Georgia Tech Institute for Robotics and Intelligent Machines

NSF NRI: Rapid Operator Awareness via Mobile Robotics (ROAMR)

Customizable Human Safety using Mobile and Wearable Co-Robots

IIS: 1830498

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Research Aim Highlights

1. ***Inform*** humans of impending threats to safety.

2. ***Recognize*** human intent in order to provide tailored assistance.

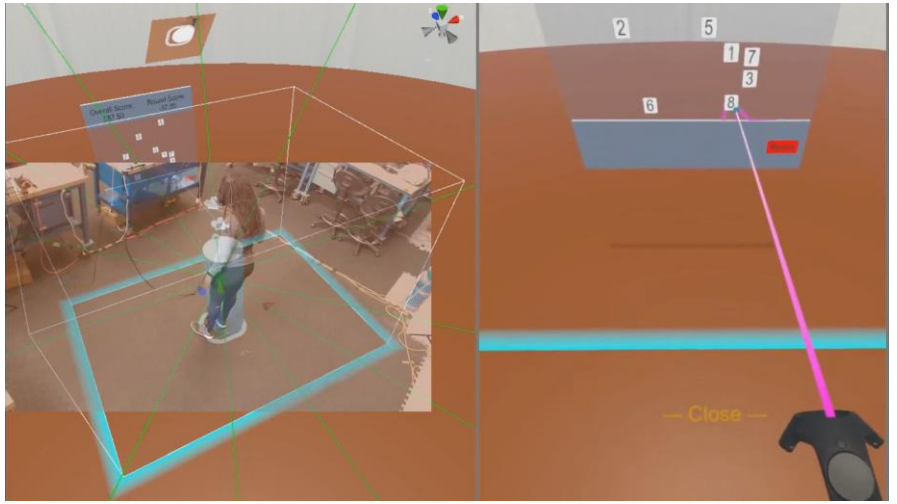
3. ***Assist*** physical human behaviors with a wearable co-robot.

A. Bajpai, J. Powell, A. J. Young, **A. Mazumdar**, "Enhancing Physical Human Evasion of Moving Threats Using Tactile Cues," IEEE Transactions in Haptics, Dec. 2019.
P. Moolchandani, **A. Mazumdar**, A. Young, "Design of an Intent Recognition System for Dynamic, Rapid Motions in Unstructured Environments," ASME Letters in Dynamic Systems and Control, April 2021.
A. Bajpai, K. Feigh, **A. Mazumdar**, A. Young, "Influencing Human Escape Maneuvers with Perceptual Cues in the Presence of a Visual Task," IEEE Transactions on Human Factors, Aug. 2021.
A. Bajpai, A. Lu, K. Choi, A. Young, **A. Mazumdar**, "Using Autonomous Motion Planning to Improve Human Safety in Dynamic Environments," IEEE Robotics and Automation Letters (*In Review*), Feb. 2022.

Aim 1: Effectively Inform Human Operators

We aim to improve human decision making and reaction times with wearable technologies and planning algorithms.

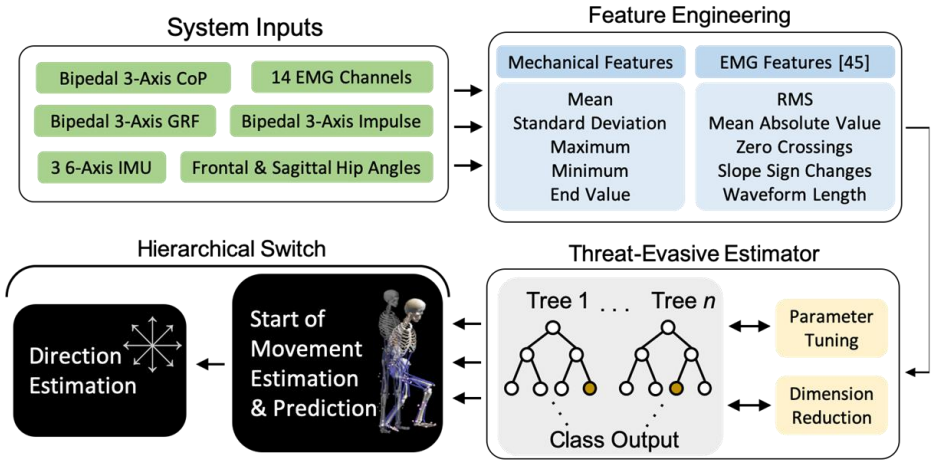
- ❑ Tactile cues have shown particular promise in the presence of visual distraction.
- ❑ Complex, dynamic environments may benefit from intelligent guidance rather than simply awareness of obstacles.
- ❑ **Currently,** we are combining perceptual cues with motion planning algorithms for AI-enabled human performance significantly past native human ability.



Aim 2: Understand Human Intent

We seek to understand the human response to threats in order to provide the most effective assistance.

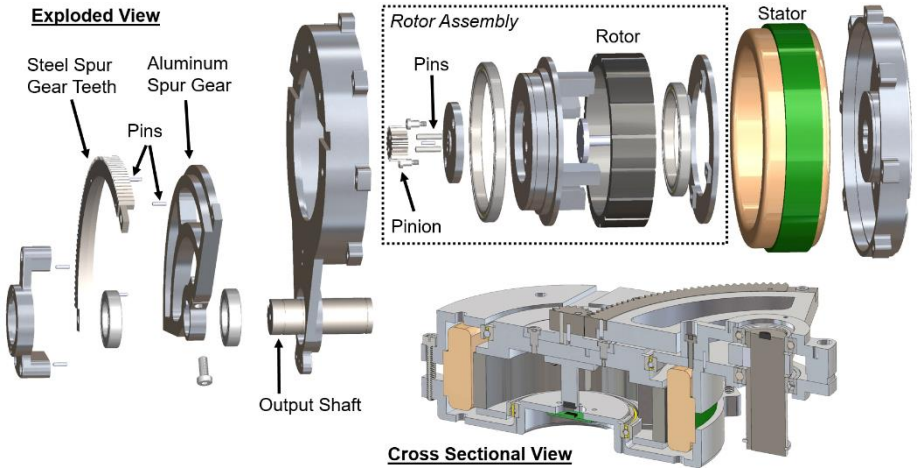
- ❑ Collected a sizable new dataset on dynamic human escape behaviors.
- ❑ Data includes human kinematics, kinetics, muscle recruitment, and knowledge of the environment.
- ❑ Machine learning-based intention recognition algorithms can predict onset and direction of movement using a set of wearable sensors useful outside lab settings.
- ❑ **Currently,** we are integrating these algorithms to run in real-time to dictate exoskeleton control.



Aim 3: Provide Physical Assistance

We are exploring how intelligent physical assistance can improve human safety.

- Physically assisting rapid human behaviors remains relatively unexplored.
- Metrics of performance include time to reach safe zone, ability to avoid moving obstacles.
- **Currently,** a range of physical assistance strategies are being explored using a novel hip exoskeleton device.



QDD based Hip Exo:
Cyclic Walking Assistance

Dynamic **A**daptive **R**obotic **T**echnologies

Exoskeleton and **P**rosthetic **I**ntelligent **C**ontrols

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