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Profile

I am a Research Scientist at Meta Reality Labs Research working on wearable interfaces for mixed reality. I leverage my diverse skill set in hardware design and fabrication, software and controls development, and interaction design to create complete systems and experiences from the ground up.

Education

Rice University — Houston, TX

Ph.D., Mechanical Engineering — Feb. 2021
Referred Haptic Feedback for Virtual Hand Interactions Through a Bracelet Interface

Master of Science, Mechanical Engineering — May 2017
Design, Characterization, and Validation of the OpenWrist Exoskeleton

Advisor: Marcia K. O'Malley
National Science Foundation IGERT Fellow

The University of Alabama — Tuscaloosa, AL

Bachelor of Science, Mechanical Engineering — Dec. 2014

Collegiate Scholarship Recipient

Research and Professional Experience

Research Scientist | **Meta Reality Labs Research** - Redmond, WA — Mar. 2021 – Present

- Research and develop next-generation wearable devices, software, and experiences for mixed reality.

Research Assistant | **Mechatronics and Haptic Interfaces Lab** - Rice University — Aug. 2015 – Feb. 2021

- Designed perceptual studies for the Tasbi haptic wristband to understand how to appropriately render haptic feedback for hand interactions in VR using sensory substitution techniques and visual illusions.
- Created Syntacts, an open-source hardware and software framework for rendering haptic feedback with audio. Disseminated work via publications, demonstrations, online resources, and conference tutorial sessions.
- Independently designed and developed the OpenWrist, a 3 degree-of-freedom wrist exoskeleton for robotic rehabilitation and haptics research.
- Investigated novel ways of intuitively integrating cutaneous skin-stretch haptic feedback with traditional kinesthetic feedback for virtual training scenarios.
- Developed numerous software libraries and lab-wide infrastructure for digital signal acquisition and processing, real-time robotic control, and user interfaces.
- Crafted engaging visualizations and interactive media for haptics and robotic rehabilitation, ranging from simple 2D haptic environments to immersive virtual reality simulators involving multiple haptic devices.
- Collaborated with researchers at the University of Texas at Austin in integrating the OpenWrist and Maestro hand exoskeleton in an effort to realize a fully articulated hand-wrist exoskeleton.
- Conducted goniometric analysis of human subjects with motion capture to investigate the kinematic and dynamic effects of exoskeletons on rehabilitative assessment accuracy.

Contract Researcher | **Facebook Reality Labs** - Houston, TX — Dec. 2018 – Dec. 2020

- Redesigned Tasbi haptic wristband with added force sensing and closed-loop squeeze force control.
- Developed demonstrations for VR hand and finger interactions (buttons, knobs, object mass, surface textures, bimanual interactions, etc.) for Tasbi in Unity Engine.
- Developed C++ and Unity APIs for Tasbi. Assisted software engineers and researchers with integration.

Research Intern | **Oculus Research** - Redmond, WA — May 2018 – Nov. 2018

- Conceptualized and designed Tasbi, a wearable haptic wrist device for augmented and virtual reality (AR/VR). Tasbi combines squeeze and vibrational haptics to deliver convincing feedback for virtual hand and finger interactions. A novel tensioning mechanism affords Tasbi high force output in a small form-factor.

- Performed system characterization of Tasbi, including force profile measurement and bandwidth analysis.
- Conducted psychophysical studies to assess Tasbi's ability to render different stiffness virtual buttons.
- Led weekly meetings with interdisciplinary team of engineers and scientists to ensure project goals were met.

Engineering Intern | **BASF** - Freeport, TX Jan. 2015 – Aug. 2015

- Organized and led an interdisciplinary team of engineers to evaluate and rank the operational criticality of over 3,000 plant items including mechanical and electrical hardware. Developed necessary assessment methodology and tools.
- Identified and corrected potential plant hazards as a member of the Fire, Explosion, and Release (FER) team.

Undergraduate Researcher | **Jordon Group** - The University of Alabama Aug. 2014 – Dec. 2014

- Created finite element models to study failure modes of portable airfield matting used by the US Army.
- Independently designed and delivered an original, lightweight matting concept, leveraging friction stir welding manufacturing techniques and novel connector geometry to the US Army.

