JAMES EDWARD COLGATE

Department of Mechanical Engineering
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Citizenship: U.S.A.
Birthdate: 9-30-62

Research Interests

- Human-Machine Systems. Especially haptic interface and cobotics.
- Physical Systems Modeling, Analysis, and Control.

Academic History

Northwestern University, Department of Mechanical Engineering

Walter P. Murphy Professor, 2022-present
Allen and Johnnie Breed University Professor of Design, 2010-2020
Director, Master of Science in Engineering Design & Innovation (EDI), 2007 – 2017
Director, Segal Design Institute, July 2010 – September 2011
Co-Director, Segal Design Institute, March 2007-June 2010
Pentair-Nugent Professor, September 2006 – August 2009
Alumnae of Northwestern Professor of Teaching Excellence, September 2003 – August 2006
Professor and Director, Institute for Design Engineering and Applications, September 2002 – March 2007
Associate Professor, September 1994 - 2002
Assistant Professor, September 1988 - September 1994

Gwangju Institute of Science and Technology

Adjunct Professor, 2007-2010

Massachusetts Institute of Technology, Department of Mechanical Engineering

PhD, Mechanical Engineering, September 1988
Advisor: Neville Hogan
Thesis: "The Control of Dynamically Interacting Systems"

S.M., Mechanical Engineering, January 1986
Advisor: Neville Hogan
Thesis: "The Design of a Dynamics Measuring Device"

Massachusetts Institute of Technology, Department of Physics

S.B., Physics, June 1983
Advisor: Neville Hogan
Thesis: "Design of a Gripper Capable of Repositioning Objects within its Grasp"

Honors

- IEEE Transactions on Haptics Best Short Paper (Runner Up) for "A low-parameter rendering algorithm for fine textures," David A. Burns, Roberta L. Klatzky, Michael A. Peshkin, and J. Edward Colgate, 2022.

- Member, National Academy of Engineering since 2021

- IEEE Transactions on Haptics Best Application Paper Award for "The Application of Tactile, Audible, and Ultrasonic Forces to Human Fingertips Using Broadband Electroadhesion," Craig D. Shultz, Michael A. Peshkin and J. Edward Colgate *IEEE Transactions on Haptics*, 11(2):279-290, 2018

- Researcher to Know, 2018 (Inaugural Class). Illinois Science & Technology Coalition

- Best Paper Award, 2018 IEEE Haptics Symposium for "On the Electrical Characterization of Electroadhesive Displays and the Prominent Interfacial Gap Impedance Associated with Sliding Fingertips: C. Shultz, M.A. Peshkin and J.E. Colgate

- Tibbets Award, US Small Business Administration (awarded to Tanvas, Inc.), 2016

- Inductee, Chicago Area Entrepreneurship Hall of Fame, 2015

- Fellow, National Academy of Inventors since 2015

- Honorable Mention Award, CHI 2014, for "Exploring Affective Communication Through Variable-Friction Surface Haptics," Mullenbach, J., C. Shultz, J. E. Colgate, and A. Marie Piper. ACM Conference on Human Factors in Computing Systems (CHI '14), Toronto, Canada

- Fellow of the IEEE since January 2014

- Best Poster Award Haptics Symposium 2012 "ActivePaD Surface Haptic Device," Joe Mullenbach, Dan Johnson, J. Edward Colgate, Michael A. Peshkin

- Best Paper Award, CHI 2011 for "Enhancing Physicality in Touch Interaction with Programmable Friction" by Vincent Lévesque, Louise Oram, Karon MacLean, Andy Cockburn, Nicolas D. Marchuk, Dan Johnson, J. Edward Colgate and Michael A. Peshkin. Proc. ACM Conference on Human Factors in Computing Systems (CHI '11), Vancouver, Canada, May 2011, pp. 2481-2490.

- Visiting Professor, University of Siena, Siena, Italy, July 2008. Taught a one-week PhD course on "The Passivity Approach to Haptic Display" sponsored by the University of Siena and the IEEE Robotics and Automation Society, Italian chapter.

