Research Goals and Objectives

Ubiquitous and human-centric sensing has become an active area of research in recent years, where various physical or physiological sensors are interconnected and designed to sense a broad spectrum of contexts for human beings, laying the foundation of pervasive computing and corresponding automated actuation. Such research can transform smart health, home, workplaces, and cities. However, several limitations and challenges are yet to be addressed, limiting the widespread use of ubiquitous sensing for practical use. My research focus is to address such challenges with emphasis on the following four scopes:

- ***Explainability and lack of annotated data:*** Explaining an automated system's characteristics and underlying reasoning allows the end-users to engender trust in these systems. Additionally, a challenge in human-centric sensing is limited annotated data. Though there are black-box ML interpretation and weakly-supervised learning techniques to address them, my recent works show a need for approaches specifically designed with explainability and data label limitation in mind to utilize those techniques fully.

- ***Development of systems deployable in in-the-wild scenarios:*** Most existing sensing-AI solutions are based on controlled datasets and are not generalizable for practical use. I focus on developing generalizable systems that readily adapt to changes in external factors and are robust against unknown scenarios.

- ***Domain adaptive integration of heterogeneous sensing modalities:*** To perceive the comprehensive context of human being, integration of heterogeneous sensing modalities capturing different aspects are important. My recent works show that effective multimodal fusion needs to be tailored to integrate the domain knowledge and the particular challenges of the target task.

- ***Security, privacy, and proven reliability in sensing:*** Human-centric systems must be secure and privacy-preserving. I focus on developing such resilient systems by understanding the sensors' and sensing domains' underlying physical characteristics. Notably, sensing AI in safe-critical applications, such as smart health, needs a proven formal guarantee of reliability. My recent and future works focus on providing formal safety guarantees in human-centric sensing and actuation, specifically on scalable and human-in-the-loop systems.

Overall, *my research emphasizes the need for tailored solutions adapting domain and task knowledge for practical use of human-centric sensing*. Examples of my works on each of the above-discussed scopes, highlighting their novelty, impact, and future directions, are discussed in later sections.

To date, my research has been funded by **two NSF grants** (Lead PI in an NSF SCH Medium # 2124285, Co-PI in an NSF CPS Small # 2148187) and **three NIH grants** (as Co-I in an NIH R01 NIDCD, an NIH R01 AI/ML administrative supplement award, and an NIH R21 NIDCD); cumulatively funded more than *$1 million just for my side of the research*. My works have appeared (or appearing soon) in top-tier computer science venues, including *IMWUT/Ubicomp, DAC, IAAI, EWSN*, etc., top-tier medical-relevant journals, *Oxford Bioinformatics*, as well as one of the most prestigious general-science journals*, PNAS*. In 2021, one of my corresponding-authored papers on Preclinical Stage Alzheimer's Disease Detection received the prestigious '**IAAI Deployed Application Award'** at the IAAI conference. In 2016, one of my first-authored papers, AsthmaGuide, was **nominated for the best paper award** at the Wireless Health 2016 conference. In 2018, I received the **Graduate Student Award for Outstanding Research** from the UVA Department of Computer Science. Additionally, I have gained the experience of working in two leading research labs (**Nokia Bell Labs and Bosch Research**) as a research intern, where I produced a top-tier publication and a patent.

Additionally, I am highly multidisciplinary, with a voluntary track assistant professor appointment at the SUNY Upstate Medical University, NY, and affiliation with the aging studies institute at Syracuse University. Outside of my ongoing active collaborations with CS departments at Rochester University, and Data Science Institute at UC San Diego, I have ongoing active collaborations with the speech clinic at Syracuse University, the Communicative Sciences and Disorders department at NYU, the Neuroscience and Psychiatry department at SUNY Upstate Medical School, Department of Psychiatry at Massachusetts General Hospital, and Crouse

Hospital at Syracuse. Previously, I worked in collaboration with the Department of Behavioral Science at the University of Southern California and the Nursing and Behavioral Science department of the University of Tennessee.

My current and future research particularly emphasizes the following scopes:

<u>Explainability and Visualization of Latent Markers/Patterns from Unlabeled Data</u>

Even in scenarios where black-box systems can outperform humans, without explainability, lack of trust, and legal and ethical uncertainties may prevent human-centric systems from reaching their full potential. Another challenge in the human-centric domain is the lack of labeled data, especially in the scope where sensing and AI approaches are being leveraged to identify latent markers. These challenges are prominent in smart health. Some of my recent work addressing these challenges are discussed below.

