Background

- Robotic hand orthoses (RHOs), such as the MyHand device, can assist stroke survivors with minimal hand function during functional activities and may also improve motor capacity through repeated practice (Khalid et al., 2021; Xu & Chen et al., 2024).
- Machine learning can use electromyography (EMG) data to detect the user's intent to open or close their hand.
- After stroke, these algorithms may have difficulty determining the intent of the hemiparetic hand due to reduced ability of the user to perform consistent actions (Xu & Chen et al., 2024).
- RHOs can provide users with feedback (e.g., visual, auditory, or haptic) on the intent being detected to encourage motor learning, improving the user's ability to use the device.
- However, little is currently known about how to optimize human-robot interactions so that users can efficiently and effectively learn to use such devices (Díaz et al., 2023).
- Our research team is investigating a novel training paradigm for MyHand that acknowledges the dynamic interaction between the person, the robot, and the task, and aims to foster motor learning during functional engagement with the device (Xu & Chen et al., 2024).

Training Protocol

User follows commands to open and close their hand while wearing the RHO

RHO uses EMG signals to classify "open" and "close" intents with machine learning

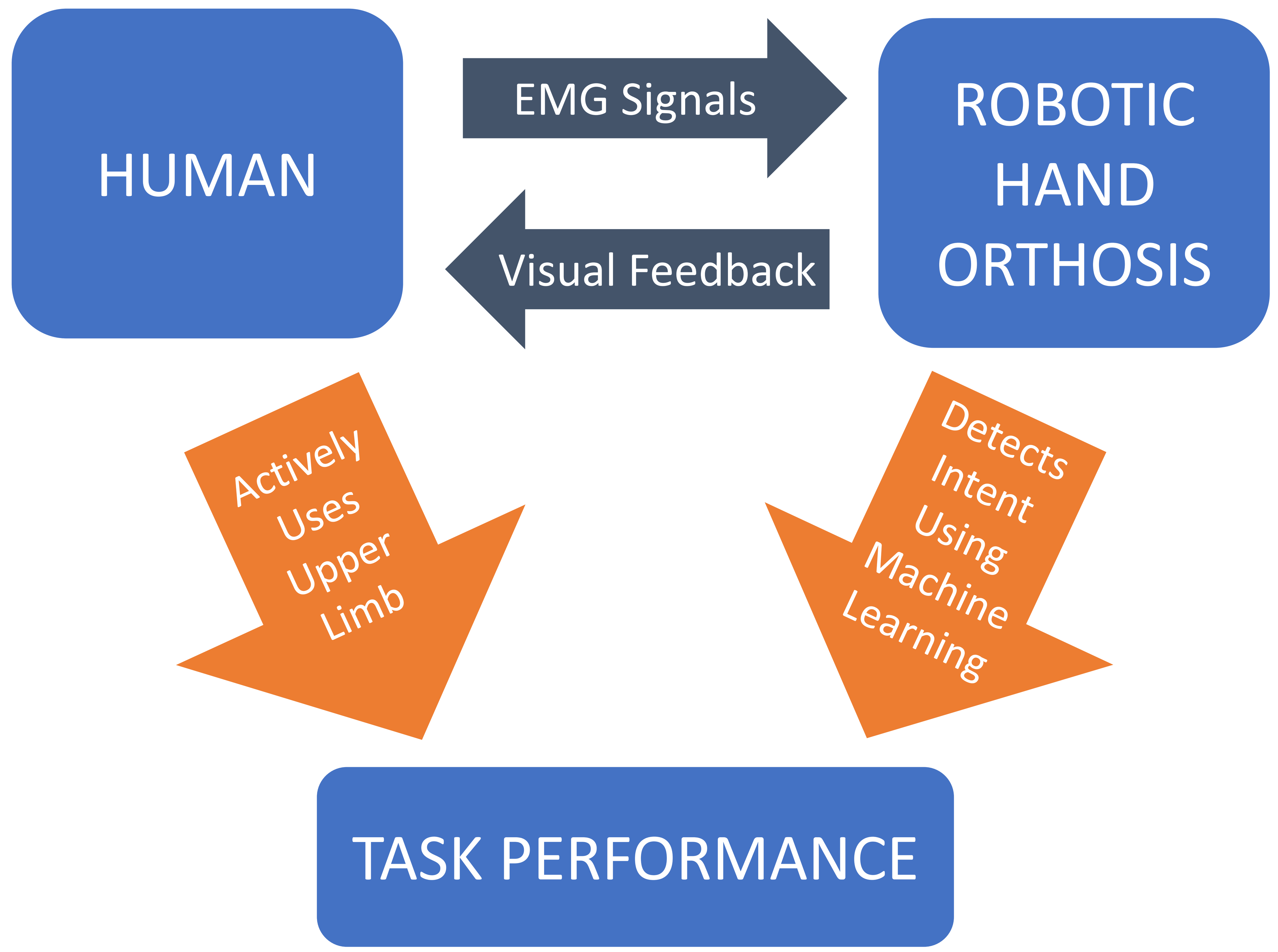
RHO provides visual feedback to the user on the intent the RHO is detecting