- Best Demonstration Award, 2007 World Haptics Conference, Tsukuba, Japan. For TPaD: Tactile Pattern Display, by Laura Winfield, J. Edward Colgate and Michael Peshkin.

- Emerald Literati Network Awards for Excellence 2007, "Highly Commended" citation for "Lessons Learned from a Novel Teleoperation Testbed" by B.P. Dejong, E.L. Faulring, J.E. Colgate, M.A. Peshkin, H. Kang, Y.S. Park, T.F. Ewing, Industrial Robot, 33(3): 187-193, 2006

- Pentair-Nugent Professorship, September 2006-August 2009

- Visiting Professor, Institut d'Organització i Control de Sistemes Industrials, Universitat Politéchnica de Catalunya, April 2006

- Leonardo Da Vinci Award for Contributing Significantly to Design Engineering, 2003. Presented by Design Engineering Division of the American Society of Mechanical Engineers.

- Alumnae of Northwestern University Teaching Professorship, 9/03 – 8/06.
- Freshman Programs Division (FPD) 2002 Best Paper Award for paper "Enriching Freshman Design Through Collaboration With Professional Designers" by P. Hirsch, J. Anderson, J.E. Colgate, J. Lake, B. Shwom, and C. Yarnoff.
- Northwestern University Alumni Association Excellence in Teaching Award, 2000
- 1998 ASME Material Handling Engineering Division Best Paper Award for paper "Cobots: A Novel Material Handling Technology" by Wannasuphoprasit, W., Akella, P., Peshkin, M., Colgate, J.E.
- Finalist, Discover Magazine Awards for Technological Innovation, 1997 (with M.A. Peshkin)
- Best Paper Award, 1996 IEEE International Conference on Robotics and Automation for paper "Nonholonomic Haptic Display" by J.Edward Colgate, M.A. Peshkin and W. Wannasuphoprasit
- Guest Researcher, Mechanical Engineering Laboratory, Ministry of International Trade and Industry, Tsukuba Science City, Japan, 2/96
- Henry Hess Award for outstanding paper by a young author in an ASME journal, 1995 for paper entitled "Coordinate Transforms and Logical Operations for Minimizing Conservativeness in Coupled Stability Criteria"
- Ralph R. Teetor Educational Award of the SAE, 1995
- Associated Student Government Faculty Honor Roll, 1994-1995
- National Science Foundation Fellow, 1983-1986
- Luis de Florez Award for best student engineering design, MIT, 1983
- National Merit Scholarship recipient, 1979

Graduate and Postgraduate Students

Postdoctoral Associates

Aksoy, Bekir (current)
Wiertlewski, Michael (Assistant Professor, Delft University of Technology)
Kim, Keehoon (Associate Professor, POSTECH)
Gillespie, Brent (Professor, University of Michigan)
Burdet, Etienne (Professor, Imperial College London)
Kotoku, Tetsuo (Robotics Department, Mechanical Engineering Laboratory, AIST, MITI)

PhD Students (completed)

Burns, David	A Multi-Scale, Low-Parameter Rendering Algorithm for Data-Efficient Virtual Textures 6/23 (Littelfuse, Inc.)
Grigorii, Roman	Capture, playback, and enhancement of tactile texture - merging physics and perception 7/21 (west coast startup)
Xu, Heng	Active Lateral Force Feedback on Bare Fingertips and Its Applications, 3/21 (Guangzhou, China)
Fenton Friesen, Rebecca	A 3-parameter Design Space for Fine Texture Display, 7/20 (Assistant Professor, Texas A&M University)
Shultz, Craig	Understanding and Exploiting Electroadhesion of Human Fingertips for High