Mental health problems are often underdiagnosed and undertreated, partly due to difficulties accessing and monitoring individuals needing services. We developed an automated and explainable approach *[Salekin et al., 2018]* to assess mental disorders' severity from moderately lengthy spontaneous speech that can be passively deployed to address the issue. However, latent markers of mental disorders in spontaneous speech are yet unknown; hence data labels are unavailable. Therefore, we developed a novel feature embedding technique named **NN2Vec**, which considers a sensing attribute's frequency in the target category data (in this case, high symptom of disorder) vs. others alongside its unique temporal context in the target category to generate a feature representation. Such feature representation enables weakly supervised NN classifiers to identify and visualize latent markers effectively. The impact of the work is not just remote and automated assessment but understanding the speech (tonality and context) markers of mental health that will enable personalized caregiving in the future. Currently, the work is being utilized for caregivers' mental health assessment in collaboration with the Nursing and Behavioral Science department of the University of Tennessee.

Speech science literature has shown that statistically, children who stutter (CWS) experience different situational arousal than others, and high arousal affects children's speech production. To identify the second-by-second fluctuations and pattern differences in situational psychophysiology of preschool-age CWS, we developed a multimodal interpretable AI approach *[Sharma et al., 2022]*. Our findings would inform the understanding of the role of physiological arousal in developing stuttering. Moreover, the developed approach can be leveraged for remote, automated, and real-time assessment of CWS's physiological responses through commercial wearables. It can be used clinically to provide just-in-time interventions that may improve speech fluency/disfluency. This work is a core part of our **NIH R21 and NIH R01** grants.

Literature has shown that neurological markers of Alzheimer's disease (AD) may appear twenty or more years before AD symptoms are perceptible. We *[Altay et al., 2021]* developed a recurrent 3D visual attention-based approach that can identify and visualize markers of pre-clinical AD between 8 to 10 years before all clinical data state that the patient is healthy from 3D MRI images. Our work will enhance the understanding of the development of AD. Moreover, it will facilitate early-stage interventions, effectively decreasing the disease's progression. The work was awarded the prestigious '**IAAI Deployed Application Award**.'

Future Direction: Explainable AI is still in its early stages. Generated interpretations are based on pseudo linear models mimicking the complex ones, adapting concepts from game theory and linear approximations. It is crucial to provide confidence factors and reliable bounds on the AI interpretations for practical use. Utilizing my other focus, formal verification in AI, I aim to generate such bounding mechanisms in explainability in the near future. Moreover, the true potential of explainable sensing and automation cannot be achieved without understanding human needs and their perspective toward developed systems. To my knowledge, only a few work [e.g., *Liao et al., 2021*] has integrated human-computer interaction (HCI) factors in explainable AI, and no literature exists on explainable human-centric sensing and HCI integration. Therefore, ***as part of my future projects,*** I plan to collaborate with behaviorists and HCI specialists to perform detailed user studies. This will further enhance sensing systems' usability, acceptability, and trust in practical domains such as smart health.

Development of Robust and Real-world deployable Sensing and AI technologies

A fundamental limitation of automated human sensing systems today is that they are trained and evaluated on limited control datasets, thus learning dataset-specific traits that are not necessarily generalizable. Therefore, there is a need for approaches that can intelligently learn the generalizable attributes, readily adapt to the changes in external factors, and remain robust against unknown data distributions and factors.

My prior work, **DER** [*Salekin et al., 2017*], extends the application of speech event detection to the challenging situation determined by the variable speaker-to-microphone distance. The performance of conventional speech event detection systems degrades dramatically at varying distances. This is due to various effects, such as background noise, feature distortion with distance, overlapping speech from other speakers, and reverberation. DER addresses the key challenges through (1) identification and removal of features from the consideration that are significantly distorted by distance, (2) creating a novel feature embedding technique called **Emo2vec** that utilizes the temporal relationships of the signal to retrieve relevant and unbiased information from the minimal-to-moderate distorted signal attributes, and (3) including overlapping speech filtering technique as part of inference generation. DER facilitates using single-microphone-based audio event assessment technologies in practical indoor scenarios where the speaker's location and environmental factors vary drastically.

