University of Basel | The Balgrist | BIROMED-Lab Medical Robotics and Mechatronics

Master Thesis

Validation of estimated orientation from inertial measurement units with an optical tracking system

Motivation:

Clinical assessment of gait in spinal cord injured patients provides no information on the improved performance, biomechanics or the gait parameters. Inertial Measurement Units on the other hand can help in gait normality measure, long term monitoring, analysis of gait parameters.

Description:

3D joint kinematics can provide important information about the quality of movements. Optical motion capture systems are considered the gold standard in motion analysis. However, in recent years, inertial measurement units (IMU)s have become a promising alternative. This thesis aims to validate IMU-based orientation estimation using strap-down integration of the lower extremities during walking.

Minimum 10 healthy participants and if possible 5 patients will be recruited for data acquisition from optical motion capture and 3D IMUs simultaneously while overground walking in the gait laboratory. Before doing the measurements, available studies will be investigated and a study protocol for uniform measurements will be designed.

Acquired data from motion capture system and IMUs will be analyzed to estimate lower limbs segments. Data will be analyzed with Matlab and Python. Finally, the results from analyzing motion capture system and 3D IMUs will be compared in order to validate the measurement and analysis of IMUs Data.

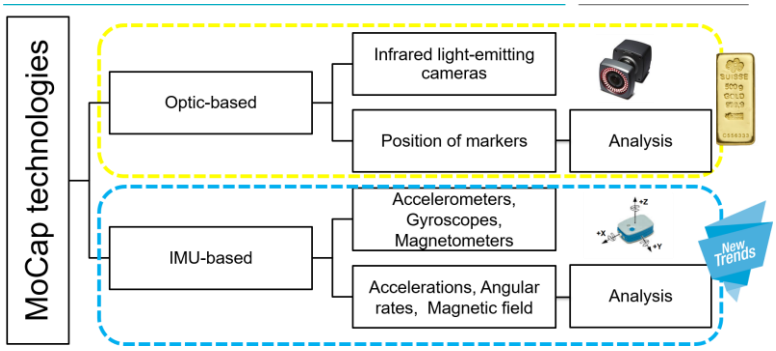

Fig 1. 3D motion capture technologies: optic-based vs. inertial measurement units

Work packages:

- Review existing study protocols for data acquisition from IMUs and the motion capture system.
- Design a study protocol for validating the IMU data with that of the motion capture system.
- Recruiting participants and doing measurements in a gait laboratory.
- Quantification and validation of IMU gait parameters with the motion capture system.

References:

[1] A. Sant'Anna, N. Wickström, H. Eklund, R. Zügner, R. Tranberg, "Assessment of gait symmetry and gait normality using inertial sensors: in-lab and in-situ evaluation". International Joint Conference on Biomedical Engineering Systems and Technologies (pp. 239-254), 2012.

[2] J. Howcroft, J. Kofman, E. D. Lemaire. "Prospective fall-risk prediction models for older adults based on wearable sensors." IEEE transactions on neural systems and rehabilitation engineering, 25(10), pp.1812-1820, 2017.

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