fellow supervisor, Yulia Valko, M.D. Presently: Neurologist, University Hospital Zurich, Zurich, Switzerland Example paper: Valko, Y, Priesol AJ, Lewis R, Merfeld DM. Vestibular labyrinth contributions to human whole-body motion discrimination. Journal of Neuroscience 2012;32(39):13537-42.
2012-2015	Post-doctoral fellow supervisor, Yongwoo Yi, Ph.D. Presently: Samsung Corporation, Seoul Korea Example paper: Yi, Y., & Merfeld, D. (2016). A Quantitative Confidence Signal Detection M 1. Fitting Psychometric Functions. J Neurophysiol, 115(4): 1932-1945.
2013-2014	Post-doctoral fellow supervisor, Torin Clark, Ph.D. Presently: Assistant Professor, University of Colorado-Boulder, Boulder Colorado Example paper: Clark, Newman, Oman, Merfeld, & Young. (2015). Human perceptual overestimation of whole body roll tilt in hypergravity. J Neurophysiol, 113(7), 2062-2077.
2013-2014	Post-doctoral fellow supervisor, María Carolina Bermúdez Rey Presently: Resident, Otolaryngology Example paper: Bermúdez Rey, Clark, Bian, Leeder, Wang, & Merfeld (2016), Vestibular Perceptual Threshold: Sex and Age Effects **7**(162).
2013-2017	Ph.D. supervisor, Koeun Lim, Harvard/MIT Speech and Hearing Biosciences
2016-	Post-doctoral fellow supervisor, Yong Bian

Local Invited Presentations

Local

1998	Invited Seminar Massachusetts Eye and Ear Infirmary *Separating Tilt from Translation: Neural Processing of Ambiguous Otolith Cues*
2002	Invited Seminar Man-Vehicle Laboratory, MIT *Chronic Electrical Stimulation of the Vestibular System: A Prototype Neural Semicircular Canal prosthesis*

2002 Invited Seminar Eaton-Peabody Laboratory, MEEI
Chronic Electrical Stimulation of the Vestibular system: A Prototype Neural Semicircular Canal Prosthesis
2005 Invited Seminar Eaton-Peabody Laboratory, MEEI
An Overview of Progress on a Vestibular Prosthesis
2008 Invited Seminar Have You Heard? Public Forum, MEEI
Vestibular Research Snapshots
2010 Invited Seminar, Neuroscience Grand Rounds, MGH
Help for patients suffering imbalance and spatial disorientation: balance aids and vestibular implants
2013 Invited Seminar, MEEI 2013 President's Lecture Series, MEEI
Imbalanced: Unlocking the Mysteries of Balance and Dizziness Disorders
2013 Invited Seminar, McGill University, Montreal Canada
Subjective Detection of Vertical Acceleration: A Velocity Dependetn Response?
2013 Invited Seminar, Harvard School of Engineering and Applied Science, Cambridge MA
Neuroengineering the Vestibular System
2014 Invited Seminar, Boston Museum of Science, Boston MA
Using Balance to Study Prevalence of Vestibular Dysfunction
2014 Invited Seminar, Schepens Eye Research Institute, Boston MA
Perceptual thresholds can help assay vestibular function and may help isolate vestibular deficits.
2014 Invited Seminar, Martinos Imaging Center, MGH Hospital, Boston MA
The Vestibular System: Moving MRI (mMRI)
2015 Invited Seminar, Audiology MEEI, Boston MA, *The Vestibular System: An Overview (including potential clinical applications)*
2015 Invited Seminar, SERI, MEEI, Boston MA, *Analyzing Confidence for a Binary Forced-Choice Direction-Recognition Task: A Confidence Signal Detection Model*

Report of Regional, National and International Invited Teaching and Presentations