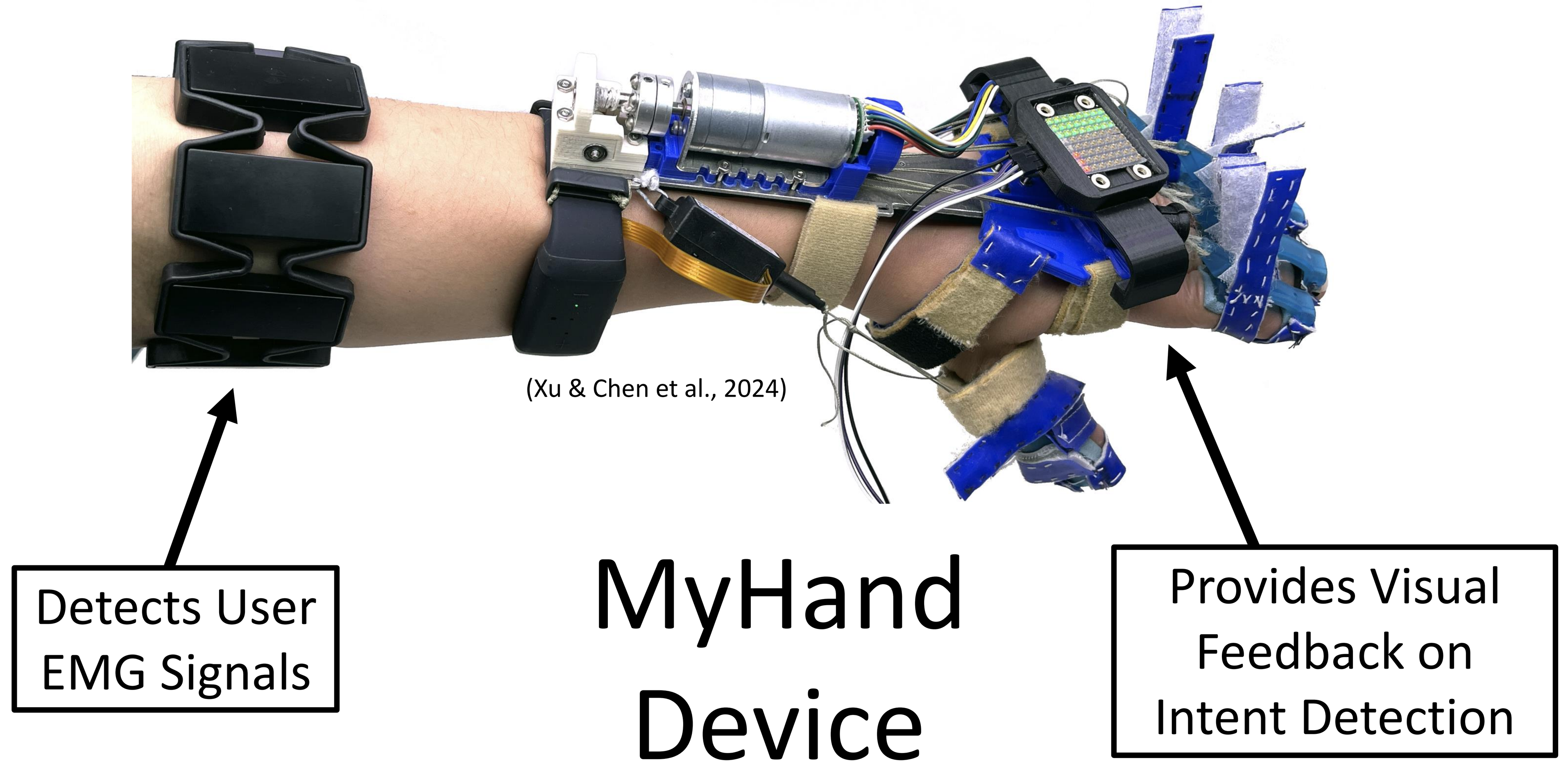
User practices with visual feedback to improve movement consistency

RHO updates intent classification based on improved user performance

(Xu & Chen et al., 2024)

Model





(Xu & Chen et al., 2024)

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Challenges and Opportunities

- RHOs, such as the MyHand device, have the potential to improve upper limb function for stroke survivors by detecting the intent of the user, and motor learning techniques, such as visual feedback, may help users learn to use such devices.
- However, we have had mixed results with initial testing, finding that within a single session, some participants improved consistency while others did not (Xu & Chen et al., 2024).
- Multiple factors such as variations in upper limb strength, muscle tone, and coordination may lead to differing responses.
- Other motor learning techniques, such as use of different types of feedback (auditory, haptic, verbal), require more exploration.
- Additionally, the amount of practice time needed to learn to use such devices is also largely unknown.
- Future research is needed to further investigate how motor learning techniques can best support stroke survivors when learning to use RHOs.

Implications for Occupational Therapy

- Occupational therapists are uniquely qualified to collaborate with engineering teams on the development of robotic hand orthoses (Proulx et al., 2021) and can use their expertise to incorporate motor learning techniques into the design of device interfaces and training protocols.

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