Robotic Surgical Training

A Comparative Human-centric Analysis of Virtual Reality Simulation and Physical Dry Lab Exercises

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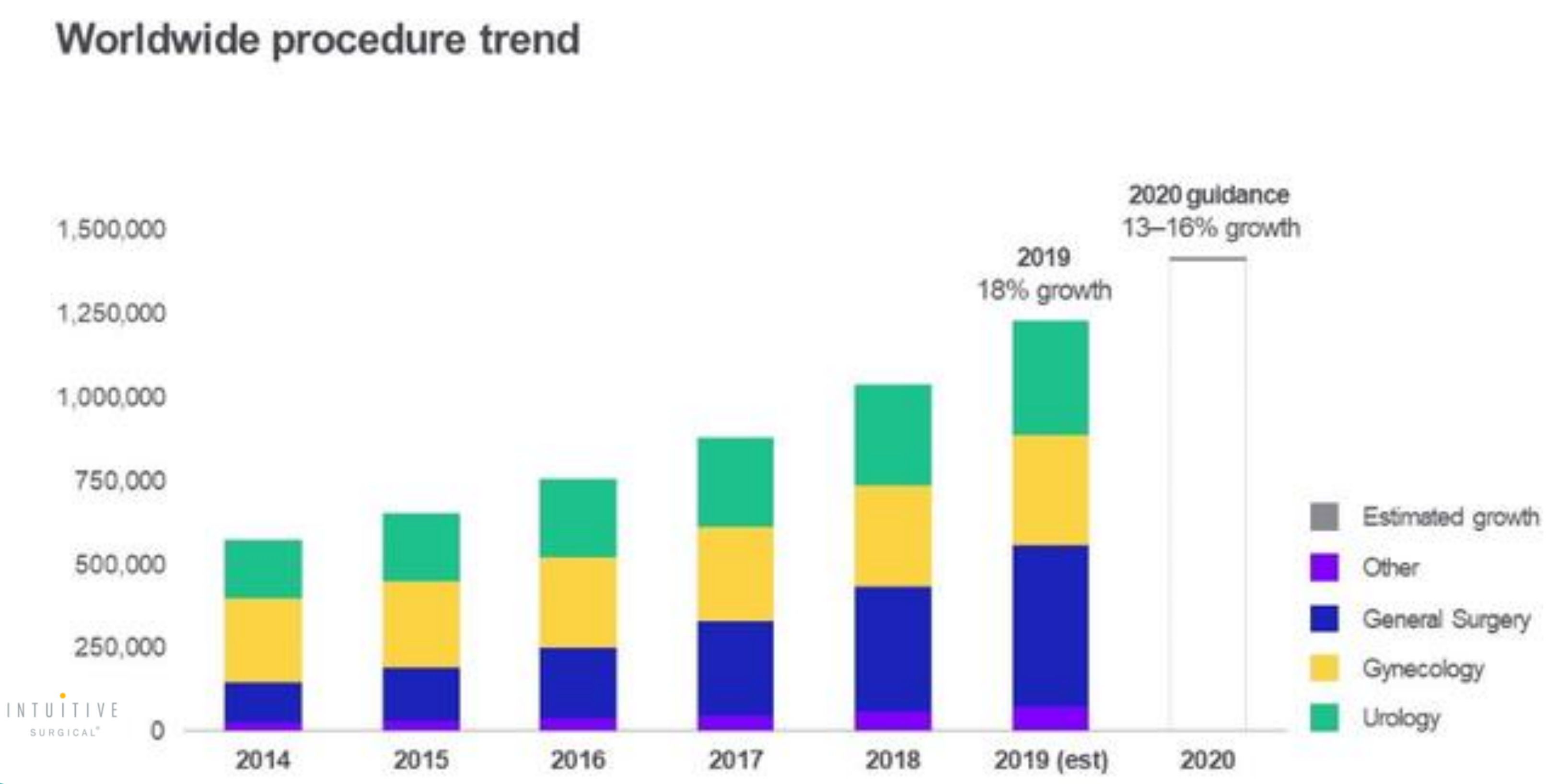
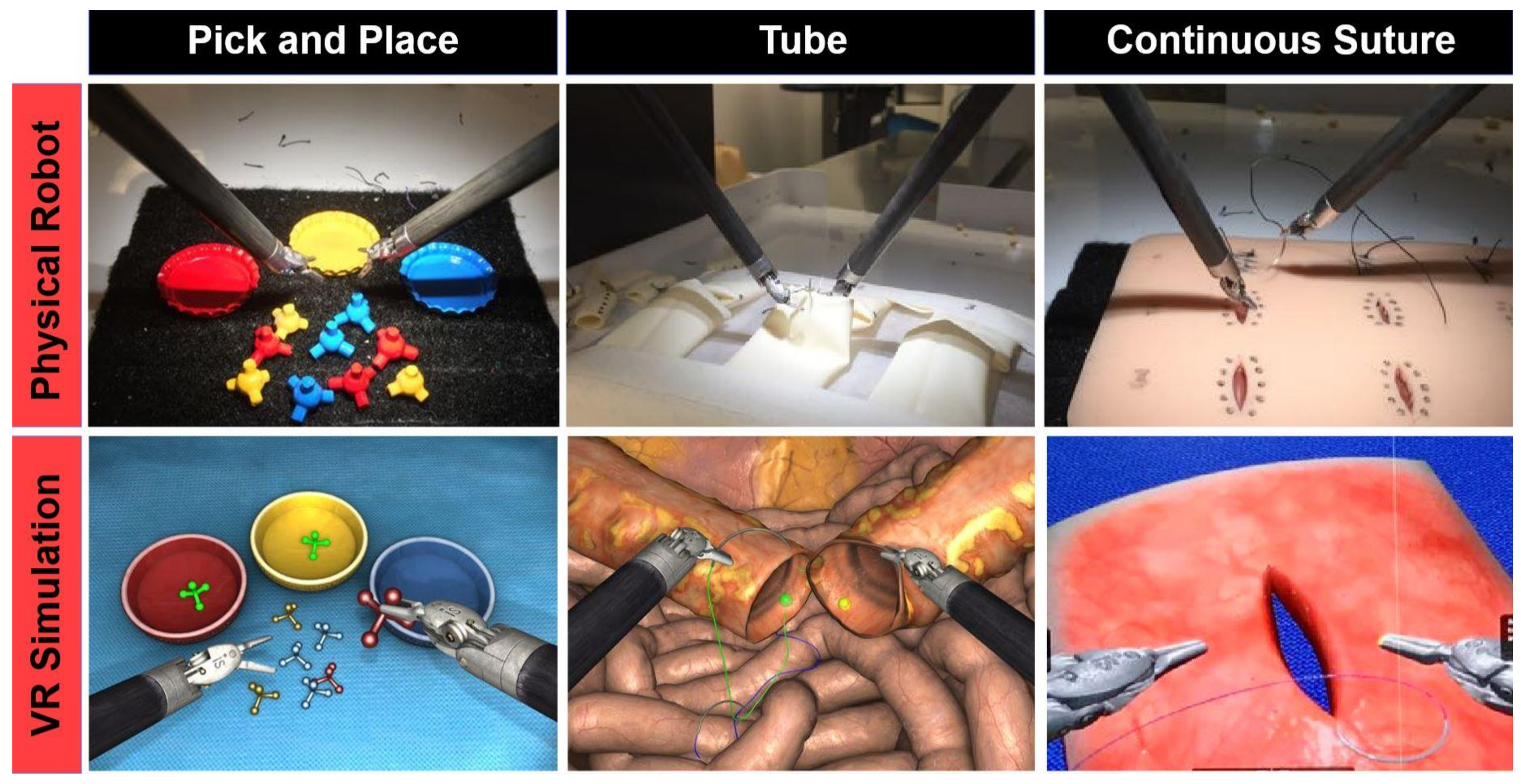
Virtual reality and dry lab simulation to train surgical residents

