# Real-Time Myoelectric Control of a Virtual Upper Limb Prosthesis via Lower Leg Gestures: Preliminary Results

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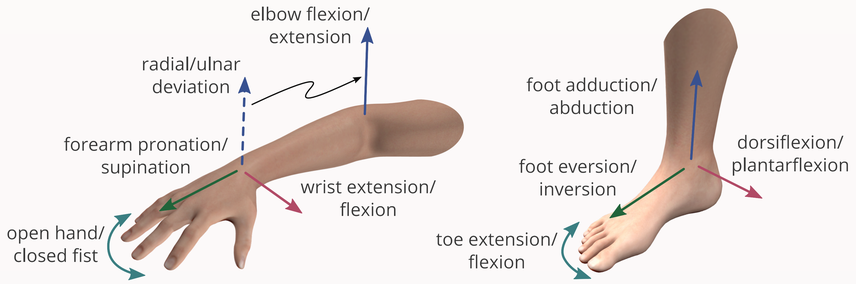
## Motivation

Creating powered prosthesis controllers for high-level upper limb amputees is a major challenge due to the limited number of muscle sites available for user control output.

By leveraging current myoeletric control techniques and the natural mapping between the arm and the leg, high-level amputees may be able to control a prosthetic arm using movements of the lower leg and foot.

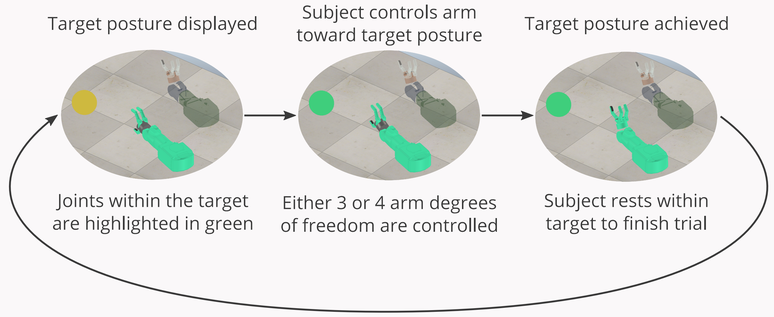
## Arm-Leg Mapping

The proposed control method is based on the alignment of the rotational axes of the wrist and the ankle which creates a natural mapping between arm and leg movements.

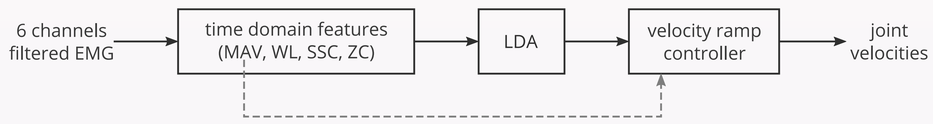



## Target Achievement Control Test

The target achievement control (TAC) test was used to evaluate real-time controllability with the leg gesture control scheme. The virtual prosthetic arm was simulated in V-REP.

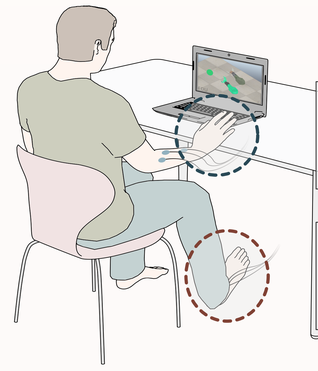



### Myoelectric Controller




## Experiment

Six subjects performed TAC test trials in two configurations: arm and leg.



**Part A: Arm Configuration (benchmark)**
EMG sensors placed on the forearm/wrist. Subjects controlled the simulated arm using arm movements.

**Part B: Leg Configuration**
EMG sensors placed on the lower leg/ankle. Subjects controlled the simulated arm using leg movements.

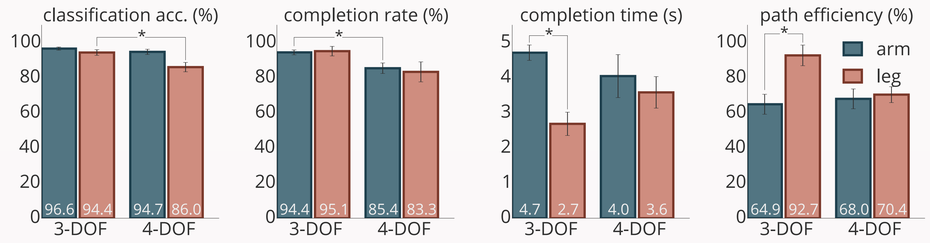
In both cases, subjects performed the task in two different complexity conditions:

- 3 active degrees of freedom (no elbow actuation)
- 4 active degrees of freedom (elbow included)

## Results

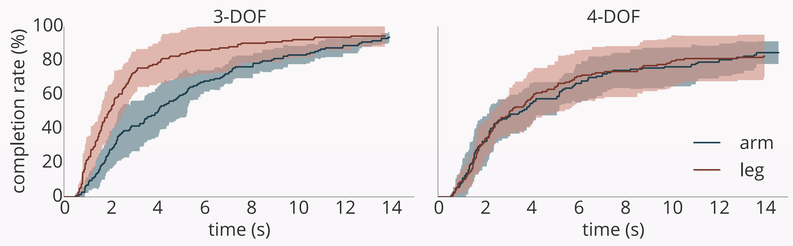
### TAC Test Metrics

Real-time TAC test performance in the leg configuration was comparable with and sometimes better than the arm configuration.




### Cumulative Completion Rate

Control was exceedingly stable in the leg configuration with 3 active degrees of freedom, leading to quick and efficient target acquisition.

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