Student Engineer | **Phifer** - Tuscaloosa, AL Mar. 2013 – Aug. 2014

- Designed, oversaw fabrication of, and implemented over 40 projects involving machine and mechanism design, rotary and pneumatic actuation, automation, and sensing.
- Established scope and oversaw execution of work by contractors and suppliers involved with projects.
- Contributed significantly to reestablishing plant operations following a plant fire by designing and installing replacement wash and vacuum systems and elevated catwalks.

Undergraduate Researcher | **PMRF Lab** - The University of Alabama Aug. 2013 – Aug. 2014

- Developed algorithms to analyze and model thermal and dynamic characteristics of additive and subtractive manufacturing processes.

Engineering Intern | **Hargrove EPC** - Mobile, AL Jun. 2010 – Aug. 2011

- Created applications to assist engineers in calculating piping temperature drops.
- Worked with engineers to revise process schematics and drawings for project with Chevron.

Journal Publications

[J4] **E Pezent**,P. Agarwal, J. Hartcher-O'Brien, N. Colonnese and M. K. O'Malley, "Design, Control, and Psychophysics of Tasbi: A Force-Controlled Multimodal Haptic Bracelet," *IEEE Transactions on Robotics*, 2022.

[J3] **E Pezent**, B. Cambio, M. K. O'Malley, "Syntacts: Open-Source Software and Hardware for Audio-Controlled Haptics," *IEEE Transactions on Haptics*, 2020.

[J2] **E. Pezent**, S. Fani, J. Clark, M. Bianchi, and M. K. O'Malley, "Spatially Separating Haptic Guidance from Task Dynamics through Wearable Devices," *IEEE Transactions on Haptics*, 2019.

[J1] C. G. Rose, **E. Pezent**, C. K. Kann, and M. K. O'Malley, "Assessing Wrist Movement with Robotic Devices," *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 2018.

Conference Publications

[C6] **E. Pezent**, M. K. O'Malley, A. Israr, M. Samad, S. Robinson, P. Agarwal, H. Benko, and N. Colonnese, "Explorations of Wrist Haptic Feedback for AR/VR Interactions with Tasbi," *CHI Extended Abstracts*, 2020.

[C5] C. Smith, **E. Pezent,** and M. K. O'Malley, "Spatially Separated Cutaneous Haptic Guidance for Training of a Virtual Sensorimotor Task," *IEEE Haptics Symposium*, 2020.

[C4] **E. Pezent**, A. Israr, M. Samad, S. Robinson, P. Agarwal, H. Benko, and N. Colonnese, "Tasbi: Multisensory Squeeze and Vibrotactile Wrist Haptics for Augmented and Virtual Reality," *IEEE World Haptics Conference (WHC)*, 2019.

[C3] **E. Pezent**, S. Fani, J. Bradley, M. Bianchi, and M. K. O'Malley, "Separating Haptic Guidance from Task Dynamics: A Practical Solution via Cutaneous Devices," *IEEE Haptics Symposium*, 2018.

[C2] **E. Pezent**, C. Rose, A. Deshpande, and M. K. O'Malley, "Design and Characterization of the OpenWrist: A Robotic Wrist Exoskeleton for Coordinated Hand-Wrist Rehabilitation," *IEEE International Conference on Rehabilitation Robotics (ICORR)*, 2017.

[C1] A. Erwin, **E. Pezent**, J. Bradley, and M. K. O'Malley, "The Effect of Robot Dynamics on Smoothness during Wrist Pointing," *IEEE International Conference on Rehabilitation Robotics (ICORR)*, 2017.

Presentations and Invited Talks

[T5] International Conference on Intelligent Robots and Systems (IROS), Las Vegas, NV, 2020.
Syntacts Workshop in Introduction to Haptics for Next Generation XR Tutorial Session

[T4] Facebook Reality Labs Guest Speaker, Redmond, WA, 2019.
Tasbi: Tactile and Squeeze Bracelet Interface

[T3] World Haptics Conference (WHC), Tokyo, Japan, 2019.
Tasbi: Multisensory Squeeze and Vibrotactile Wrist Haptics for Augmented and Virtual Reality

[T2] Haptics Symposium, San Francisco, CA, 2018.
Separating Haptic Guidance from Task Dynamics: A Practical Solution via Cutaneous Devices

[T1] National Science Foundation IGERT Retreat, Houston, TX, 2017.
Design and Control of a Robotic Exoskeletal Device for Hand-Wrist Rehabilitation

Patents

[P2] Patent application filed with USPTO in 2019 with Facebook Reality Labs

[P1] US 10,678,334 B1 "Systems and Methods for Providing Substantially Orthogonal Movement of a Device About a User's Body Part"

Fellowships, Grants, and Awards

Facebook Reality Labs Sponsored Research Agreement (Rice University) 2020 – Present
Grant awarded to study object interactions in AR/VR with multisensory haptic devices.

