NRI: FND: The Robotic Rehab Gym: Specialized co-robot trainers working with multiple human trainees for optimal learning outcomes

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Challenges

How a team of robotic trainers supervised by a human expert can efficiently teach multiple skills to groups of human trainees over a long time period.

- Dynamic multi-robot task assignment with uncertainties.
- Training outcome estimation from trainees' current training performance.
- Human-robot collaborative planning of rehabilitation training.

Scientific Impact

- Contributions to multi-robot task planning that assigns human trainees to robots with the goal to optimize long-term group training outcome.
- Contributions to robot perception that estimates a trainee's skill level and potential for improvement.
- Contributions to human-robot collaboration that leverages the complementary benefits of human and machine intelligence.

Solution

- A multi-robot task scheduling and allocation system based on mixed integer nonlinear programming (MINP) to automatically allocate multiple human trainees to multiple robotic trainers.
- A neural network computational model learned from demonstration to imitate a human expert's decision-making for automatic and dynamic trainee-robot assignment.
- A neural network computational model predicting training outcome to guide the dynamic training assignment.

Broader Impact on Society

Artificial intelligence methods created in this project will be adopted in rehabilitation gyms and will be beneficial in other applications of machine intelligence-aided group learning such as sports, surgery, language therapy, education, etc.

Broader Impact on Education and Outreach

- Project results to be used for developing interdisciplinary courses focusing on co-robots in both PIs' universities.
- Lectures and research internship opportunities for K-12 and community college students in Wyoming.
- Results dissemination to the general public.

Broader Potential Impact

The methods created in this project will help reduce the costs and the need for human expert to deliver effective rehabilitation to a group of patients, alleviating the already severe shortage of physical and occupational therapists in healthcare facilities.

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