	Performance Surface Haptic Applications, 11/17 (Assistant Professor, UIUC)
Mullenbach, Joseph	Force Feedback on the Fingertip: Creating a Surface Haptic Display through Oscillation of an Electroadhesive Surface, 5/16 (CEO, Fluid Reality)
Meyer, David J.	Design Considerations and Digital Tools for Implementing Variable Friction Tactil Displays, 11/15 (Apple)
Manuel, Steven	Perceiving More than We Feel: Extrapolating Diverse Structures from Sparse Force Feedback at Multiple Fingers, 6/14 (Intuitive Surgical)
Aguirre-Ollinger, Gabriel	Active Impedance Control of a Lower-Limb Assistive Exoskeleton, 9/09 (National University of Singapore)
Weir, David	Assessing and Increasing Z-Width of Haptic Displays with Active Electrical Damping, 6/08 (Intuitive Surgical)
Dejong, Brian	On Cyclic Robots for the Lower Limb, 12/07 (Central Michigan University)
Epstein, Michael	Generating Thrust with a Biologically Inspired, Robotic Ribbon Fin, 9/06
Faulring, Eric	The Cobotic Hand Controller: Design, Control and Analysis of a Novel Haptic Display, 12/05 (HDT Robotics)
Salada, Mark	Fingertip Haptics: Preliminary Experiments on the Perception of Slip in Haptic Feedback, 6/04 (entrepreneur)
Miller, Brian	Stability of Haptic Systems Exhibiting Non-Passive Behavior, 9/00 (Intuitive Surgical)
Reger, Bernard	A Neuro-Robotic Interface for the Study of Synaptic Plasticity in Sensorimotor Adaptation, 6/99 (US Army)
Wannasuphoprasit, Witaya	Cobots: Collaborative Robots, 6/99 (Professor, Chulalongkorn University, Bangkok Thailand)
Brown, J. Michael	Passive Implementation of Multibody Simulations for Haptic Display, 6/98 (Intuitive Surgical)
Stanley, Michael	High Fidelity Haptic Display of Complex Environments, 6/97
Tsai, Jui-Chang	Toward Guaranteed Stability in the Haptic Display of Virtual Environments, 6/96
Millman, Paul	Haptic Perception of Localized Features, 12/95 (Intuitive Surgical)
Grace, Ken	Kinematic Design of an Ophthalmic Surgery Robot and Feature Extracting Bilatera Manipulation, 6/95
Matsumoto, Hirofumi	Mechanisms and Characteristics of Micro Electrostatic Linear Actuators, 6/92 (Nippon Mektron, Ltd.)

Teaching

Dynamic Systems and Control

- ME 495 Robot Design Studio

- ME 495 Haptic Interface
- ME 390 Introduction to Dynamic Systems

Since 2012, I have taught this required ME course as a flipped classroom. I have created ~80 videos, each approximately 10 (+/- 5) minutes long. Students watch 2 or 3 of these each evening and hand in a single "lecture comprehension" problem in class the next day. Class begins with me working out the solution to that problem, and then goes into either homework or group activities. I have learned many things in the past two years, the most important of which is that creating good video content is only the tip of the iceberg in the flipped classroom milieu. The real opportunity for brick-and-mortar universities is creating great in-classroom experiences, and in this regard, a great deal of innovation and experimentation is needed.

- ME 391 Fundamental of Control Systems
- ME D91 State Space Control Theory
- ME 492 Robust Control Theory
- ME D95 Computational Mechanics

Design

- Robot Design Studio
- MOOC: Leadership Through Design Innovation. Part of a Coursera Specialization in Organizational Leadership: https://www.coursera.org/specializations/organizational-leadership
- DSGN 401-1,2 Human Centered Design Studio
- IDEA 306 Technology Assessment and Innovation
- IDEA 298/398 Multidisciplinary Design Projects
- ME C98 Capstone Design
- Design Thinking and Communications (DTC)

I was a founding co-Director (with Donald A Norman) of the Segal Design Institute (www.segal.northwestern.edu) which focuses on teaching and researching design methodology in multiple contexts, including business, engineering, and communications. Segal offers a variety of programs, including MMM, a joint degree of the engineering and business schools; EDI, a one-year master's program in human-centered design for the recent engineering graduate; MaDE, a bachelor's degree in manufacturing and design engineering; the Certificate in Engineering Design that any undergraduate can earn; a freshman program called "Design Thinking and Communication" (DTC) which is a standard part of the engineering curriculum at Northwestern and is taken by nearly 400 students annually. I was instrumental in starting EDI, the Certificate in Engineering Design, and DTC. In 2011, I stepped down from the Segal directorship to focus on reinvigorating my haptics research program and to start a company, but I continued to direct the EDI master's program until beginning entrepreneurial leave in 2017.