Another work, **ARASID** *[Chen et al., 2019]*, introduced an artificial reverberation generator with adjustable environment-specific parameters that enable tailoring of already developed environment-neutral speech event assessment techniques online for the target setup without additional data or processing. ARASID facilitates speech assessment technologies, such as smart speakers, to be readily adaptive in different environments. The presence of unknown data distribution and inference categories can completely disrupt the usability of the neural network (NN) classifiers. Our recent work *[Gao et al., 2021]* addressed this challenge in sensing by combining conventional NN networks with an out-of-data-distribution (OOD) solution, making automated sensing solutions readily usable in unknown/unseen scenarios.

Notably, all the above-mentioned studies collected and evaluated real-scenario deployed sensor data from the target population (in some cases from specific health and disorder domains) and environments, making them highly impactful on multiple ongoing and previous NSF-funded projects. I plan to continue addressing challenges in this scope of research. ***In the near future***, I aim to address distance and partial perceptibility due to occlusion issues in thermal cameras and RF sensors.

Integration of Heterogeneous Sensing Modalities

Many human events (e.g., disease) are depicted through perceptually independent patterns (e.g., symptoms) in disjoint timestamps and modalities. Hence, for comprehensive understanding, the integration of diverse sensing modalities while incorporating domain knowledge is critical, which is a focus of my research *[Sharma et al., 2022,Xiao et al., 2022,Salekin et al., 2017,Rahman et al., 2021]*, some of which are discussed below.

Our recent work on children's distinctive situational arousal pattern identification *[Sharma et al., 2022]* addresses a unique multimodal challenge. Different sensors perceive physiological parameters, such as heart rate, electrodermal activity, and respiration activities. Children's arousal indicative patterns across those parameters are yet unknown, meaning no labels are available. However, our preliminary analysis indicated the markers in each modality are sparse and disjoint in different timestamps, needing modality-wise distinctive pattern identification. Additionally, literature has shown that the correlation of those seemingly disjoint patterns is informative, requiring cross-modality relationship assessment. To address the challenge, we developed a modality invariant multiple-instance learning **(MI-MIL)** approach. **MI-MIL** extracts modality-specific sparse and latent patterns/markers leveraging modality-specific attention-based weakly-supervised learning paradigm and finally extracts the cross-modality relations by leveraging a novel adaptation of non-local convolution blocks. As a result, MI-MIL is effective in visualizing the sparse latent patterns from each modality.

Additionally, one of our recent works addressed the challenge of identifying and visualizing speech articulators' deviation from the fluent speech of children who stutter (CWS) *[Xiao et al., 2022]*. The challenges for this study include the similarity of fluent speech by CWS and other children, subtle markers, and the unavailability of labels. Since we know that the physiological response in CWS may affect their speech in different manners, a speech analytic approach that is adaptive to the speaker's physiological changes can be effective. However, the conventional multimodal approaches concatenate the sensing streams within their network architecture, thus, are incapable of identifying the independent contribution of one modality (speech). Therefore, we developed an approach named **PASAD**, which utilizes a HyperNetwork structure that leverages the speaker's real-time psychophysiological parameters to update a sequential speech classifier's weights dynamically. Hence, the speech classifier has a new set of weights at each timestamp, meaning it can analyze different aspects of speech acoustic conforming to the speaker's real-time psychophysiology. Moreover, since the classifier only utilizes speech in its inference generation, visualization of the independent contribution of speech aspects is feasible.

The works mentioned above are part of several **NIH** grants and may revolutionize the monitoring and intervention of speech disfluency. These works demonstrate that the multimodal approaches need to adapt domain knowledge, and the challenges and respective solutions would vary depending on the target task.

Future Direction: I aim to leverage my expertise to develop novel and domain-specific multimodal sensing solutions as part of my ongoing funded projects. For example, as a part of our **NSF SCH** grant, we are collecting physiological parameters through wearables, speech, thermal, and RF signals of opioid-use-disorder individuals from real home environments, where one of the aims is to assess opioid craving. However, craving symptoms are heterogeneous, and its comprehensive assessment would need perceiving knowledge from different modalities and a scalable and effective multimodal integration solution to be used in practical real-time, day-to-day living scenarios. Similarly, as part of our **NSF CPS** grant, we are collecting localization (through ultra-wideband), physiology, and movement information from farm animals that would require unique scalable multimodal solutions to understand animals' group dynamics and affective states.

