# Assessing gait quality for the development of a human-in-the-loop tuning algorithm for robotic ankle prostheses

NRI: INT: COLLAB: Accelerating Large-Scale Adoption of Robotic Lower-Limb Prostheses through Personalized Prosthesis Controller Adaptation

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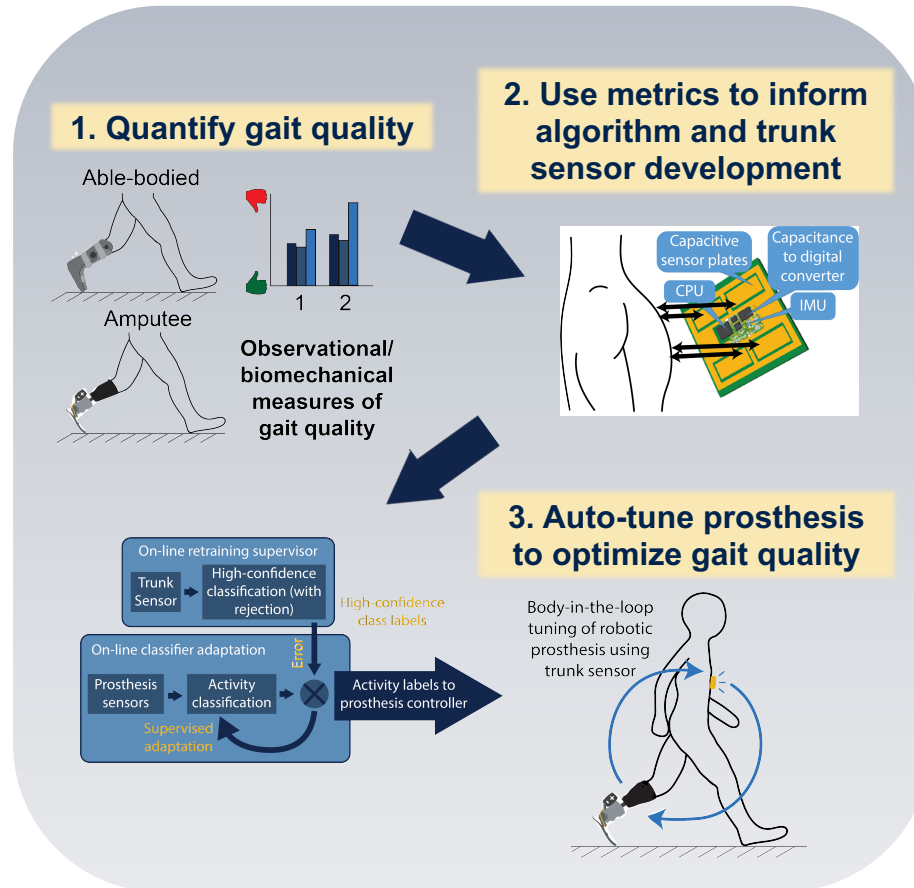
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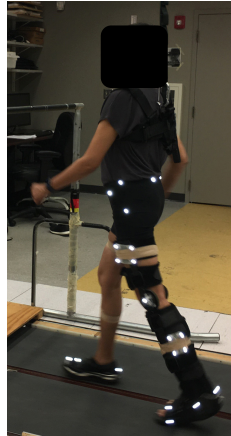
Challenges

- Tuning robotic prostheses is non-trivial and time consuming for clinicians
- How do we quantify "good gait"?

Solution

- Use gait quality metrics to develop an algorithm that will automatically tune robotic prostheses using a trunk motion sensor
- Test on healthy controls with systematic perturbations to joints and users with transtibial amputation wearing novel prosthesis

1. Quantify gait quality
Able-bodied
Amputee
Observational/ biomechanical measures of gait quality

2. Use metrics to inform algorithm and trunk sensor development
Capacitive sensor plates
Capacitance to digital converter
CPU
IMU

3. Auto-tune prosthesis to optimize gait quality
On-line retraining supervisor
Trunk Sensor
High-confidence classification (with rejection)
High-confidence class labels
On-line classifier adaptation
Prosthesis sensors
Activity classification
Error
Activity labels to prosthesis controller
Supervised adaptation
Body-in-the-loop tuning of robotic prosthesis using trunk sensor

Scientific Impact

- Development of novel wearable sensor and robotic prosthesis controller
- Improved understanding of how human expertise-based tuning optimizes gait quality of amputees

Broader Impact

- Clinical/patient perspectives: Restoration of functional mobility is an important metric of quality of life following an amputation
- Collaborative perspectives: Roboticists and clinicians have greater accuracy and speed in tuning a device to a specific user
- Educational Perspectives: Programs for Enrichment and Accelerated Knowledge in STEAM and Hands On Future Tech