An advanced experimental platform for physical human-machine interaction

CPS Synergy: Cyber-Enabled Motions in Rehabilitation

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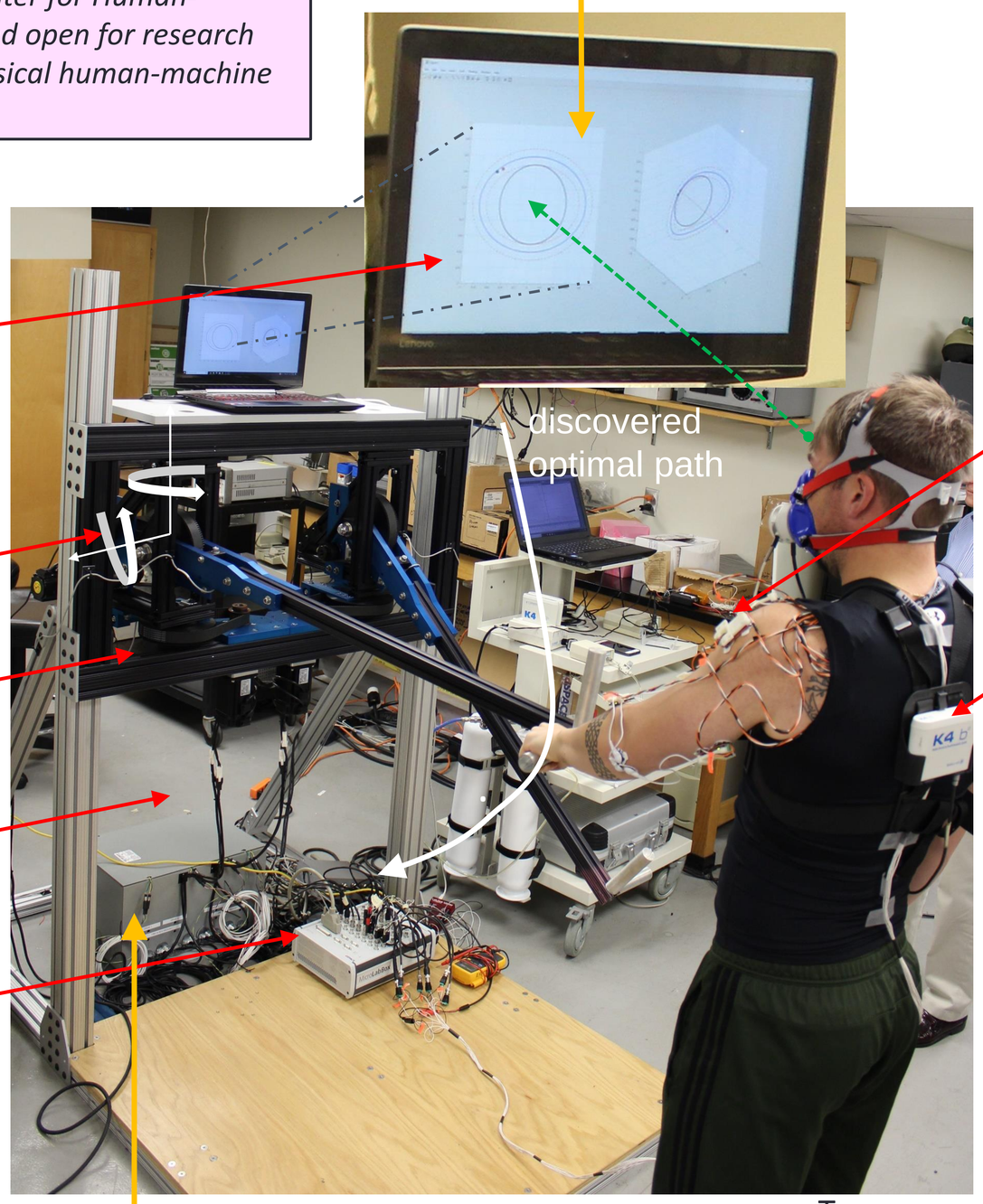
The CSU 4-degree-of-freedom optimal exercise system (CSU 4OptimX) is in operation at the Center for Human-Machine Systems and open for research collaboration in physical human-machine Interaction.