<u>Security, Privacy, and Formally Verified Reliability in Scalable Sensing</u>

Security: Sensor anomaly or injection attacks on human-centric sensing systems can generate erroneous inferences, causing adverse outcomes. For example, an injection attack or a defective sensor in a wearable may randomly report high-stress mental states for a PTSD patient, resulting in inappropriate treatment. My recent work *[Xin et al., 2022]* has shown that human sensing data comprise the respective individual's traits. We developed a framework combining the Siamese network and multiple-instance learning to identify possible sensing-stream-segments with dissimilar traits and from which to identify the injection attacks.

Moreover, multi-modal systems comprise heterogeneous sensors whose data streams convey correlation due to their inherent redundancy. My work *[He et al., 2020]* has shown that such sensory streams exhibit inconsistent correlation patterns in the presence of anomalies. We leveraged deep auto-encoders trained to identify the bounds in which inconsistency between heterogeneous sensory streams indicates attacks or anomalies. ***In the future***, I aim to continue working on this domain with a specific emphasis on developing attack-resilient approaches by understanding the sensors' and sensing domains' underlying physical characteristics.

Privacy: Sensing data may leak users' private information. E.g., smart speakers listen to our speech to execute commands. However, recent research has shown high efficacy in human affective state and mental disorder assessment from spontaneous speech. Hence, the smart speaker companies or an attacker on the smart devices may learn such sensitive information, which is underivable. Recently, we developed **DARE-GP** *[Testa et al., 2022],* a genetic algorithm-based additive speech spectral noise generation approach. Dare-GP can mask the privacy-sensitive spectral attributes of speech in real-time, prohibiting any undesirable emotional information leakage while keeping the transcription-relevant attributes intact. ***In the future,*** I aim to extend the concept to develop universal adversarial additive noises that will protect a specific utility (e.g., a particular category of classifications) while prohibiting all other possible utilities (even unknown ones) from extracting information.

Formally Verified Reliability in Scalable Sensing: Developing neural networks (NNs) executables in real-time on resource-constrained platforms fit for safety-critical applications has been a longstanding interest. It requires sparse models with a guarantee of robustness. Though recent research combined adversarial training with pruning or sparsification, none provides proven formal guarantees on the sparse model's robustness. We developed **SparseVLR** *[Kaur et al., 2022]*, the first framework to search highly sparse, formally verified (i.e., with proven guarantees) locally robust NN networks. SparseVLR trains the sparse models from scratch, significantly reducing the training time than conventional compression techniques, like pruning. ***In the future***, I aim to integrate domain knowledge in formally verifying NN techniques to ensure enhanced proven guarantees on safety-critical applications. E.g., undesirable interventions may harm an individual for safety-critical human-in-the-loop applications. Conventional probability-based AI recommenders cannot provide guarantees against such outcomes. As part of my NSF SCH grant, I plan to introduce formal guarantees against known adverse effects while providing interventions to opioid-use-disorder individuals to mitigate their drug craving.

Broader Impact and Vision

I envision my work having twofold impacts. *First*, my research addresses challenges in practical and impactful domains. My **NSF SCH**-funded project can increase the quality of life for substance abusers going through rehabilitation, reduce costs by facilitating recovery from home, and significantly reduce relapses, leading to saving lives. My **NIH NIDCD**-funded projects address challenges relevant to child stuttering and speech disfluency. Research findings are enhancing the understanding of situational psychophysiological responses' role in speech disfluency and developing a path for automated, remote, and personalized monitoring and interventions. My **NSF CPS**-funded project would promote a humane way of farming and enhance productivity through automated sensing and adaptive suggestions for the farmers. *Notably,* the novelty of my research comes from the sensing and AI sides. Alongside the target domains, as discussed above, my solutions are generalizable (evaluated in benchmark generalizable datasets) and will enable the widespread use of ubiquitous sensing and AI in practical applications, even outside the human-centric sensing or smart-health domains.

Teaching Goals and Objectives

A successful academic career is about a good balance between teaching and research. One of the reasons I pursued an academic career is because I derive gratification from exchanging ideas with my students and satisfaction from seeing them apply the concepts for solving practical problems. During teaching, I always strive to create an environment that enables students and me to engage in critical discourse with adequate room for experimentation, observation, questioning, and, importantly, productive criticism. Such an environment is necessary for a healthy and practical learning experience.

