

Daniel J. Finnegan

Teaching and Research Statement

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Research Goals

My research aims to address the following question: “How can we design virtual environments such that they are perceptually real?”. In pursuing this goal, I turned to an interesting problem in VR relating to our ability to perceive distances to objects. My EngD addressed this in the context of head mounted display (HMD) technology, and contributed a method for reducing the perceptual phenomenon of distance compression in virtual reality. My research interests currently lie in investigating further the efficacy of my EngD approach, and how it interacts with other aspects of VR such as immersion, sense of presence, and the perception/motor loop.

My research is practical and applicable to not just entertainment, but productive applications of VR. Applications involving judgement or decisions to be made based on our perception of space, for example a real estate agent exploring a digital reconstruction of a property in order to assess its value, remote control of a drone through a VR interface, or even simulation of emergency response training regimes all require veridical perception of space.

Research & Commercial Experience

I come from a background in computer science, with both theoretical and practical experience. My undergraduate project was research based; its aim was to investigate state of the art methods for object detection and recognition in 2D video and cross referencing with depth maps. My project was awarded two distinct awards, one from the Department of Computer Science, and one from Deloitte, for a novel 2D/3D hybrid detection system.

My work on incongruence in virtual environments as part of my EngD was published and presented at the CHI conference 2016. The paper details the fundamental contribution of my EngD: distance compression in virtual environments may be *systematically* reduced by creating artificial incongruity between the sound source position and the visual position of audiovisual targets. The paper draws on theories in the psychology literature related to multi-sensory integration of information. My work applies these theories to distal cues from the interactive virtual system; the interaction between spatial audio cues such as parallax and inter-aural level differences, and visual cues for example occlusion and binocular disparity, in order to understand distance perception and reduce compression in such environments.

As a practical HCI researcher, my theory is grounded in empirical human participant experimentation. When I need software to conduct an experiment, if I can't get off the shelf implementation, I'll write it myself. I have spent considerable time in industry where I worked on production level code for multi-platform deployment. I am familiar with open-source tools such as Blender, and industry

grade engines like Unity, having used both throughout my EngD. I have experience designing 3D scenes, with some experience in animation and 3D modelling. Given my multi-modal interaction interests, I have also implemented systems to render spatial audio, and have integrated these into Unity using its plugin architecture. I've used my binaural renderer, using CoreAudio on OSX through the JUCE API, in order to create 3D audiovisual environments for my research studies.

I endeavour to maintain a clean code base; I ensure my software has zero local dependencies, implementing 'switzerland tests'¹ to ensure that the software will build and compile on any host machine, making multi-platform distribution and deployment smoother. This is essential in any commercial related project, as it is impossible to determine the host libraries installed on a client's system. Due to my high standards in code publishing, I was appointed as maintenance programmer in my previous employment to handle code updates and software releases.

My work is inherently cross-disciplinary; I have worked with computer scientists, software engineers, game designers, as well as social scientists and cognitive scientists/psychologists. My approach is to learn from the experts of various fields that VR will make an impact in. My methodology is practical; I design and conduct experiments to empirically evaluate my hypotheses, implementing my own software where necessary (and is typical in the cutting edge field of VR, where most of the tools are still in active development). I quantitatively analyse my results from the perspective of an applied psychologist, treating our perceptual process as a black box, presenting input in the form of sensory stimuli and observing our response. I am thus skilled in rigorous experimental design and statistical analysis, ranging from traditional quantitative approaches such as ANOVA and regression models, to more advanced psychophysical analyses for multi-sensory perception studies.

I have presented my work to different audiences; I enjoy the challenge of adapting my phrasing and the specifics of my talk depending on the audience present, removing domain specific terminology and simplifying the narrative. Feedback from my talks is positive, with members of the audience congratulating me on the ease in which I communicate my ideas. I credit this to the multi-disciplinary context of my research; on a daily basis I interact with colleagues from different fields, maintaining positive relationships across discipline boundaries.

Teaching Experience & Approach

My personal teaching interests span software engineering principles, research methods, and practical signal processing in C++. I have taught at undergraduate level on many separate occasions, and I enjoy educating students and passing on my expertise. In previous TA roles, I demonstrated lab sessions, being on hand to respond to any student's queries not just to give the answer, but guiding them to understanding the problem and deriving the answer themselves. I also have experience correcting assignments and reporting to the course lecturer.

I believe that a concrete understanding of fundamental aspects of psychology are paramount to good HCI research, both in academia and industry. I would be comfortable teaching psychology students from a computer science perspective—covering aspects of software implementation, basics in scene construction in Unity for experiment design—as well as a cohort of computer science

¹a term my EngD industrial advisor used to prescribe to testing software on clean, fresh machines with no dependencies installed

students from a psychology perspective, the pertinent aspects being multi-sensory integration for multi-modal HCI research and audiovisual processing in perception. I feel the two disciplines are increasingly intertwined, and therefore becoming the best possible practitioner requires experience in psychological methods and IT practicalities.

Working with me, I would cultivate the following attitudes in my students; my own application of an OCEAN model to strong PhD candidature: A good PhD candidate...

- ...is someone who embraces new opportunities and experiences, open to failure and a tenacity to take risks.; I strongly advocate 'proto-teering' where HCI students prototype real systems to convey their ideas (Openness to experience)
- ...will seek advice, not supervision; be didactic in their research, sourcing answers through breadth of search (Conscientiousness)
- ...has a willingness to branch outside their core research field for ideas that can equip students with inter-disciplinary skills to solve complex, multi-faceted problems (Extraversion in study)
- ...exhibits a rigour that invites rather than rejects alternative hypotheses, listening to and learning from peers in the same and other fields (Agreeableness)
- ...is dynamic, with a reactive personality that embraces data that disagrees with the original hypothesis, as opposed to insecurity and stubbornness (Neuroticism)

I truly believe novelty and creativity blossom from exposure to multiple paradigms and approaches to problems. Indeed, my own EngD activity is a testament to this.

Summary

In summary, I wish to emphasize my enthusiasm and appropriate skill sets. I am a multidisciplinary researcher, with skills covering experiment design and implementation, through to software engineering and systems architecture. I have strong analytical, verbal, and written skills as demonstrated by my publications and experience presenting to multi-disciplinary audiences. I engage with my colleagues on topics directly related to my work, as well as casual exploration of tangential topics which may lead to further exciting collaboration. I possess the ability to prioritise my workload, structuring my time in order to effectively deliver results. My industrial experience makes me a veteran team player, having contributed to industrial applications across all aspects of production from core concept straight through to app store distribution and post-release maintenance. I continuously strive to a high standard, and maintain a cool head under pressure. I look forward to opportunities enabling me to further my experience with research, teaching, supervision, and collaboration.