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2)

Research Idea 1: Mobile Monitoring and Assistance

Develop technologies that enable natural collaborative interaction between a human user and an autonomous mobile robotic partner in field and service domains. By "natural" interaction, enabling the human user to maintain their own situation awareness while supervising the robot (e.g., allocating robot tasks) and leading the movement of the group (e.g., movement through an environment). Such technologies could also detect anomalies in human performance during routine task, allowing for early diagnosis of potential health issues.

Our existing work (in press) has explored a "hands-free" multi-modal HRI in field and service appliications with strictly onboard processing, control, and sensing. This work integrated nascent sensing modalities (e.g., time-of-flight cameras) with standard techniques for gesture recognition and person detection and following as a step towards enable seamless human-robot coordination.

Research Idea 2: Biomechanical Human Tracking

Develop technologies to track biomechanical state (e.g., musculoskeletal configuration) from multi-modal sensing (e.g., vision, EMG, force plates) in common human environments. Such technologies would utilize and further refine models of human biomechanics as predictive mechanisms. These predictions would be used in the context of state estimation along with likelihood functions, which evaluate possible human states to sensory observations. Tracking of biomechanical state could serve to estimate more physiologically-relevant (e.g., muscle tension, ground impacts) data about how individual are functioning. As biomechanical tracking improves, sensing modalities can become increasingly less intrusive, moving from EMG to vision-based techniques. Our recent work (in press) in using rigid body dynamics for human tracking demonstrates improved accuracy but, more importantly, estimation of ground forces for walking gaits:

http://robotics.cs.brown.edu/projects/dynamical_tracking/