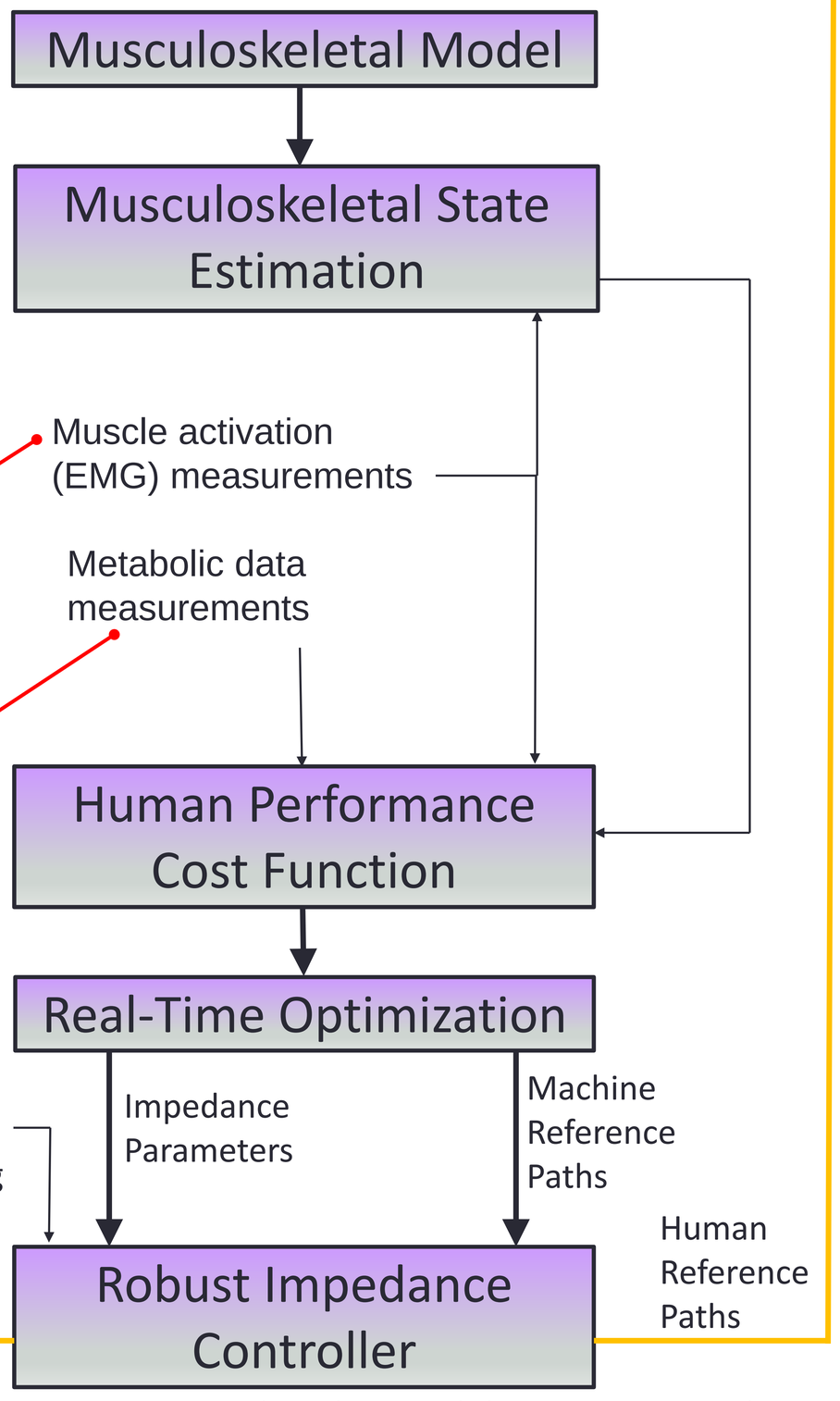
Visualization and human control references

Two powered rotational axes per side

Force sensing on each axis

Four torque control servos

High-performance DAQ and real-time control



- Biomechanical models support simulation studies on self-optimizing control and are used by state estimators.
- State estimation involves Kalman filters and sliding-mode observers. It aims to produce reliable estimates of muscle activations with a reduced set of EMG sensors.
- The impedance controller is based on integral sliding modes.
- The real-time optimizer is based on extremum-seeking control, with model-based methods also considered.`

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