Invited Presentations and Courses

Regional/National

1991 Invited Presentation "Sensing and Controlling Motion"
Effect of Gravity on Monkey Vestibulo-ocular Reflex
1994 Invited Seminar Boston University
An Observer Theory Model of Human Spatial Orientation
1994 Invited Seminar Tulane University
An Observer Theory Model of Human Spatial Orientation
1994 Invited Seminar R.S. Dow Neurological Sciences Institute
An Observer Theory Model of Human Spatial Orientation
1994 Session Organizer Neural Control of Movement Meeting
1996 Invited Seminar NAS/AAO-HNF/NASA
Video Eye Movements Measurements
1997 Invited Seminar Neurological Sciences Institute
Separating Tilt from Translation: Neural Processing of Ambiguous Otolith Cues
1997 Invited Seminar Oregon Graduate Institute
Spatial Orientation and Space

1998 Invited Seminar Gordon Conference on Gravitational Effects on Living Systems
Do humans use an "internal model" to separate gravity from linear acceleration?

1999 Invited Seminar Mt. Sinai School of Medicine
Separating Tilt from Translation: Neural Processing of Ambiguous Otolith Cues

2000 Invited Seminar University of Massachusetts – Worcester
Neural Processing of Ambiguous Otolith Cues

2000 Invited Seminar Boston University
Neural Processing of Ambiguous Otolith Cues

2001 Colloquia Colby College
Mathematics in Neurophysiology

2001 Invited Seminar Johns Hopkins University
Vestibular implants

2002 Invited Seminar NIH Neural Prosthesis Workshop
Vestibular Prostheses

2002 Invited Seminar Neurological Sciences Institute
Vestibular Implants: Introduction and Preliminary Studies

2002 Keynote Speaker 6th Symposium on Role of Vestibular Organs in Space Exploration
Influence of Rotational Cues on Tilt and Translation Responses

2002 Invited Speaker Orcas Island Satellite to the Barany Meeting
Roll Tilt Perception Depends on Roll Canal Cue

2002 Invited Seminar NIDCD Advisory Council
Preliminary Scientific Research on a Neurovestibular Prosthesis

2003 Session Chair Biomedical Engineering Society, Nashville, Tennessee

2003 Invited Seminar Conference on Implantable Auditory Prostheses
Preliminary Progress Towards a Neurovestibular Prosthesis

2003 Invited Lecture ARO Short Course, Vestibular System 101
Spaceflight Adaptation: The Influence of Rotational Cues on Tilt Responses

2004 Invited Speaker, NIDCD Workshop on Electrical Stimulation of the Vestibular Nerve
Central Aspects of Electrical Stimulation of the Vestibular Nerve

2005 Invited Seminar UC-Irvine, Irvine California
Progress Toward the Development of a Neurovestibular Prosthesis

2005 Session Chair Society for Neuroscience, Washington DC

2005 Invited Seminar Conference on Implantable Auditory Prostheses
Chronic Multi-Species Studies of Vestibular Prostheses

2005 Invited Seminar University of Utah, Salt Lake City, Utah
Multi-Species Studies of Vestibular Prosthetics

2006 Invited Seminar Kresge Hearing Research Institute, Ann Arbor Michigan
Vestibular Prosthetics: A Series of Multi-Species Investigations

2006 Invited Seminar Engineering Research Center, U. of Michigan, Ann Arbor Michigan
Vestibular Prosthetics: Multi-Species Investigations

2007 Invited Seminar Division of Engineering and Applied Sciences, Harvard University
Vestibular Prosthetics and Ultra-High Frequency Electrically-Evoked VOR

2007 Invited Talk, Media Lab, MIT
Vestibular Implants: Chronic Pre-Clinical Testing of a Novel Prosthetic

2008 Invited Seminar, University of Pittsburgh, Pittsburgh Pennsylvania
Vestibular Implants

2008 Invited Seminar, Schepens Eye Research Institute, Boston, MA
Ultra-High Frequency Vestibulo-ocular Reflexes

2008 Invited Speaker, Mathematics Biosciences Institute Workshop, Columbus Ohio
The contributions of internal models to the dynamics of vestibular perception and action

2012 Invited Seminar, Kresge Seminar Series, University of Michigan
Vestibular direction-recognition thresholds as a function of frequency: Translating basic research to the clinic

2012 Invited Shulman Seminar, Clarkson University
Vestibular direction-recognition thresholds as a function of frequency: Translating basic research to the clinic

2015 Invited Seminar, Johns Hopkins University
Perceptual Thresholds can help assay vestibular function and may help isolate vestibular deficits.