Professional Activities

Professional Associations

- ASME
- IEEE (Fellow)
- ASEE

Editorial Responsibilities

- IEEE Transactions on Haptics, Founding Editor-in-Chief, 2007-2014
- IEEE Transactions on Robotics and Automation, Associate Editor, 1998-2003

- Journal of Dynamic Systems, Measurement and Control, Associate Editor, 1995-1998
- Robotics and Computer Integrated Manufacturing, U.S. Editor, 1995-1999

Commercialization

- Founder (with M.A. Peshkin) of Tanvas, Inc. Tanvas developed haptics technology for touch screens and touch pads. Served as CEO 7/17-9/19.
- Founder (with M.A. Peshkin and D. Brown) of Kinea Design, LLC (www.kineadesign.com). Kinea Design applies robotics to enhance the physical activity of people. Kinea is now HDT Robotics.
- Founder (with M.A. Peshkin) of Cobotics, Inc (www.cobotics.com). Cobotics is the leading provider of human assist technology for the industrial marketplace. From June 1999 until September 2000, I took a sabbatical leave from Northwestern University to serve as the Company's President. In 2002 the company was sold to The Stanley Works.

Selected Other Activities

- Awards Chair, IEEE Technical Committee on Telerobotics Best Student Paper, 2023
- Awards Chair, World Haptics Conference 2023
- Judge for the ANA Avatar XPrize, 2019-2022.
- Awards Chair, World Haptics Conference 2021
- Advisory Committee for Smart Haptics 2017-2021, the first industry-facing haptics conference
- Chair of Steering Committee, IEEE World Haptics Conference, 2015-2017
- General Chair of World Haptics 2015, Evanston, IL. WHC15 was the largest haptics conference ever held. In it, we introduced many features new to the field: two presentation tracks rather than one, a new work-in-progress paper category and associated evening poster presentation, "referral" of the top-reviewed papers to the *IEEE Transactions on Haptics*, and a Student Innovation Competition. All of these features have been retained in subsequent conferences.
- Chair of Steering Committee, *IEEE Transactions on Haptics*, 1/1/2015-12/31/16
- Member, Board of Directors, Methode Electronics Corporation (NYSE:MEI), 2004-2014. Methode is a global manufacturer of component and subsystem devices with manufacturing, design, and testing facilities in the United States, Mexico, Malta, United Kingdom, Germany, Egypt, Singapore, and China.
- Student in "Management Skills for Innovative University Leaders," Kellogg School of Management, Northwestern University, January-March 2013.
- Founding Chair (with B.D. Adelstein) of the "Symposium on Haptic Interfaces to Virtual Environments and Teleoperators," which is today the leading conference of the haptic interface research community. Dr. Adelstein and I organized this conference from 1992 until 1995.
- Organizing Committee, "Strategic Development of Products and Environments for People with Stroke: Designing for a Unique Market." Rehabilitation Institute of Chicago Academy, October 6, 2006.
- Member, External Advisory Board, University of Delaware Department of Mechanical Engineering, 2008-2009
- Host for the Haptics Community Web Page (haptic.mech.northwestern.edu) that was developed by my graduate students J. Michael Brown and Bernard Reger.