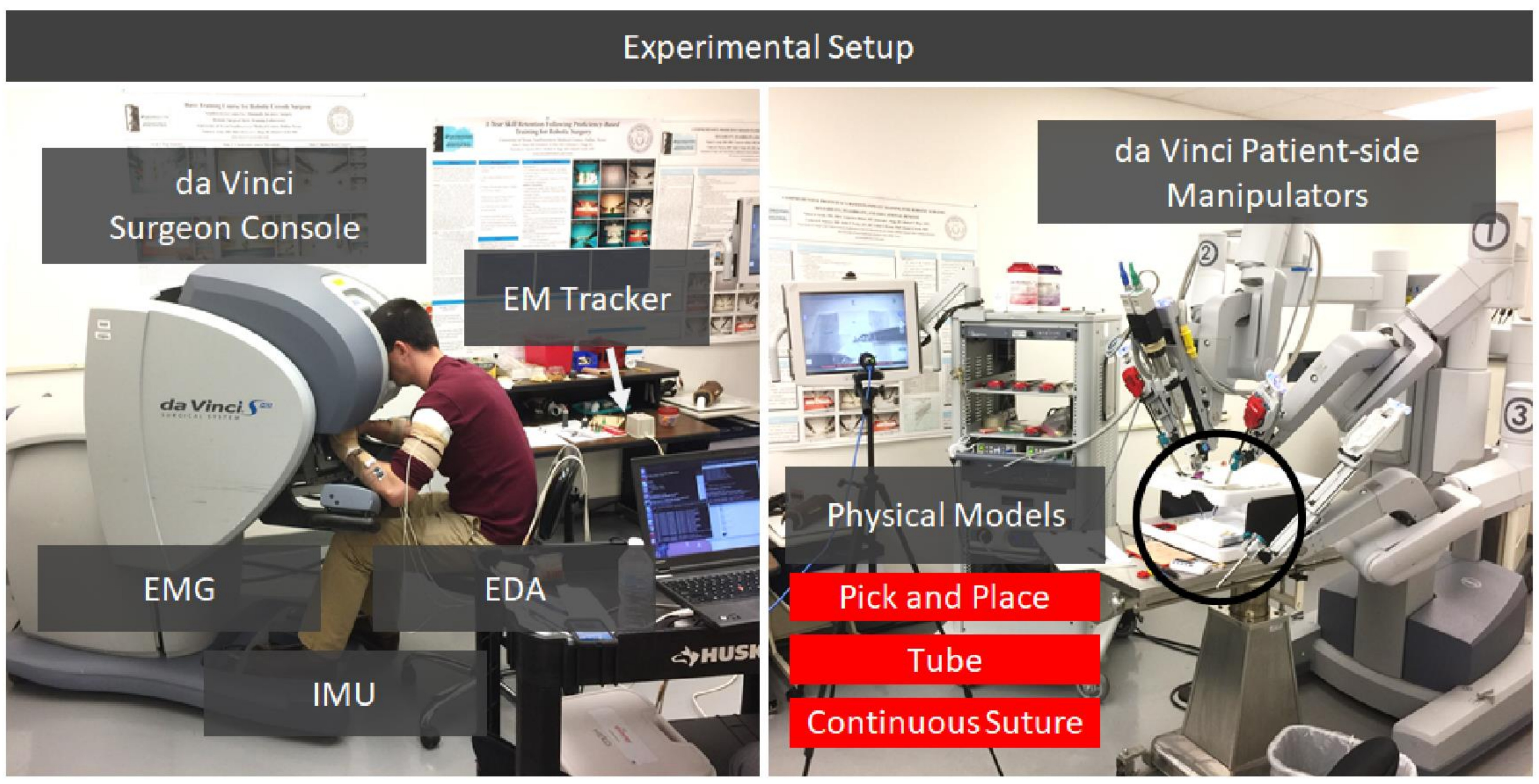
- **Robotic-minimally invasive surgery (RMIS)** is being adopted in an increasing range of surgical specialties