2015 Grand Rounds, Otolaryngology, Columbia University
Perceptual Thresholds can help assay vestibular function and may help isolate vestibular deficits: Basic and Translational Studies

2015 Invited Seminar, Kinesiology, U. Mass - Amherst
Perceptual Thresholds can help assay vestibular function and may help isolate vestibular deficits: Basic and Translational Studies

2016 Invited Seminar, Naval Medical Research Unit – Dayton (NAMRU-D)
Vestibular perceptual thresholds: Basic and translational studies

2016 Invited Seminar, Biomedical Engineering, The Ohio State University
Vestibular Confidence: Studying the Cinderella of Decision-Making Quantitatively

2016 Invited Seminar, Otolaryngology, The Ohio State University
Can vestibular perceptual thresholds help improve patient diagnosis & provide a functional assessment?

2016 Invited Seminar, BRAIN Program, NIH/NINDS
Can vestibular perceptual thresholds help improve patient diagnosis & provide a functional assessment?

2016 Invited Seminar, Otolaryngology, U. of Miami
Vestibular Confidence: Quantitative Clinical and Engineering Studies

2016 Invited Seminar, Biomedical Engineering, U. of Iowa
Vestibular Confidence: Studying the Cinderella of Decision-Making Quantitatively

2016 Invited Seminar, Otolaryngology, U. of Iowa
Can vestibular perceptual thresholds help improve patient diagnosis & provide a functional assessment?

2016 Invited Seminar, Psychology Department, Brandeis University
A Confidence Model for Vestibular Psychophysical Thresholds

2016 Invited Seminar, Draper Laboratories, Cambridge MA
A Confidence Model for Efficient Estimation of Vestibular Thresholds

International

1995 Invited Talk Neurology of Human Spatial Orientation, Ibiza Spain
Eccentric Rotation Responses in both Humans and Monkeys

2001 Invited Seminar York University, Toronto, Ontario, Canada
The influence of rotational cues on the neural processing of tilt and translation

2002 Invited Lecturer International Space University
Rotation Otolith Tilt Translation Reinterpretation (ROTTR) Hypothesis: New Investigations of Neurovestibular Adaptation to Spaceflight

2003 Invited Seminar University of Geneva, Switzerland

Preliminary Scientific Research on a Neurovestibular Prosthesis

2005 Invited Lecturer German Summer School, Munich, Germany
Vestibular Prostheses: Chronic Studies in Three Mammalian Species

2006 Invited Seminar Wahrnehmungskonferenz, Tubingen, Germany
Investigations Developing a Vestibular Prosthesis

2006 Invited Seminar University of Rome Tor Vergata, Rome, Italy
Processing Ambiguous Gravito-inertial Cues: Qualitatively Different Strategies Are Used to Elicit Reflexive and Perceptual Responses

2008 Invited Seminar International Workshop on Biomimetic System Design, KAIST, S. Korea
Investigations of a Sensorineural Implant to Replace Absent Vestibular Function

2008 Invited Seminar University of Nijmegen, The Netherlands
The dynamics of human motion perception

2008 Invited Seminar Jeju Science School, Jeju, S. Korea
Replacing a broken sensory system: Vestibular prosthesis research

2008 Invited Seminar Biomimetics Laboratory ME Dept., KAIST, S. Korea
Contributions to roll tilt perception

2009 Invited Speaker DGN Neuroprosthetics Symposium, Nuremberg, Germany
Vestibular Implants: State of the Art

2010 Invited Seminar Fixational Eye Movements and Visual Stabilization, Stockholm Sweden
VOR threshold dynamics

2011 Invited Speaker Bertarelli Program in Translational Neuroscience and Neuroengineering Lausanne, Switzerland *Vestibular Neuroengineering: A Glimpse to the Future?*