Teaching Activities

After joining Syracuse University, I designed a new 700-level (research topic-based) course titled 'Ubiquitous Computing' (in the first semester, the title was 'ML for IoT application'). So far, I have taught the course in Spring 2020, 2021, and 2022. I changed the week-by-week theme distribution, hands-on assignments, and lectures in all the iterations. In this course, I integrated conventional active learning [Prince et al., 2006] with flipped learning [Karabulut-Ilgu et al., 2018] methods. In half of the lectures, I discuss concepts on sensing, cyber-physical system, scalable and trustworthy AI, and AI interpretation techniques. On the other half, after covering each concept, I, with the students, conduct review sessions, where students read papers and write detailed reviews before the lecture. During the lecture session, they discuss and debate the novelty, impact, weaknesses, fallacies, possible improvement, and lessons learned from the reading materials. Additionally, each student performs a hands-on assignment where they develop a ubiquitous sensing approach, integrating the concepts discussed in the course. Students have developed various exciting projects as part of their assignments, some of which have been applied to their Ph.D. or master's research, leading to publications. For this course, I regularly receive a high overall evaluation quality rating (about *4.5-4.65 out of 5*), which includes comments like, "The course is thought out perfectly, encouraging everyone's participation. Learning all together in class through paper reading.", "Dr. Salekin goes out of his way to answer my questions and make sure I understand the topics. I am glad he was my instructor."

Moreover, I regularly teach graduate-level algorithms (CIS 675) and undergraduate-level algorithms (CIS 477), two of the core courses of the EECS department at Syracuse University. I am passionate about algorithms, and one of my primary goals in teaching these courses is to help students realize the beauty in algorithms themselves. I completely re-designed the courses by integrating both fundamental theories of algorithms, their impact, and practical use. A large fraction of my lectures involve students in activities to enhance their understanding of how algorithmic solutions and their proofs are designed. This has been a challenge, particularly in the larger courses (e.g., the most recent semester of CIS 675 had *170* students), but active learning is one of the best ways for students to learn this material. I regularly receive high evaluation quality ratings (The last CIS 675 rating was *4.25/5*, and the CIS 477 rating was *4.68/5*), which include comments like, "Excellent instructor-very good at explaining concepts and clearly motivated to help students succeed. Homework assignments were challenging, but not too challenging, and were a great help towards being successful on the exams. I look forward to taking courses from Dr. Salekin in the future.", "I really enjoyed this course. I believe Professor Salekin did a great job at challenging us and getting across the topics greatly. Great semester!".

As a voluntary track assistant professor, I delivered a couple of lectures on Machine learning for smart health in a course named *ML Nano course series in 2020*. Giving lectures to future and current medical professionals enriched my understanding of the impact, knowledge gaps, and challenges of deploying AI, Cyber-physical systems, and human-centric systems in practical but safety-critical domains, such as health care.

Mentoring Activities

Involving students in my research is an essential part of being a professor to me. This helps my research, but equally importantly, seeing these students grow as researchers is gratifying. It makes me proud to see them succeed in school and beyond. Whenever I teach a course, I end the semester with a brief presentation on my research and invite students to contact me for research opportunities. Since teaching multiple core master's and undergraduate courses, I regularly have multiple students who have taken me up on this offer. In some cases, this has been extremely productive for both the students and me: two such students decided to stay on for their Ph.D. at Syracuse. One master's student first authored a top-tier paper and received the 'IAAI Deployed Application Award.' One undergrad student recently submitted his paper to the top-tier venue IMWUT.

Currently, I am directing the Laboratory for Ubiquitous and Intelligent Sensing (UIS Lab) at Syracuse University. I mentor six Ph.D. students, ranging from those in their first year to those in their fifth year, five master's, and two undergrad students. I spend significant time with my mentees brainstorming new research ideas to understand where my mentees' passion lies. On several occasions, they have surprised me with exciting and unique ideas, resources, or solutions that I would have never thought of. I extensively work with my students to evaluate the ideas, impact, novelty, and feasibility. Specifically, a new research idea should be able to address the questions posed by Heilmeir's Catechism. I work closely with my mentees, from forming the research questions to developing codes and evaluating the systems/approaches, simultaneously making sure to give them enough room to grow as independent researchers.

Additionally, starting in the summer of 2022, I am inviting one underrepresented student from Syracuse Area. A K-12 student (named Elijah Barboza) worked in my lab with the master's and doctoral students this summer. I partnered with the STEP program at Syracuse University to host such students. I hope to continue hosting K-12 students in my lab each summer.

Service Objectives

My service to date has focused primarily on four aspects: (1) Reviewing conference and journal papers, (2) Community outreach, (3) Service to Syracuse University, and (4) Service to the field.