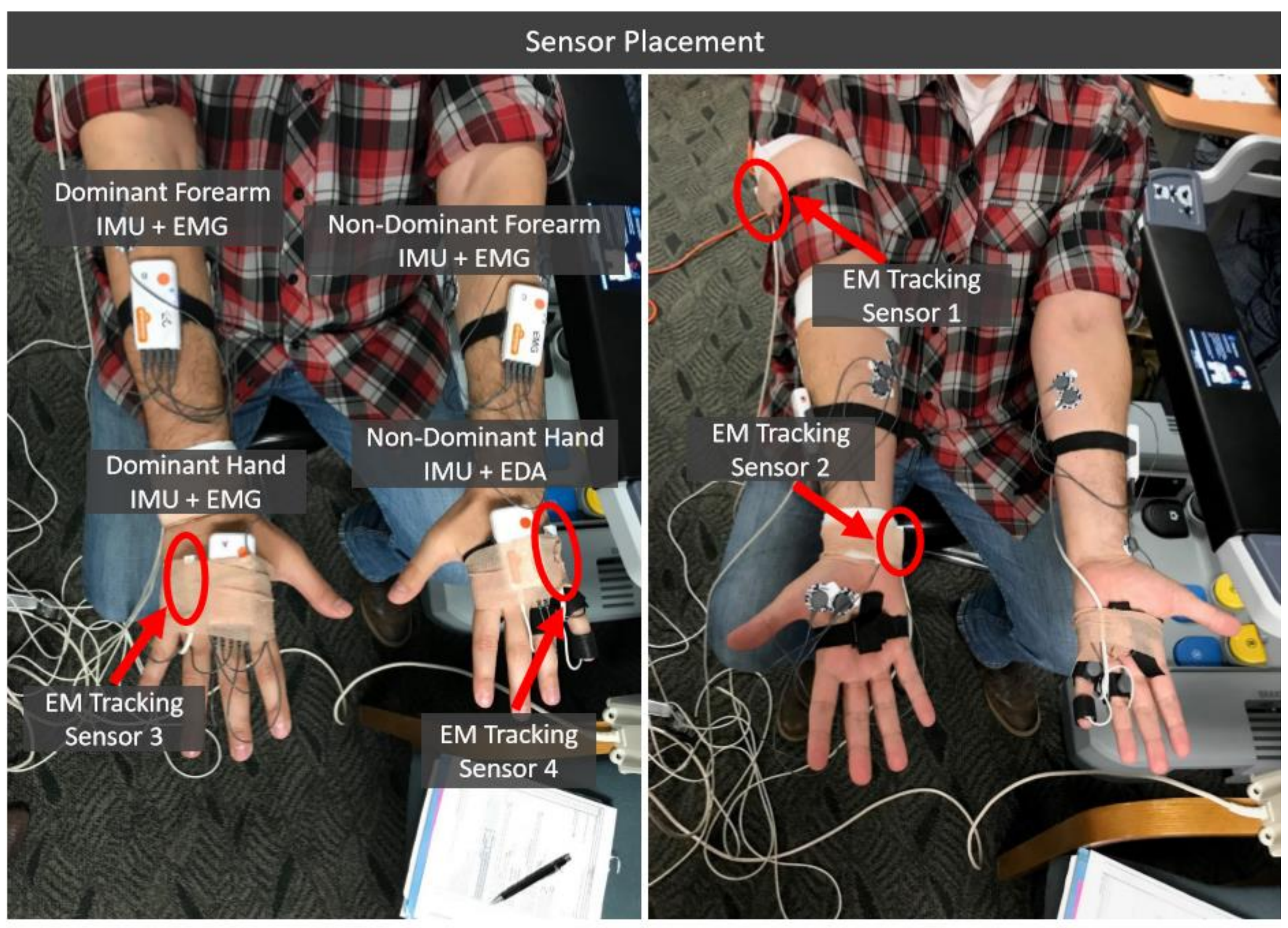




- Surgical training systems developed to overcome the steep learning curve
- Are virtual reality and dry lab training skills learned interchangeable?