- Reviewer for numerous publications, NSF programs, and multiple other funding agencies
- ASME Dynamic Systems and Control Division, Robotics Panel, Chair 1993-1995

Service to Northwestern University

Committees, University

- Faculty Appeals Panel, 2022-2024
- Conflict of Interest Policy Committee, 2013-2015
- Evanston Space Planning Advisory Committee, 2005-2008
- Parking Committee, 2003-2006
- Information Technology Committee, 1997-2003
- UFRTDAP, 1995-2000

Committees, McCormick School of Engineering and Applied Science

- Search Committee, EECS Faculty, 2017
- Promotion & Tenure Committee, 2005, 2008-2010, 2014-2015, 2019-2021
- Ford Engineering Design Center Building Committee, 2000-2005
- Co-op Committee, 1998-1999
- Undergraduate Curriculum Revision Committee, 1995-1996
- Computer Committee, 1989-1994
- Academic Standing Committee, 1992-1995
- McCormick Committee on Excellence (Subcommittee on Comparing Academic Cultures), 1993
- Dean's committee for assessment of Lower Division requirements in science and mathematics, 1989-1991.

Committees, Department of Mechanical Engineering

- Executive Committee, 2021-
- Department Chair Search Committee, 2019-2020
- Awards Committee, 2006-present
- Shop Committee, 2000-2005
- Executive Committee, 1998-2000
- Graduate Studies Committee, 1994
- Graduate Curriculum in Mechanics, Control and Manufacturing, 1993
- Benchmarking Committee, 1993
- Undergraduate Curriculum in Mechanics, Control and Manufacturing, 1988-1989

Other

- Wildcat Days Speaker, 2014-2016 (research presentation to admitted students and parents)

Sponsored Research

NSF, *"Unboxing" Haptic Texture Perception: Closing the Loop from Skin Contact Mechanics to Novel Haptic Device*, with Profs. Melisa Orta Martinez and Roberta Klatzky (CMU) and Cynthia Hipwell (TAMU), 10/1/23-9/30/26

DOE, *Mobile Robotic Hot Cell/Glovebox System for Hazardous and Radioactive Waste Disposition*, 2/24/23-1/31/24.

NSF, *Shape-Based Remote Manipulation*, 9/1/22-8/31/26, with Profs. Matt Elwin, Carl A. Moore (FAMU) and Rodney Roberts (FAMU).

NSF, *TouchBots for Surface Haptics*, 10/1/21-9/30/24, with Profs. Liz Gerber and M. Cynthia Hipwell (TAMU).

DARPA, *Complete Fog of Force Control*, 3/31/20-12/31/20, with Prof. Todd D. Murphey (PI).

NSF, EXP: *Advancing Early STEM Learning through Haptic Feedback Displays*, 9/1/15-8/31/18, with Profs. Anne Marie Piper (PI) and Ellen Wartella.

NSF, *TextureShop: Tools for the Composition and Display of Virtual Texture*, 7/1/15-6/30/19, with Profs. Michael Peshkin, Roberta Klatzky, and Sliman Bensmaia

NSF, *Autonomous Synthesis of Haptic Languages*, 8/1/14-7/31/17, with Prof. Todd D. Murphey (PI).

NSF, *Force Feedback for Fingertips*, 8/1/13-7/31/16, with Profs. Michael Peshkin, Tom Royston and Dieter Klatt

NSF, *Surface Haptics via Tractive Forces*, 7/1/10-6/30/14, with Profs. Michael Peshkin and Roberta Klatzky

DARPA (Subcontract with Johns Hopkins University Applied Physics Laboratory), *Revolutionizing Prosthetics 2009 Phase II*, 4/00-4/10, $420,000, with Prof. Michael Peshkin

Lemelson Foundation, The NUberwalker: Low Cost Body Weight Supported Treadmill Training System, 9/1/05-12/31/06, $20,000

Ford Motor Company, *Enhancing the Continuous Awareness of Automobile Drivers for Increased Safety*, 10/06-9/07, $72,000, with Profs. Michael Peshkin and Donald A. Norman

DARPA (Subcontract with Johns Hopkins University Applied Physics Laboratory), *Revolutionizing Prosthetics 2009 Phase I*, 12/05-11/07, $433,305, with Prof. Michael Peshkin

DARPA (Subcontract with DEKA Corporation), *Prosthetics 2007*, 12/05-11/07. $244,168, with Prof. Michael Peshkin

Honda Research Institute, *Coupled-Stable Human Interface to an Assistive Exoskeleton*, 12/1/04-3/31/06, $100k, with Prof. Michael Peshkin