2013 Invited Speaker Neurology, University Hospital Zurich, Zurich, Switzerland
Assaying Vestibular Function via Threshold Testing: Basic and Translational Research

2013 Invited Speaker Psychology Institute, Bern University, Bern, Switzerland
Assaying Vestibular Function via Threshold Testing: Basic and Translational Research

2013 Invited Speaker EPFL, Lausanne, Switzerland
Multi-Species Studies of a Vestibular Implant

2014 Invited Speaker University of Geneva Hospital, Geneva, Switzerland
Perceptual Thresholds can help assay vestibular function and may help isolate vestibular deficits

2014 Invited Speaker Neural Control of Movement Vestibular Satellite, Amsterdam
Perceptual Thresholds can help assay vestibular function and may help isolate deficits

2015 Invited Speaker MedEl, Innsbruck, Austria, "*Multi-species studies of a vestibular implant*"

2015 Invited Speaker ORH-HNS, Prague, "*Perceptual thresholds can help assay vestibular function and may help isolate deficits: Basic and translational studies"*

2015 Invited Speaker ORH-HNS, Prague, "*Multi-species studies of a vestibular implant*"

2015 Keynote Address 8th Australasian Workshop on Computational Neuroscience and Neuromorphic Engineering, Queenstown New Zealand, *Translating Vestibular Neuroengineering and Neuroscience to the Clinic*

2016 Speaker Barany Society Meeting, Seoul, Korea
Multi-Species Vestibular Implant Studies

2016 Invited Speaker Barany Society Satellite Meeting, Seoul, Korea
Vestibular Perceptual Thresholds Vary Consistently with Age

2016 Invited Speaker MedEl Workshop, Frankfurt, Germany
Multi-Species Vestibular Implant Studies

Report of Technological and Other Scientific Innovations

Patent # 6,546,291	Merfeld, D, Rauch, S, Wall, C, and Weinberg, M (2003). Balance Prosthesis.
Patent # 7,454,246	Merfeld, D (2008). Sensor Signal Alignment
Patent # 7,488,341	Merfeld, D (2009). A method for optical stimulation of the vestibular system
Patent # 7,789,838	Merfeld, D, Haburcakova, C, and Saginaw, M (2010). Audible Range Oculocometry for Assessment of Vestibular Function
Patent # 7,730,892	Merfeld, D, Gong, Rauch, Terry, Wall (2010). Mechanical vestibular stimulator
Patent # 7,933,654	Merfeld, D, Gong, Rauch, Wall (2011). Vestibular stimulator
Patent # 7,912,542	Merfeld, D (2011). Sensor signal alignment
Patent # 7,962,217	Merfeld, D, Gong, Rauch, Wall (2011). Vestibular stimulator
Patent # 8,372,127	Merfeld, D (2013). Optical Vestibular Stimulator
Patent # 8,430,823	Merfeld, D, Gong, Rauch, Terry (2013). Vestibular Canal Plug
Patent # 8,532,759	Merfeld, D (2013). Sensor Signal Alignment
Patent # 8,543,212	Merfeld, D, Gong, Rauch, Wall (2013). Vestibular stimulator

Report of Scholarship

Publications

1. **Merfeld DM**, Kelly AJ, and Jahn RG (1986). MPD Thruster Performance: Propellant Distribution and Species Effects. Journal of Propulsion and Power 2(4):317-322
2. Arrott AP, Young LR, and **Merfeld DM** (1990). Perception of Linear Acceleration in Weightlessness. Aviation, Space and Environmental Medicine 61(4):319-326.
3. **Merfeld DM**, Young LR, Tomko DL, and Paige GD (1991). Spatial Orientation of VOR to Combined Vestibular Stimuli in Squirrel Monkeys. Acta Otolaryngologica Supplement 418:287-292.
4. **Merfeld, DM** and Young LR (1992). Three Dimensional Eye Velocity Measurement Following Postrotational Tilts in Monkeys. Annals of the New York Academy of Science 656:783-794.
5. **Merfeld DM**, Young, LR, Paige GD and Tomko DL (1993). Three Dimensional Eye Velocity Measurement Following Postrotational Tilts in Monkeys. Journal of Vestibular Research 3(3):231-239.
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Thesis

