Research Statement

Anahita Sanandaji

My primary research area is Human-Computer Interaction (HCI). Additionally, software engineering and testing, information visualization, and computer networks are among my research interests. As a researcher in the field of HCI, I focus on designing innovative user interfaces and technologies that improve human interaction with computers. My research methodology is a mix of theory, Human-Centered Design (HCD), implementation, and evaluation. Including a human in the loop is the key component in all research areas I am involved in while HCD provides the mechanism for addressing the fundamental problem of how to make computational technologies useful for humans.

Past and Current Research

For the last four years, I have been serving as a graduate research assistant at Oregon State University (OSU). My experience at OSU has familiarized me with several research groups as well as quantitative and qualitative methods in HCI including case studies, grounded theory, and visual analytics.

I have had the opportunity to be part of an on-going NSF-funded research with collaborators at the University of North Texas and Washington University in St. Louis. This project focuses on understanding the cognitive and perceptual basis of how experts extract 3D shapes from volumetric data, (e.g., MRI or CT imaging). This process, known as "3D image segmentation" is a fundamental step in many scientific and biomedical applications such as locating tumors. My role in this research is to understand human factors involved in segmentation process to make the process more efficient and accurate. I travelled to several medical research institutions including University of Utah, University of Californian San Diego (UCSD), Oregon Health and Science University (OHSU), and Pacific Northwest National Laboratory (PNNL) with the research team to observe expert segmenters on-site while interacting with their tools, data, and computer systems. In our studies, we designed a novel hybrid protocol that blends observation, interviews, surveys, and eye-tracking, to capture in-depth data [1]. We then developed and validated data coding schemes which could successfully discern segmenters' low-level perceptual actions, higher-level cognitive tasks, and different segmentation strategies utilized by expert versus novice segmenters to analyze the data captured [2]. Finally, we developed a measurement instrument to evaluate segmenters' spatial abilities and how they build mental models based on 3D images [3].

For my PhD dissertation, I'm developing a training pedagogy to help human novices do segmentation in a more efficient and accurate way, while separating learning the tool set from learning how to segment. I am implementing the training guidelines in a 3D volume segmentation tool named *VolumeViewer*. *VolumeViewer* is an open source interactive tool for fitting surfaces to volume data. It provides features including visualization, contouring, surface reconstruction, editing and review.

In parallel with my PhD dissertation, I worked on other research projects in areas including usability engineering, machine learning and information visualization.

In another project titled "Guided Structure-Aligned Segmentation of Volumetric Data", I and another PhD student from University of Washington in St. louis, investigated the idea of guided contouring protocols that provide guidance in the form of an automatic navigation path to arbitrary cross sections, example marks from similar data sets, and text instructions. I was responsible for conducting user studies to evaluate the usability of this system with non-expert users in terms of segmentation accuracy,

consistency, and efficiency. Results of our work was selected as the best paper in International Symposium on Visual Computing [4].

In the project named "Visualizing Social Network Analysis (SNA) Metrics for Open Source Projects", I designed and implemented an effective visualization to display SNA metrics for different open source projects during 18 months of forking period. The goal of the visualization was to help software developers and project managers observe and track the changes in metrics and trends during the forking period as part of their analysis for evaluating and predicting the open source project evolution.

In the project named "Intelligent model for traffic flow prediction", I used machine learning techniques to develop a novel real time prediction model for ramp metering. I designed and developed a smart algorithm that utilizes historical traffic data, as well as traffic measures such as speed, current traffic volume, and breakdown capacity to control ramp signal based on the current and predicted traffic flow.

Future Research and Outlook

I am planning to extend and apply the experience, principles, and findings of my current research more broadly in new domains including spatial HCI, and spatial cognition. Expanding the applications of the training tool I developed as a part of my PhD dissertation in these areas is a future research plan**.** I am also interested in conducting applied research in usability and user experience area to develop design and evaluation methods of novel multimodal interfaces**,** as well as integrating programming and development into creative tools (e.g., sketching and prototyping tools) to aid designers and developers create well-structured user interfaces.

I plan to pursues future funding from both private and public sources. HCI, and visualization research has recently received much interest from both government agencies such as NSF, and DOE as well as companies (such as fellowships funded by Microsoft Research). In addition, the interdisciplinary nature of HCI affords several promising collaborations with new colleagues. Performing collaborative research with multi-disciplinary teams at The University of Maine as well as other universities and industries is among my future research goals.

Working on both theoretical and practical aspects of research and development in areas of HCI, visualization, databases, programming, and machine-learning, will provide opportunities for both undergraduate and graduate students to leverage their academic skills such as performing independent research as well as applied skills such as programming and user-centered design enabling them to pursue future careers either in academia or industry.

It is an exceptional privilege to have the opportunity to join the University of Maine School of Computing and Information Science and have the chance to collaborate with growing number of outstanding faculty members with diverse research interests and expertise on many interdisciplinary research projects. In particular, I found many common research interest areas with Dr. Giudice, Dr. Moratz, and Dr. Egenhofer which opens up doors to collaborative research in the School of Computing and Information Science.

I choose to work as a university professor, not only because I am passionate about HCI research, but that I would also like to convey this passion to my students and train the next generation of researchers.

Selected Publications

[1] Ruth West, Meghan Kajihara, Max Parola, Kathryn Hays, Luke Hillard, Anne Carlew, Jeremey Deutsch, Brandon Lane, Michelle Holloway, Brendan John, **Anahita Sanandaji**, and Cindy Grimm,

"Eliciting Tacit Expertise in 3D Volume Segmentation", The 9th International Symposium on Visual Information and Communication and Interaction (VINCI 2016), September 2016.

[2] **Anahita Sanandaji**, Jeremy Deutsch, Max Parola, Meghan Kajihara, Anne Carlew, Ruth West, and Cindy Grimm, "Where do Experts Look while doing 3D Image Segmentation", *Proceedings of the Ninth Biennial ACM Symposium on Eye Tracking Research & Applications Pages (ETRA 2016)*, March 2016, pp 171-174.

[3] **Anahita Sanandaji**, Cindy Grimm, and Ruth West, "How Experts' Mental Model Affects 3D Image Segmentation", *2016 ACM Symposium on Applied Perception (SAP 2016)*, July 2016.

[4] Michelle Holloway, **Anahita Sanandaji**, Deniece Yates, Amali Krigger, Ross Sowell, Ruth West, and Cindy Grimm, "Guided Structure-Aligned Segmentation of Volumetric Data",*11th International Symposium (ISVC) 2015, published in Advances in Visual Computing*, December 2015, pp 307-317 (Winner best paper award).