NSF, *Variable Compliance Haptic Field Displays*, 9/1/04-8/31/07, $517k, with Profs. Michael Peshkin and Kornell Ehmann

Rehabilitation Institute of Chicago, *IDEA Training*, 10/03-9/08, $287k

NIST (ATP) and Rehabilitation Institute of Chicago, *Kine-assists for Physical Therapists*, 6/03-11/04, $1,814,626, with M.A. Peshkin and D.A. Brown

NSF, *Institute for Design Engineering and Applications: Fostering Creative Synthesis Across the Curriculum*, 9/02-8/03, $100k, with W. Hopp, A. McKenna, S. Mehrotra, D.Norman, G. Olson

NSF, *Fingertip Haptics: a Novel Direction in Force Feedback Systems*, 9/01-8/04, $327k

DOE, *Remote manipulation for D&D exhibiting tele-autonomy and tele-collaboration*, 10/01-9/04, $400k, with Professor Michael Peshkin

NSF Grant Opportunities for Academic Liason with Industry, 2000-2002, *GOALI - Haptic Cobots*, $450K (with M.A. Peshkin, Pietro Buttolo, Paul Stewart)

Ford Motor Company, 2000-2002, *University Research Program - Haptic Cobot*, $150K (with M.A. Peshkin)

Ford Motor Company, *Human Factors*, 8/99, $50,000, with Professor Michael Peshkin

ONR, *The Wildcat: A High Performance Haptic Display*, 9/97-2/98, $104,800

Murphy Society, *Engineering Design and Communication: An Infrastructure Proposal*, 9/97-9/98, $85,278

Proctor and Gamble, *Engineering First: Engineering Design and Communication* , 6/97-6/00, $150,000

NSF, *Vehicle Assembly Assistive Devices Using Programmable Constraint Machines*, 9/96-8/99, $326,847, with Professor Michael Peshkin

NSF, *Robust Haptic Display of Dynamical Virtual Environments (for R. Brent Gillespie)*, 3/96-3/98, $46,191

The Margaret W. and Herbert Hoover Jr. Foundation, *GRIN Endoscope Imaging of the Retina: Applications to Microsurgery*, 7/95-6/96, $39,914, with Professor M.R. Glucksberg

General Motors Corporation, *Operator Assistive Devices for Vehicle Assembly*, 5/1/95-4/30/00, $500,000, with Professors A. Haddad, L. Massone, M. Mavrovouniotis, M. Peshkin, and M. Van Oyen

ONR, *The Organization of Motor Behavior by the Combination of Vector Fields in Biological and Artificial Systems*, 3/1/95-2/28/98, $357,445, with Professor F.A. Mussa-Ivaldi

NASA, Graduate Student Researchers Program (for J. Michael Brown), 7/1/94-6/31/95, $22,000

NASA, *A Preliminary Investigation of Haptic Display for EVA Training,* 6/94-2/95, $47,995

NSF, *Real-Time Haptic Display of Rigid Body Dynamic Systems,* 6/94-5/97, $150,803

The Margaret W. and Herbert Hoover Jr. Foundation, *A Microinjection System for Treatment of Retinal Vascular Occlusion: Transition to Clinical Practice*, 1/94-12/94, $34,208, with Professor M.R. Glucksberg

NSF, *Average Power as a Measure of Dexterity in Generalized Hand Tool Use,* 1/93-12/95, $203,000

NSF, Research Experiences for Undergraduates Supplement, *Dexterity Enhancement Via Macro-Micro Bilateral Manipulation,* 7/92-6/93, $8,875

The Margaret W. and Herbert Hoover Jr. Foundation, *A Microinjection System for Treatment of Retinal Vascular Occlusion,* 1/92-12/93, $91,324, with Professor M.R. Glucksberg

Chrysler Corporation, *Performance Investigation of Hydroelastic Mounts,* 9/91-8/93, $170,900, with Professors L.M. Keer and W.K. Liu

NSF, *Dexterity Enhancement Via Macro-Micro Bilateral Manipulation,* 6/91-6/94, $200,000