National Science Foundation IGERT Fellowship (Rice University) 2017 – 2019
Provides two years of support and interdisciplinary training to graduate students in STEM.

Institute of Biosciences and Bioengineering Travel Award (Rice University) 2017
Provides support for graduate students to present their research at conferences.

Sue H. and Harold R. Galloway Graduate Fellowship (Rice University) 2015 – 2016
Additional stipend awarded to a single incoming engineering graduate student.

Carl Albright Jr. Scholarship (The University of Alabama) 2012 – 2013
Merit-based scholarship providing partial tuition to undergraduate students.

Collegiate Scholarship (The University of Alabama) 2010 – 2014
Merit-based scholarship providing almost full tuition to undergraduate students.

Dean's Engineering Excellence Scholarship (The University of Alabama) 2010 – 2014
Merit-based scholarship providing partial tuition to undergraduate students in engineering.

Service

IEEE Haptics Symposium 2022 - Sponsorship Committee

Advising and Mentoring

Ahalya Lettenberger, Rice undergraduate student in Mechanical Engineering S' 2020 - Present
Syntacts: Open-Source Software and Hardware for Audio-Controlled Haptics

Roderico Garcia, Visiting undergraduate student from Tecnologico de Monterrey S' 2020 - F' 2020
Design of a Low-Cost, High-Density Tactile Wristband

Brandon Cambio, Rice MS student in Mechanical Engineering F' 2018 - S' 2020
Ultra-Low Latency Control of Large Vibrotactile Arrays for Haptic Interactions

Casimir Smith, Rice undergraduate student in Mechanical Engineering S' 2019 - S' 2020
Spatially Separated Cutaneous Haptic Guidance for Training of a Virtual Sensorimotor Task

Joshua Bradley, Rice MS student in Mechanical Engineering F' 2016 - S' 2018
Enhancing Human-Machine Interaction with Wearable Haptic Devices

Teaching Experience

Introduction to Robotics (Rice University MECH 498/598)

- Developed curriculum and interactive software for teaching modeling and control of robotic devices.
- Conducted help sessions and served as guest lecturer.

Design of Mechatronic Systems (Rice University MECH 488/588)

- Designed hardware and software for mechatronic teaching apparatus.

Modeling of Dynamic Systems (Rice University MECH 343)

- Organized and led weekly hands-on laboratory sessions covering mechanical and electrical systems.

Invited Reviews

- IEEE Transactions on Haptics (ToH)
- IEEE Transactions on Robotics (T-RO)
- IEEE Robotics and Automation Letters (RA-L)
- IEEE Transactions on Neural Systems and Rehabilitation Engineering (TNSRE)
- ASME Journal of Mechanisms and Robotics (JMR)
- IEEE Haptics Symposium
- IEEE World Haptics Conference (WHC)
- IEEE International Conference on Rehabilitation Robotics (ICORR)
- IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob)
- Eurohaptics Conference

Graduate Coursework

Robotics, Mechatronics, Dynamics and Control, Motion Planning, Machine Learning, Artificial Intelligence

Technical Skills

Programming: C/C++/CMake, C#, Python, MATLAB, Lua, Java

Software: git, Mercurial, Perforce, Real-Time Linux, LabVIEW, Simulink, QUARC, Solidworks, DipTrace, Unity Engine, Unreal Engine, Qt, Blender, Adobe Suite, Keyshot

Hardware: NI controllers/DAQs (cRIO, myRIO, NI-DAQmx), Quanser DAQs (Q2, Q8, QPID), servo amplifiers, motion controllers, encoders, force/torque sensors, virtual and augmented reality HMDs, marker-based motion capture (OptiTrak), Phantom Premium and other desktop haptic devices

Prototyping: CNC milling machines and lathes, 3D printing, laser cutting, waterjet, molding and casting, PCB design