Control design for a soft exoskeleton in simulation and identification of the role of different sensor modalities

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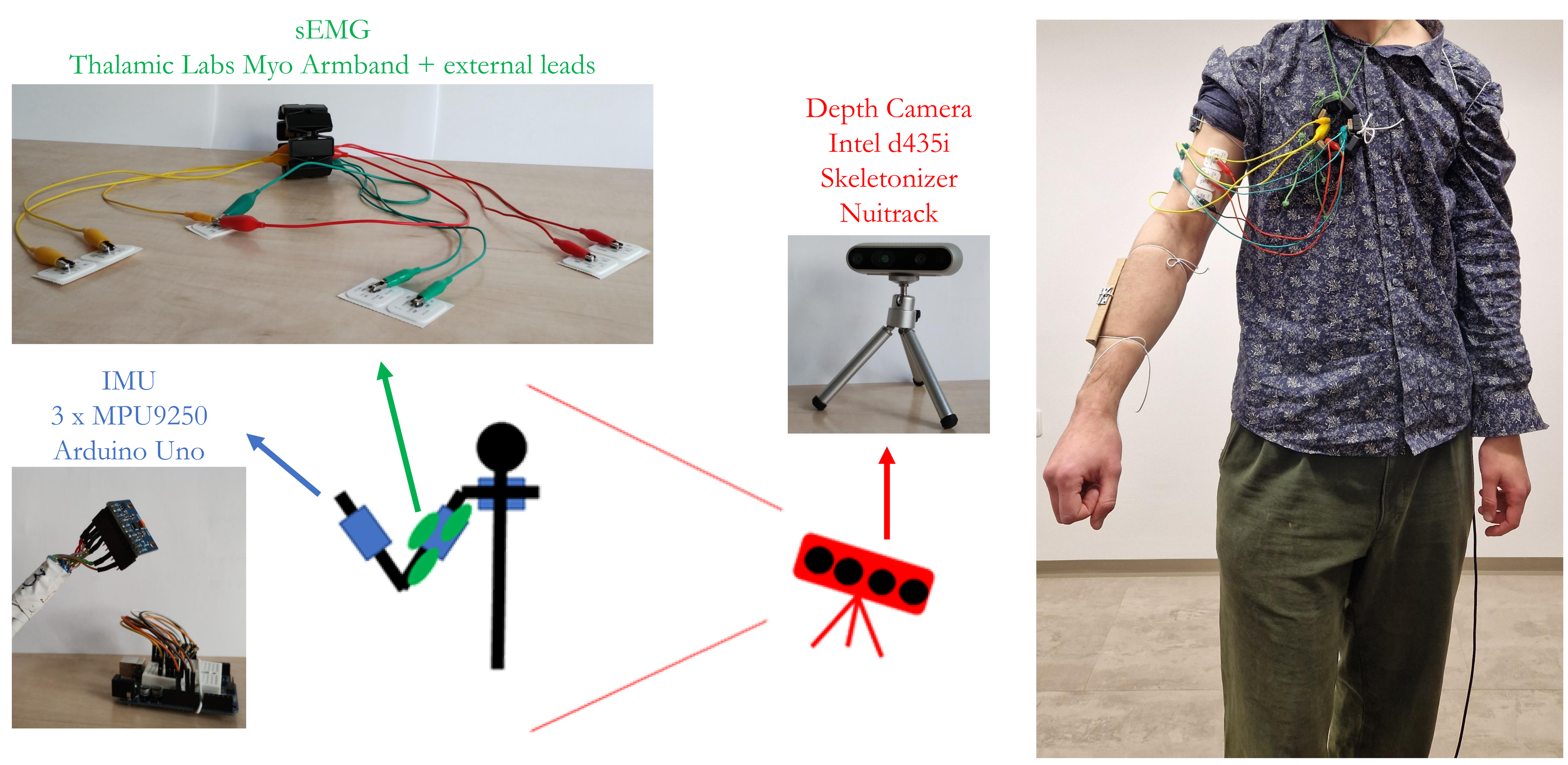
Project description

- Help people living with athetosis in their daily activities and improve their chance of labor-market integration.
- Collaboration with a special primary school using conductive pedagogy in the habilitation of affected students.
- Soft exoskeleton development that can aid its users' movements and attenuate their involuntary movements.
- Simulations can aid the development of a control algorithm for the exoskeleton and help to understand the biomechanical background.