Whitaker Foundation, *Linear Electrostatic Microactuator Development: Potential Building Blocks for Artificial Muscles*, 4/91-3/94, $179,937

Nippon Mektron, Ltd., *Linear Electrostatic Actuator Development,* $18,000 in kind support, 1/91-8/93

Engineering Foundation, *Dexterity Enchancement Via Macro-Micro Bilateral Manipulation,* 9/90-8/91, $20,000

Invited Presentations

Touching the Virtual and Remote
Ocado Group, June 2023

Robots and Cobots
CTO Forum, May 2023

Progess in the Design of Distributed Electroadhesive Haptic Displays
Materials Research Society Spring Meeting, April 2023

Growing the Tactile Gamut
Johns Hopkins University, March 2023

Toward the Design of High-Realism Texture Displays
Materials Research Society Fall Meeting, December 2022

How Haptic Technologies will Reshape our Lifestyle
Association of Chinese-American Scientists and Engineers, October 2022

Growing the Tactile Gamut
The Polytechnic University of Hong Kong, July 2022 (85th Anniversary Distinguished Lecture)

Growing the Tactile Gamut
Cirrus Logic, June 2022

Growing the Tactile Gamut
Walker Eminent Lecture in Mechanical Engineering, Texas A&M University, April 2022

Growing the Tactile Gamut
Arizona State University, November 2021

Growing the Tactile Gamut
Washington State University, September 2021

Growing the Tactile Gamut
Feinberg School of Medicine, Northwestern University, September 2021

Toward the Haptic Display of Texture
Materials Research Society Virtual Spring/Fall Meeting and Exhibit, special session on Materials and Mechanics Challenges in Haptics for Human-Machine Interfaces, December 2020

Toward Tools for Tactile Texture
AsiaHaptics 2020 Special Online Workshop, November 2020 (**keynote**)

Faculty Entrepreneurship
Kellogg Innovation and Entrepreneurship Initiative, October 2020

Designing with Surface Haptics
Smart Haptics Conference, Seattle WA, December 2019

Force Feedback for Fingertips
Cirrus Logic, August 2019

Touching with Feeling: Integrating Haptics with Touch Display
International Display Workshop 2018, Nagoya, Japan, December 2018 (**keynote**)

The Rise of the Haptic Designer
Smart Haptics 2018, San Diego, CA, December 2018

The Mechanics of Electroadhesion
Workshop on Contact Mechanics for Electrovibration, Eurohaptics Conference, Pisa, Italy, June 2018

Force Feedback for Fingertips (or "My Complex Relationship with Passivity")

Robotics Research Jam Session, University of Pisa, Pisa, Italy, June 2018

The (Digital) Worlds of Touch
Smart Haptics 2017, San Diego, CA, December 2017

Touching with Feeling: Bringing Haptics to the Surface
11th Conference on Pen and Touch Technology in Education, Evanston, IL, October 2017 (**keynote**)

High Bandwidth Electroadhesion
Workshop on Electrostatic Tactile Displays, IEEE World Haptics Conference, Munich, June 2017

Surface Haptics
NAE Regional Meeting, May 2017 (with Michael Peshkin)

Surface Haptics: How Friction Modulation Lets Us Touch Virtual Worlds
Bert L. Newkirk Lecture in Tribology, Rensselaer Polytechnic Institute, February 2017

Surface Haptics: How Friction Modulation Lets Us Touch Virtual Worlds
STLE Tribology Frontiers Conference, Chicago IL, November 2016 (**keynote**)

On the Mathematical Representation of Tactile Textures
Institute of Neuroscience, Catholic University of Louvain, Brussels Belgium, September 2016

Haptic Illusions for Fun and Profit
Workshop on Tactile Illusions, Eurohaptics Conference, Imperial College London, July 2016

Haptic Interface
Murphy Scholars, Northwestern University, April 2016

Thinking about Careers: Industry vs. Academia
McCormick Graduate Leadership Council, Northwestern University, April 2016