Reviewing Papers: I have been serving as an Associate Editor for the ACM Transactions on Computing for Healthcare Journal. I have been a program committee member for several important conferences, including the AAAI 2022, 2023, CVPR 2021, IMWUT/Ubicomp 2017, 2018, 2019, 2020, 2022, IFIP Performance 2018, ISSRE 2018, DSN 2019, reviewer of the ACM Transactions on Cyber-Physical Systems 2019 and the ACM Transaction on Privacy and Security 2022. Also, I served as a TCP member in PerIoT 2020 and PerIoT 2021.

Community Outreach: I actively work on involving underrepresented students in computing and relevant research activities. During the early days of the COVID-19 pandemic (April-July, 2020), I mentored six undergraduate students (three women) in developing a COVID-19 symptom tracker smartphone app[1]. In partnership with Google Research, Syracuse University organizes an undergraduate student engagement program, RESORC (Research Exposure in Socially Relevant Computing). The goal is to encourage students from historically underrepresented groups within computer science to apply, which includes, but is not limited to, women, students of color, first-generation college students, and LGBTQ+ students. In 2021, I participated in the program by giving a talk on 'Ubiquitous and human-centric computing in healthcare' and showing demos on different health sensing systems.

One of my major long-term interests is in developing outreach programs for underrepresented students from local schools. In 2021, I reached out to the local schools in the Syracuse area, and in partnership with the Cicero-North Syracuse High School and the STEP[2] program, I extended a paid internship opportunity to a K-12 student and hosted the student for six weeks in the summer of 2022 in my lab. The student got hands-on research experience alongside my lab's Ph.D., master's, and undergraduate students. The STEP program provides academic support services and enrichment activities to students in grades 7-12 in Syracuse and surrounding communities. In partnership with the program, I am recruiting two underrepresented K-12 students for paid internships in the summer of 2023. I am committed to mentoring these students in STEM research and actively supporting and encouraging them to pursue their undergraduate studies in STEM. I firmly believe that involving students in my lab for the long term and mentoring them after that has a lasting impact. I am committed to continuing such efforts throughout my academic career.

One of my key research areas of interest is human-centric sensing with smart health applications. Research in smart health would only realize its full potential with the active engagement, understanding, and acceptance of current and future medical professionals. In 2020, I organized a talk and demo session at SUNY Upstate Medical University to enhance awareness and involvement of smart sensing and AI technologies in healthcare. Additionally, in the summer of 2020, I delivered a couple of lectures on Machine learning for smart health in a course named ML Nano course series 2020. Recently, in October 2022, my lab organized a seminar and demo session for medical professionals of Crouse Hospital at Syracuse, demonstrating the recent advancement of health sensing and AI technologies. These talks, lectures, and demo sessions not only encouraged medical professionals to utilize current AI and sensing technologies but also enriched my understanding of the impact, knowledge gaps, and challenges of deploying AI, Cyber-physical systems, and human-centric systems in the health domain.

[1] https://news.syr.edu/blog/2020/04/28/ecs-students-team-up-with-public-health-and-anthropology-faculty-to-develop-covid-19-symptom-tracking-app/?fbclid=IwAR0Jetvm68IUqCu8zXT1mjP-WzXSKmwAAXbPwuDYnAz3sDM039iWvnzWsZw
[2] https://academicopportunity.syr.edu/step/

Service to Syracuse University: As a junior faculty member, my departmental service has been limited. Since 2020, I have served on the EECS qualifying exam (QE 1) committee, actively setting questions, proctoring, and grading the exam papers for the Algorithm part of the exam. Since 2020 to until now, I have served as the undergraduate student advisor for 27 undergraduate students (currently 24 for Spring 2023). I served on the Syracuse University CUSE grant review panel in 2020. Also, in 2020, I actively participated in developing one faculty position for the second round of cluster hiring competitions in Aging, Health, and Neuroscience. I have served on seven Ph.D. proposals and four Ph.D. defense committees. I plan to increase my contribution to service over the next years.

Service to the Field: I have been a panelist for Four NSF panels: (1) Served on Phase I: Big Data and Advanced Analytics (Virtual) SBIR review panel in 2020, (2) Served on NSF Multimodal Sensor Systems for Precision Health Enabled by Data Harnessing, Artificial Intelligence, and Learning (SenSE) panel in 2021, and (3,4) Served on NSF Smart and Connected Health (SCH) panel in 2022 and 2023. Also, I attended and presented my work at the NSF SCH PI meeting in 2022 and the NSF CPS PI meeting in 2022.

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