MAXENCE LAVAILL

POSTDOCTORAL FELLOW | PROGRAM 1
ARC TRAINING CENTRE FOR JOINT BIOMECHANICS

Appointment duration: November 2022 - May 2022

PhD (QUT) **MEng** (Universite de Technologie de Compiegne)

Research Interests: Better understanding of how the human shoulder is able to create stability and movement using computational modelling and experimental motion data. I am passionate about new technologies and how we can apply them to provide insights into misunderstood neuro-musculoskeletal disorders to improve patients' lives.

RESEARCH SUMMARY

The multitude of muscles spanning the shoulder joint makes even simple motions physiologically complex to coordinate. This complexity makes internal body forces, such as muscle forces, hardly measurable and access to those appears as one of the biggest challenges, if not the biggest, in the biomechanics and orthopaedics community nowadays. Computational musculoskeletal modelling provides one of the only methods to simulate and predict muscle and joint forces. Nonetheless, its computations cannot be trusted without the use of patient-specific data to drive and or validate them. Thus, the availability of experimental data, such as surface and deep electromyograms (EMG) as well as instrumented implant, unlocks new insights into which co-contraction strategies are best, optimised and/or physiologically selected. My research within the ITTC-JB focuses on understanding the different shoulder muscle recruitment strategies to achieve motion by using computational biomechanics driven by experimental data.

PROJECT LIST

Latarjet's muscular alterations increase glenohumeral joint stability: a theoretical study

- To quantify the changes in muscle moment arms, muscle forces and joint reaction forces following a Latarjet procedure, during simple shoulder planar motions by using computational shoulder modelling. To investigate whether the dynamic implications produced by the Latarjet-based muscle alterations can be considered as a dynamic contributor to the stability of the glenohumeral.

Validation of the mymobility App for assessing shoulder range of motion in a clinical and in-home contexts

- To compare the shoulder motions from healthy individuals estimated using 2D pose skeletal tracking (mymobility App) against those derived from 3D motion capture in abduction, flexion, extension, external rotation and internal rotation.

Status of the static optimisation and EMG-informed shoulder recruitment strategies in the stochastic map of possible muscle co-contractions during an abduction and flexion task.

- To study two state-of-the-art muscle recruitment strategies, i.e., a pure optimisation of shoulder muscle activations and an EMG-informed recruitment during a shoulder abduction and flexion tasks. To validate these two solutions against instrumented shoulder implant data and to compare them to the entire stochastic map of possible muscle co-contractions.

GRANTS

- ARC ITTC for Joint Biomechanics - Seed grant scheme (9949 AUD) "Toward precision tracking of the shoulder joint using ultrasound tomography." Principal investigator: Dermot O'Rourke, Co-investigator: Maxence Lavaill
- Faculty write-up scholarship (6635 AUD), Recipient: Maxence Lavaill
- Supervisor HDR scholarship (96 585 AUD), Recipient: Maxence Lavaill

SELECTED PUBLICATIONS

- Lavaill M., Martelli S., Cutbush K., Gupta A., Kerr G.K., Pivonka P. Simulation of the Latarjet procedure for muscular assessment of shoulder stability Computer Methods in Biomechanics and Biomedical Engineering (2022) 25 (Supplement 1): S173-174. doi:10.1080/10255842.2022.211688
- Lavaill M., Martelli S., Gilliland L., Gupta A., Kerr GK., Pivonka P. The effects of anatomical errors on shoulder kinematics computed using multi-body models. Biomechanics and Modeling in Mechanobiology (2022) 21 (5):1-12. doi:10.1007/s10237-022-01606-0 Open-Access

SUPERVISION

- Mr Luke Gililand (Capstone, 2020), Ms Blaike Rose (Capstone, 2021) & Mr Francois Bruyer-Monteleone (PhD, current)

ORCID HTTPS://ORCID.ORG/0000-0001-6124-1869

maxence.lavaill@qut.edu.au

@Max Lavaill

Joint Biomechanics Training Centre