Measuring human operator kinematics and physiological response





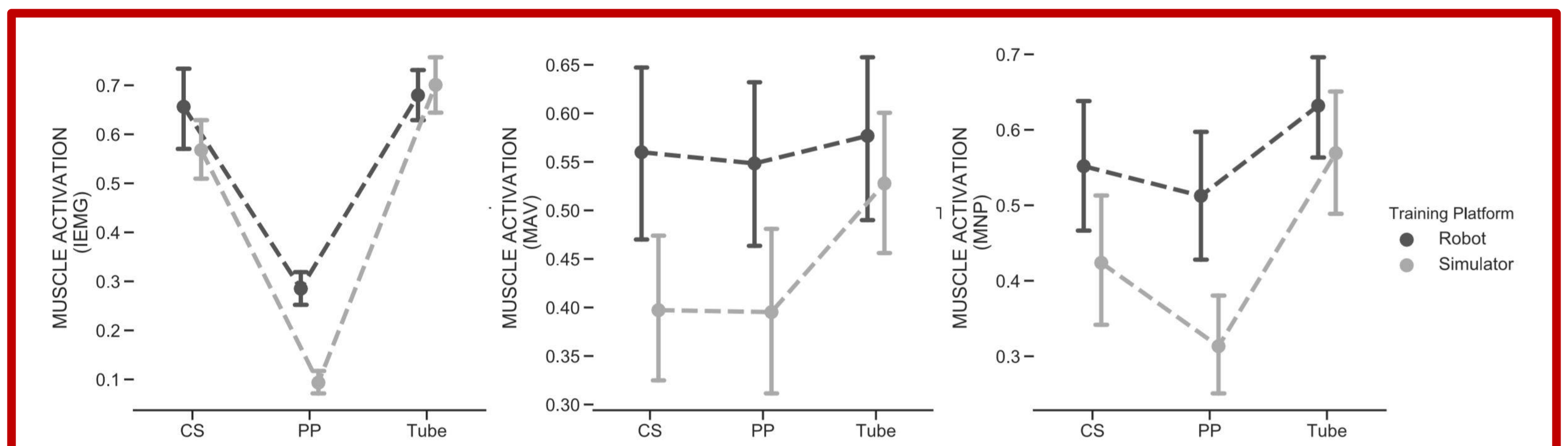
(a) Front Arms Sensor Placement (b) Back Arms Sensor Placement

Data Collection:

- Total of 72 individual experiment trials containing human physiological response signals
  - Surface muscle **electromyography (EMG)**
  - **Electrodermal response (EDA)**
  - Motion kinematic data of user dominant and non-dominant arms: **position, angular velocity,** and **linear acceleration** collected from **electromagnetic (EM)** and **inertial measurement unit (IMU)** sensors.

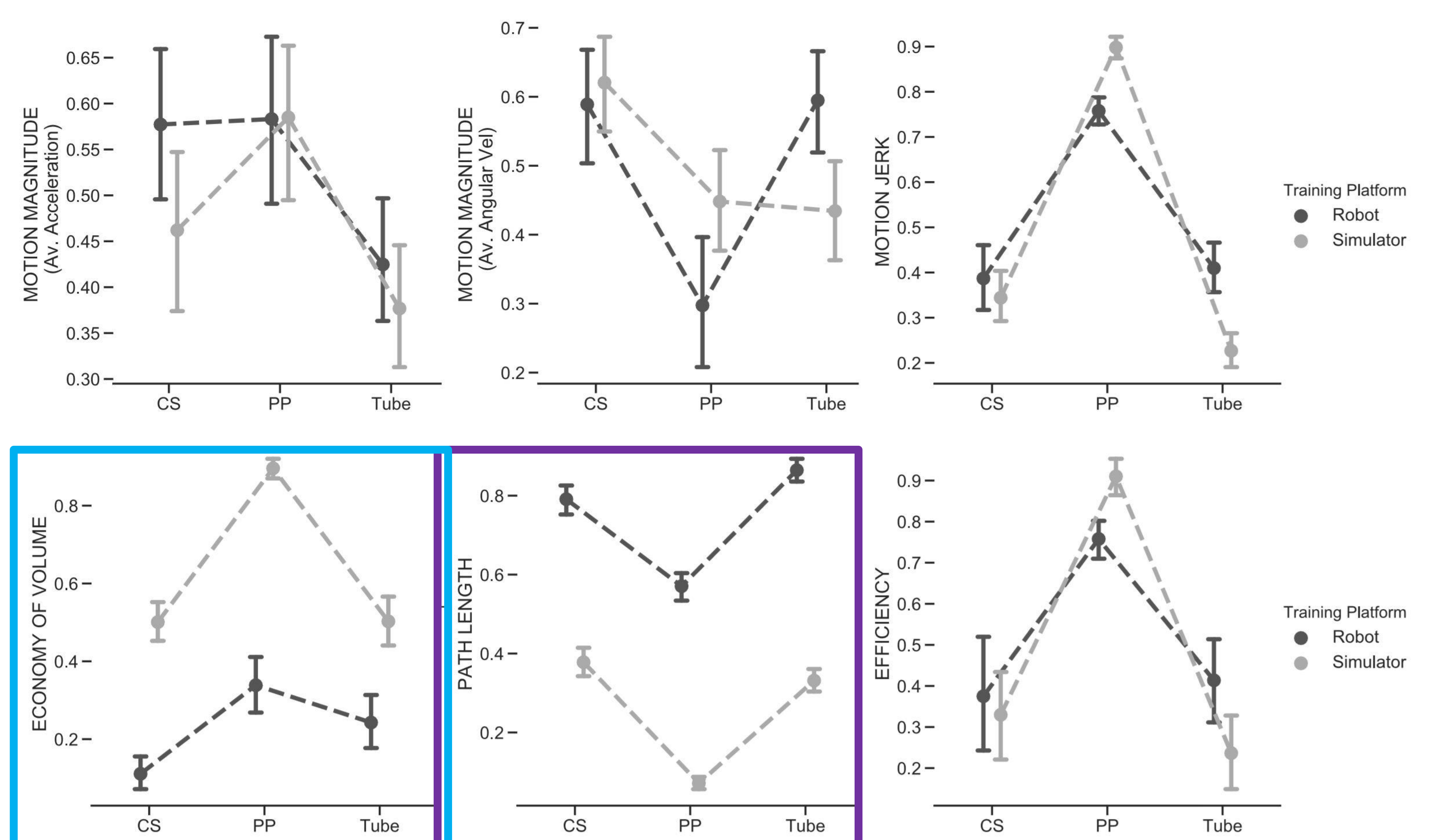
Feature analysis between physical and simulated training exercises