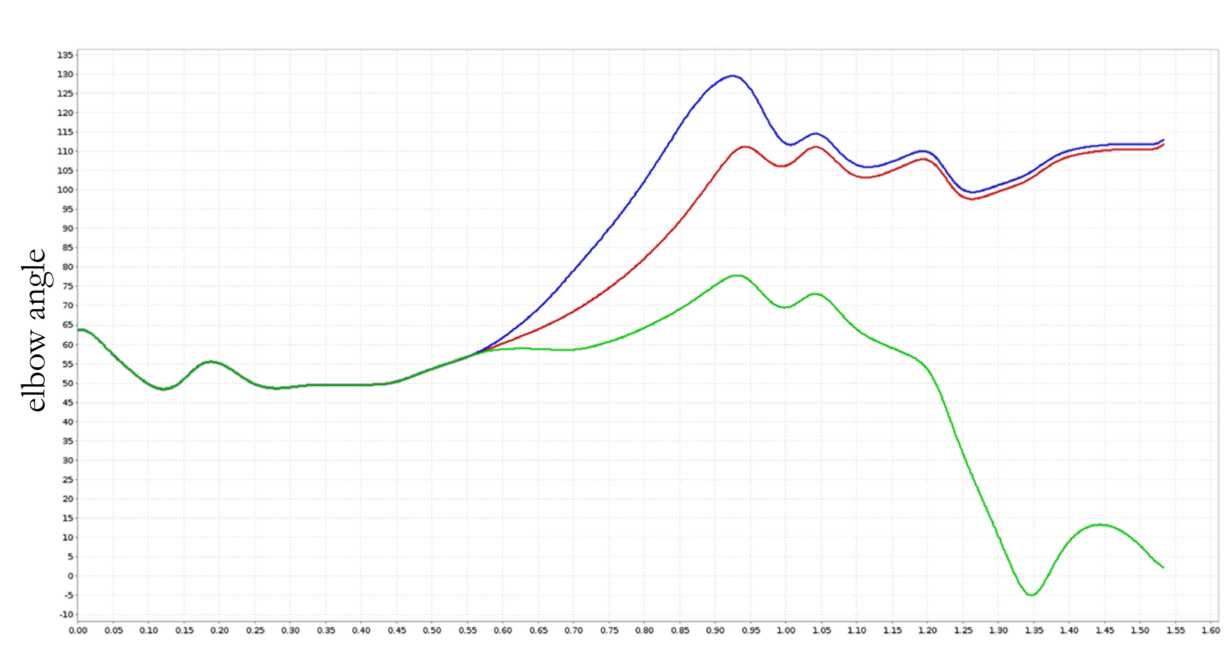
Measurements

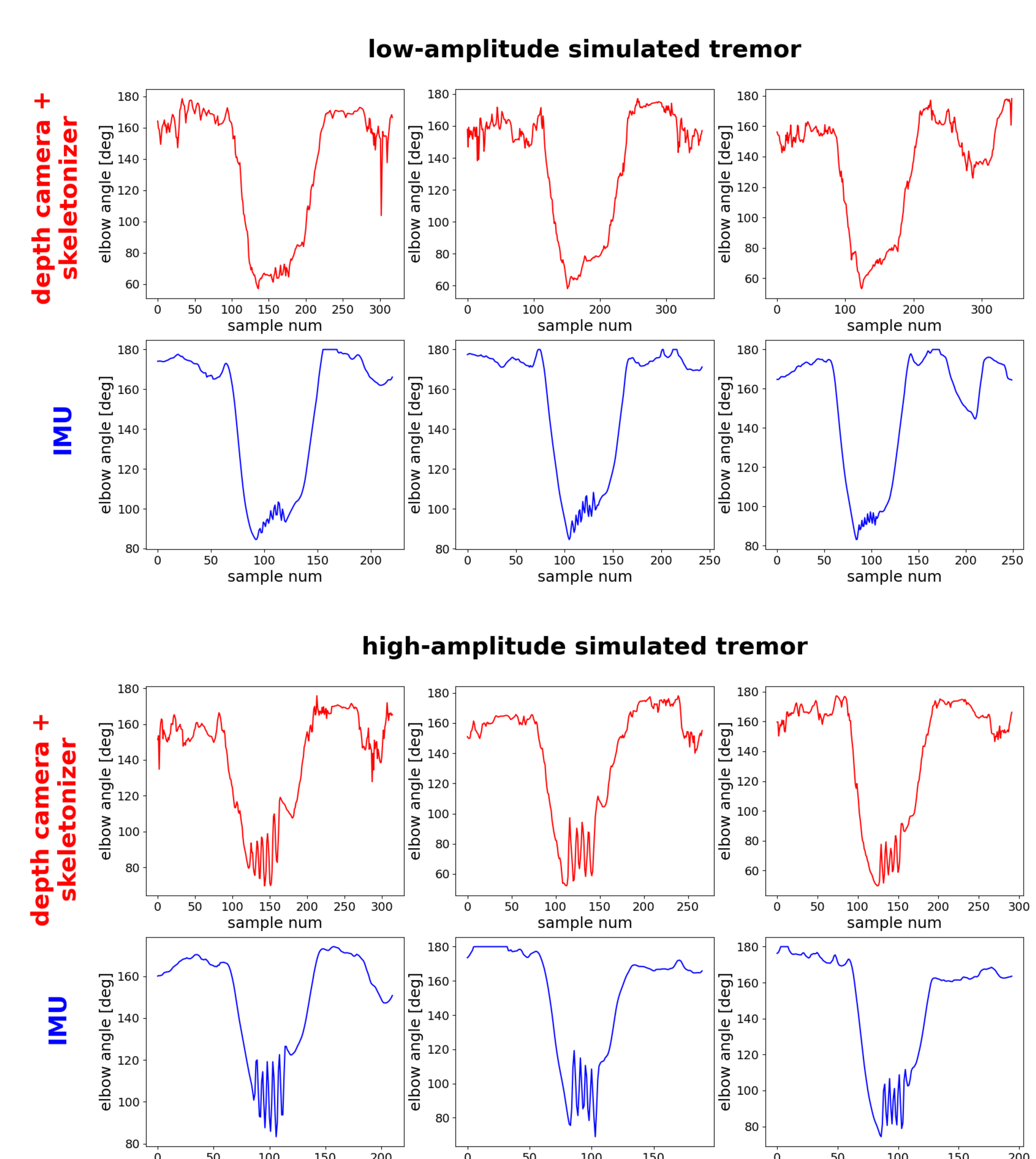
- On two healthy subjects.
- Repeated movements on a given trajectory and simulated tremors.
- Three modalities
  - Vision-based measurement: Intel RealSense d435i + Nuitrack v0.35.13
  - Inertial sensor: 3 x 9 DoF MPU9250 IMU
  - Muscle activity sEMG: Thalamic Labs Myo Armband



Results

- While the vision-based skeletonizer often smoothed out low-amplitude tremors in the spatiotemporal trajectory, the IMUs recorded them clearly.
- Although the direct measurement of muscles (sEMG) allows earlier detection of movement initiation, the use of IMU data helps provide a more robust and accurate measurement of displacement.
- Data were imported into OpenSim v4.3 and paired to an existing arm model (MoBL-ARMS, 7DoF, McFarland et al.[1] after Saul et al.[2] with Millard et al.[3]). In the case of sEMG data, we defined additional external constraints in order to examine the possible effects of our developed exoskeleton. Although the autonomy of the dynamical system ceased due to the outer effect (muscles' reactions unknown), to a certain degree, we could still accept the simulated modified limb movements.





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