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Narrative Report

I am a neuroengineer/neuroscientist who performs both basic and translational research related to the vestibular system and our sense of equilibrium. My research has shown that tilt and translation perception result from multi-sensory signal convergence via internal models. As translational research, I developed vestibular implants and demonstrated feasibility of this new treatment for vestibular loss. My most recent basic and translational research efforts focus on vestibular thresholds and understanding how the brain processes information in the presence of noise and how this might impact clinical diagnoses. My primary teaching contribution has been organizing and teaching a required Harvard bioengineering undergraduate class. Indicating national service, I have chaired an NIH grant review panel and have been a regular member of the Sensorimotor Integration (SMI) study section since 2012. I have also served as an Associate Editor for the Journal of Neurophysiology since July 2014.

My early research focused on understanding how the brain processes ambiguous sensory information with a specific focus on how signals from the otolith organs are interpreted and processed by the nervous system. This research – both modeling and experimental – showed that the nervous system uses rotational signals from the canals to help keep track of the relative orientation of gravity via internal models. Furthermore, my research was the first to show that these internal models influence translation perception and the first to show that rotational cues provided via vision (i.e. optokinetic cues) influence both translational reflexes and perception. More recently, we showed for the first time that vestibular "perception" and "action" can use *qualitatively* different neural mechanisms. Recent research builds on these earlier findings and focuses on the measurement of thresholds, which is one way to assay vestibular "noise" so that we can learn how vestibular information is processed in the presence of noise. We also have begun using objective electroencephalography (EEG) recordings to accompany perceptual recordings. Finally, we have also begun to develop a novel brain imaging technique that we call moving MRI (mMRI); our long-term goal is to image brains of behaving humans during naturalistic motions.

I have also been heavily involved with translational research. As first in the field, my collaborators and I developed vestibular implant methods and technologies that are now used by other groups. Explicit recognition is demonstrated by the fact that I have been invited to speak about vestibular prosthetics to the NIDCD Advisory Council (2002) and at the NIH Neural Prosthetic Workshop (2003). I also participated in the NIDCD Workshop on Electrical Stimulation of the Vestibular Nerve (2004). Other tangible gauges include 11 patents – with 7 of these patents licensed by a commercial entity. As a separate, though clinically- related project, we are now working to improve vestibular diagnostics.

As Jenks Vestibular Physiology Lab Director, my administrative responsibilities focus on developing and managing infrastructure and policies to promote sharing of scarce resources by multiple PIs.

I have also made significant education contributions. Each fall for 8 years, I taught the engineering systems course ("ES145: Physiological System Analysis") required of Harvard undergraduate bioengineering students. I also initiated and organized the Harvard-MIT HST course entitled "Sensory-Neural Systems: Spatial Orientation from Vestibular End Organs to Behavior and Adaptation", which has been taught every other year since 2002. Furthermore, despite never having a primary appointment at an engineering institution, I have also been a primary supervisor for three MIT Ph.D. engineering theses. Finally, I am a coauthor on an undergraduate textbook entitled Sensation and Perception; it is the only current sensation and perception text to include an in-depth chapter on the vestibular system. This book is now in its fourth edition and is established as a popular sensation and perception textbook.

In summary, I am an neuroengineer/neuroscientist who performs basic and translational research; my translational research focuses on the development of new diagnostics and new treatments for patients suffering vestibular disorders. Since obtaining my first NIH grant I have maintained continuous NIH funding for 20 years. I have served as an NIH grant review panel Chairman, served on more than 15 NIH review panels, and am serving as a regular member of the SMI study section from 2012 to 2018. I have sought opportunities to teach and am even the co-author on a popular undergraduate textbook.