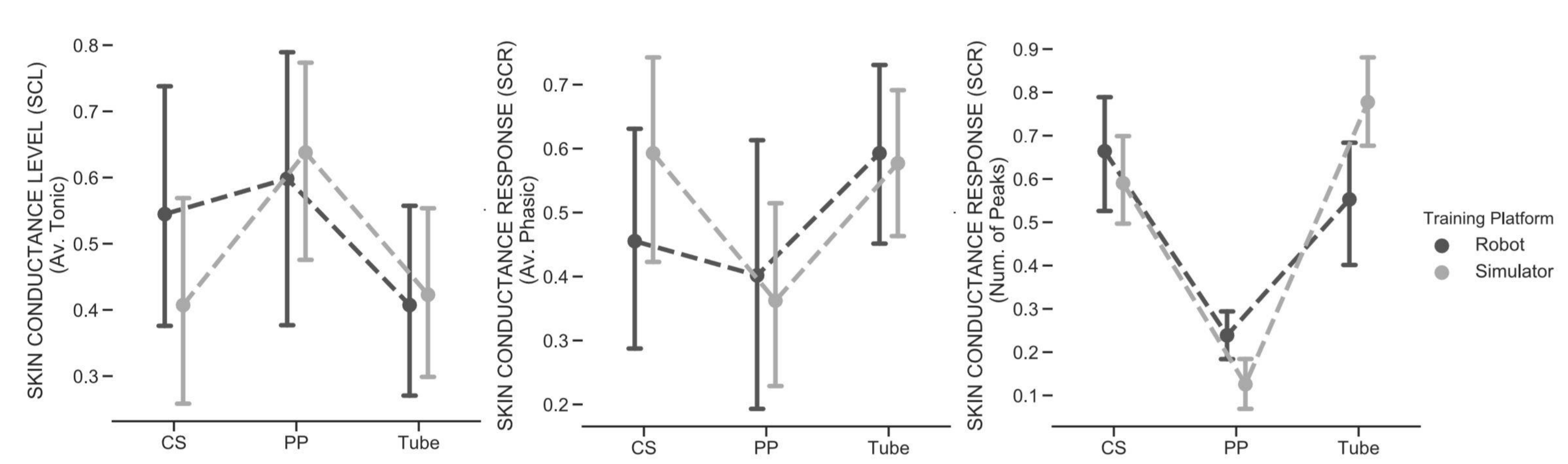
- Significant differences (p-value < 0.05): muscle activation, path length, and economy of volume



(a) Muscle Activation (EMG)

Motion Kinematics (IMU and EM)





(b) Electrodermal Response (EDA)