Friedrich-Alexander University
Erlangen-Nuremberg

ASSISTIVE
INTELLIGENT
ROBOTICS

FAU

Bio-Sensors

Sensors for Myocontrol

1. Visualize FMG and TMG with a sketch. Explain each system.

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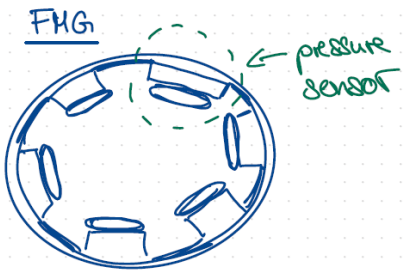
FMG

Force Myography (FMG) is a way to detect muscle activity by measuring pressure exerted by the volumetric changes of the muscle contraction. An easy implementation is the usage of pressure sensors in a semi-rigid structure (e.g. socket / housing) Pressure sensors detect the muscle deformation against the structure.



TMG

For Tactile Myography (TMG) – also HD-FMG – the same basic principles apply as for FMG. Pressure sensors measure muscle activity exerted by the volumetric changes of muscle contraction. Instead of a single array (e.g. 8) sensors, a much higher number of sensors is used in this case (e.g. 10 modules with 4 x 8 cells = 320 input sensors).

Sensors for Myocontrol

2. State 2 potential advantages of FMG over sEMG in the context of robotic prosthesis control

Sensors for Myocontrol

2. State 2 potential advantages of FMG over sEMG in the context of robotic prosthesis control

- Not influenced by fatigue and sweat
- Cheaper, simpler electronics
- No direct skin contact required

Posture Tracking

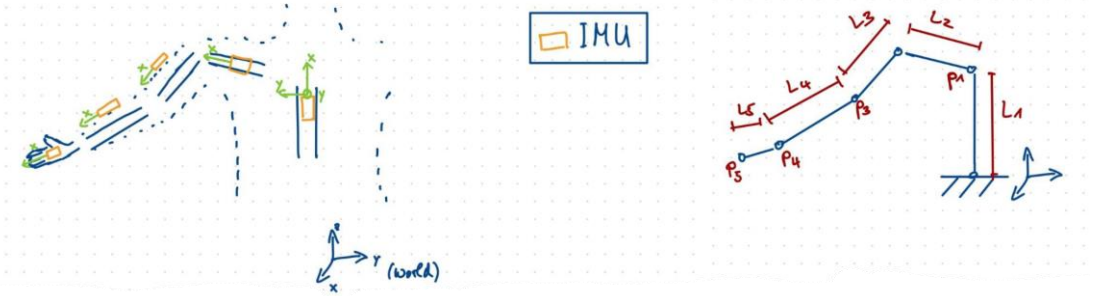
3. How could you use IMUs for tracking the pose of the hand?

4. Explain what drift is and why it is a common issue with IMUs?

3. How could you use IMUs for tracking the pose of the hand?

this approach only gives information about the hand as a whole and not the individual segments or joints.

- Mount an IMU to the hand
- Mount an IMU at each link
- etc.



By having an IMU on the chest, you can differentiate between movements of the hand/arm and movements of the entire body. This is important because if the body moves, the hand and arm IMUs will detect these movements. The chest IMU helps to isolate and subtract the body's motion from the hand/arm's motion, leading to more accurate hand pose estimation.

4. Explain what drift is and why it is a common issue with IMUs?

Drift in IMUs (Inertial Measurement Units) refers to the gradual deviation of the sensor's reported position, velocity, or orientation over time from its true value. This occurs due to the accumulation of small measurement errors in the accelerometers and gyroscopes, which can be caused by sensor noise, temperature changes, and biases in the sensor. Drift is a common issue with IMUs because these small errors continuously integrate over time, leading to significant inaccuracies in the sensor's output if not corrected.

To accurately track the hand's pose, you need to combine the data from all IMUs. This involves:
Sensor Fusion: Combining accelerometer and gyroscope data from each IMU to get precise orientation and position estimates.

The chest IMU provides a stable global frame of reference against which the orientations and positions of the hand and arm can be measured. This helps in determining the hand's absolute position and orientation in space.

By comparing the chest IMU data with the arm/hand IMU data, you can isolate and subtract the body motion, ensuring accurate tracking of the har

Behind Pose Control

5. Where would you mount IMUs to teleoperate a bimanual tele-operation setup?

6. What issues might occur if drift is observed?

Behind Pose Control

5. Where would you mount IMUs to teleoperate a bimanual tele-operation setup?

- Chest
- Upper arms
- Forearms
- Hands

6. What issues might occur if drift is observed?

- The robots might crash into each other
- There will be an increasing shift in the direction of the drift
- Even if the user does not move, the robots will move

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Thank you for your attention