On the Mathematical Representation of Tactile Textures
Tactile Research Group Meeting, Chicago, November 2015

Surface Haptics
AsiaHaptics, Tsukuba, Japan, November 2014

Robotics and Haptics @ NU
Ford Motor Company, April 2014

Haptics: Interacting with Virtual Environments Through Touch
Alumnae of Northwestern University, October 2013

Force Feedback for Fingertips
Purdue University, August 2013

Force Feedback for Fingertips
Microsoft Research Asia, April 2013

Force Feedback for Fingertips
Arizona State University, March 2013

Force Feedback for Fingertips
Qualcomm, Inc., January 2013

Surface Haptics: Virtual Touch on Physical Surfaces
Robotics Institute Lecture Series, Carnegie Mellon University, November 2012

Haptics: What is it Good For?
Inaugural presentation in the Bayer Materials Science Webinar series, October 2012

A Haptics Symposium Retrospective: 20 Years
(with Bernard Dov Adelstein)
Haptics Symposium 2012, Vancouver, March 2012 **(keynote)**

Surface Haptics: Virtual Touch on Physical Surfaces
Distinguished Lecture Series, University of Utah, January 2012

Surface Haptics: Virtual Touch on Physical Surfaces
University of Pierre and Marie Curie, Paris, October 2011

Surface Haptics: Virtual Touch on Physical Surfaces
ETH Zurich, Distinguished Seminar in Robotics, Systems and Control, October 2011

Surface Haptics: Virtual Touch on Physical Surfaces
Plenary Talk, IEEE World Haptics Conference, Istanbul, Turkey, June 2011

Surface Haptics: Virtual Touch on Physical Surfaces
Plenary Talk, IROS, San Francisco, September 2011

Surface Haptics: Virtual Touch on Physical Surfaces
Microsoft Research, Seattle, October 2011

Human Centered Design
Northwestern University Medical School, 10/10

Surface Haptics
Yale University, 2/10

Surface Haptics
EECS Meet the Faculty Series, Northwestern University, 10/09

Edison's Quadrant: Putting Design-Thinking into Engineering Education

2009 ASME Asia-Pacific Engineering Education Congress, Taipei, Taiwan (**keynote**)

Lecture Series on Haptics and Prosthetics
Gwangju Institute of Science and Technology, Gwangju, Korea, 4/09

Three Lives of the Cobot: Material Handling, Haptics and Prosthetics
2009 International Symposium on Robotics, Barcelona, Spain (**plenary**)

Variable Friction Haptic Interfaces
Tactile Research Group, Psychonomics Society
Chicago, IL 11/08

Edison's Quadrant: Putting Design-Thinking into Engineering Education
Harvard University, 4/08

Haptic Prostheses for Upper-Extremity Amputees
University of Pennsylvania, 4/08

A Sense of Touch that is Virtually Real: Haptic Prostheses for Upper-Extremity Amputees
ACM Virtual Reality Science and Technology, 11/07 (**keynote**)

Cobotics
Southeast University, Nanjing, China, 8/07

Lecture Series on Haptics and Cobotics
Gwangju Institute of Science and Technology, Gwangju, Korea, 8/07

Haptic Augmentation
RO-MAN Conference, Jeju Island, Korea, 8/07

The Passivity Approach to Haptic Diplay
IEEE/TRA Haptics Summer School, Paris, France, 9/06

Cobot Kinematics and Control
University of Illinois Urbana-Champaign, 4/06

Haptic Interface for Advanced Prosthetics
DARPA, 1/05

Cobotics
University of British Columbia, 7/04

Engineering First and Design Throughout the Curriculum
University of British Columbia, 7/04

Cobotics
Rice University, 4/04

Cobotics
Georgia Tech, 1/04

Industrial Applications of Intelligent Assist Devices
IROS 2003, Las Vegas

EDC: Northwestern University's Foundational Course in Engineering Design
University of Toronto, 3/02

Cobot Control
Johns Hopkins University, 11/01

Cobot Control
University of Michigan, 11/01

Considerations for Robust Haptic Interaction with Virtual Dynamic Systems
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