RIT

AWARE-AI NSF Research Traineeship Program

Spotlight on Research Track: Human-sensing AI Hardware

Dr. Ferat Sahin and his Trainees have been conducting research studies with human participants interacting with collaborative robots as part of the research track focusing on AI hardware. In this work, the interactions of participants with industrial collaborative robots are observed while physiological signals are collected from the subjects. This research addresses the goals of the research track towards understanding how comfortable and safe humans are in their physical interaction with the robot during collaborative activities.

Three main challenges are addressed in this research track: safety, human trust in automation and productivity. The objective is to build human trust while working with the robot, and ensuring human safety while optimizing task productivity. Even though collaborative robots are inherently safe to work with, any unexpected human-robot physical contact can cause the human to become apprehensive of the robot's movements and consequently feel less trust, which can impact productivity. The work focuses on observing and analyzing the effect of increasing safety for the human and for productivity through comfort index estimation.

The track's current research activity measures participants' comfort during their interaction with a collaborative robot through their physiological signals. To qualify and map physiological signals to emotions, the track team uses the circumplex model mapping arousal and valence of a person to their emotional state. Then, machine learning models are used to estimate comfortability through four emotions - anxiety, surprise, boredom, and calmness - using physiological signals such as galvanic skin response, heart rate, heart rate variability, and pupil dilation. The machine learning models were based on data collected from over 60 subjects in three experimental setups of industrial human-robot collaboration.

Dr. Sahin and Trainees are studying how to optimize human robot collaboration using real-time comfort index estimation with physiological signals where safety and high throughput are achieved in AI-informed automation.