Augmented and Virtual Reality PhD Training Program at the University of Rochester

Program Overview

This NSF Research Traineeship (NRT) Program is an interdisciplinary PhD training program in the science, technology, and applications of Augmented and Virtual Reality (AR/VR).

Our Mission and Vision

- Train a new cohort of PhD students with a unique set of competencies in the AR/VR domain that cannot be attained through existing traditional graduate programs.
- Advance interdisciplinary research with an innovative theme: integration of quantitative models of human perceptual-cognitive processes into cross-layer design approaches to create and quantitatively evaluate new AR/VR technologies and applications.
- Integrate AR/VR research throughout the campus into our program through trainee projects and theses.
- Use evidence-based strategies for inclusive participation.
- Develop technical and professional skills of the trainees.

Education and Training

The training program admits PhD students from six departments representing the disciplines encompassed by AR/VR:
1. Electrical and Computer Eng.
2. Optics
3. Biomedical Eng.
4. Brain and Cognitive Sciences
5. Computer Science
6. Neuroscience

The program also offers one-year funded fellowships to a limited number of trainees.

The program involves three innovative courses and other training elements as listed below.

Introductory Course on AR/VR

This course provides a broad introduction to AR/VR, is cross-listed by seven departments at the University, and taught by nine instructors.

Goals

- Build a common base of understanding and knowledge for all trainees in the program as well as provide a foundation on which they can build their research.
- Benefit trainees with diverse backgrounds.

Structure

- Two parallel components:
  1. Lectures providing introduction and awareness on all aspects of the AR/VR domain.
  2. An individualized, guided self-study component for each student aimed at providing more intensive training on aspects of AR/VR on which the student is less knowledgeable.
- Lectures cover aspects of AR/VR including:
  - History, platforms/hardware, computation and coding, graphics and displays, perceptual/cognitive aspects, sensors, data processing and machine intelligence for AR/VR, visual/auditory/haptic AR/VR interfaces and applications, as well as current challenges, societal implications, and ethical aspects.
- A coherent course rather than a collection of independent lectures.
- Course is designed and taught multiple faculty with expertise on different aspects of AR/VR.
- Each student determines a self-study theme with the guidance of the coordinating faculty.

Semester/Year in Ph.D. | Training Element
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Fall/1 | Introductory course
Spring/1 | Modular course
Fall/2 | Practicum course
Summer/2 | Internship
All Years | Professional development encounters
2-5 | Annual Program showcase and student-run conference
3-4 | Undergraduate capstone project supervision
All Years | AR/VR-related research

Modular Course

- Three one-month modules in each offering
- Modules offered:
  1. Fundamentals of optics for AR/VR
  2. AR/VR in the silicon
  3. Foundations of visual perception in the context of AR/VR
  4. Computer audition and acoustic rendering
  5. Measuring the human brain
  6. Deep learning and visual recognition for AR/VR
  7. Brain-computer interfacing in a virtual environment
  8. 3D interfaces and interaction
  9. AR/VR for collaborative education & professional training

In conjunction with modular course taught, students are exposed with weekly seminar live talks from industries leaders.

Focused in-depth exposure to problems in the AR/VR domain addressed by the other disciplines.
Industry-Sponsored Fellowships

Students in this program also have opportunities to engage with companies through fellowships given by the company. We would require a 1-3 year commitment from the company to sponsor a student. It is the goal of some of the companies and our program to offer Diversity Fellowships to less advantaged students of color and women especially.

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NRT PhD Trainees—Cohort starting in 2020-2021

Frank Cwitkowitz — Is an Electrical Engineering Ph.D. student working with Dr. Zhiyao Duan in the Audio Information Research (AIR) lab at the University of Rochester. His research interests span music information retrieval, music signal processing, and machine learning, and his work focuses heavily on the problem of automatic music transcription. **Research Interests:** He joined the AR/VR Ph.D. training program with the hope to work on applications involving audio-visual music entertainment and music education.

Jeremy Goodsell — Completed his B.S. in Applied Physics at Brigham Young University in 2017. While there, he worked with Dr. Daniel Smalley on holographic and volumetric display technology. **Research Interests:** Since beginning his Ph.D. in Optics at the University of Rochester, he is most involved with studying the application of freeform surfaces and meta-gratings to the field of augmented and virtual reality (AR/VR).

Narges Mohammadi — Came to the University of Rochester in 2018, and is a PhD student in the Signal, Data, and Imaging Science Lab (SDIS), in the department of Electrical and Computer Engineering. **Research Interests:** are focused on computational imaging, low-level computer vision, optimization, and statistical signal processing tools for AI. Narges is currently working on developing constrained optimization algorithms composed of AI and physical models that solve challenging inverse problems including global image restoration tasks (like image reconstruction) and local ones (including image deconvolution, super-resolution, deblurring).

Eleni Patelaki — Is a PhD student in Biomedical Engineering at the University of Rochester, working under Professor Edward Freedman. **Research Interests:** Her work aims to un-mask Parkinson’s disease risk by systematically loading cognitive and motoric neural circuits, utilizing the Mobile Brain-Body Imaging modality. She holds a BSc and MSc in Electrical and Computer Engineering from the National Technical University of Athens and an MSc in Biomedical Engineering from the University of Rochester.

Shadi Sartipi — Received her B.Sc. and M.Sc. in Electrical Engineering (Communication Systems) both from Urmia University, Urmia, Iran, in 2015 and 2018, respectively. She joined the Ph.D. program at the University of Rochester in September 2018. **Research Interests:** include VR/AR, brain-computer interfaces (BCIs), statistical and biomedical signal processing, affective computing, and machine learning.

Yuxiang Wang — Is a PhD student in Electrical and Computer Engineering at the University of Rochester. **Research Interests:** includes spatial audio, HRTF and auditory models. Yuxiang has always been very interested in the topics of study in virtual auditory display. Yuxiang feels that the fast-growing ARVR industry has enhanced his study in this field with more possibilities.

You (Neil) Zhang — Is a Ph.D. student in the Audio Information Research (AIR) Lab in the Electrical and Computer Engineering department at the University of Rochester. He received his bachelor’s degree in Automation from University of Electronic Science and Technology of China (UESTC) in 2019. **Research Interests:** in machine learning and its applications in speech processing, such as voice spoofing detection, audio-visual understanding, spatial audio, etc. In his free time, he enjoys movies, badminton and traveling.

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