

Contact-Aware MHE for Inertial Motion Capture

Foot-ground contact as a complementarity constraint

Context

Rokoko makes wearable, inertial motion-capture systems – the Smartsuit Pro II (body), Smartgloves II (hands), and the Coil Pro electromagnetic reference – that take motion capture out of dedicated optical studios and onto any set or home office. They're used for character animation in games and film/VFX, for virtual production, and increasingly for robotics and embodied-AI data: teleoperation and full-body / hand demonstrations for training. Our sensor-fusion stack turns the on-body sensors into full-body motion, and we are developing a next-generation estimator that recovers full-body pose – including position through space – in a single optimization: a **moving-horizon estimator (MHE)** on the whole-body kinematic chain.

The problem

IMUs measure acceleration, not position, so integrating them drifts without bound. The physical anchor is **foot-ground contact**: a planted foot pins the body and arrests the drift. Contact is **switched and nonsmooth** (heel-strike, toe-off), and bringing it *inside* the estimator turns the MHE into a problem with **complementarity constraints**. How best to model contact – from a switched constraint through to full contact dynamics – and how to solve the resulting nonsmooth problem inside the sliding window, is the open question.

What we're looking for

A strong background in optimization or optimal control, and comfort programming in C++ or Python. Some exposure to estimation, robotics, or numerical methods is a bonus. Most of all: someone independent and curious.

What Rokoko provides

- Hardware
- Simulated and recorded locomotion datasets
- Our solver codebase (under NDA)
- Industry co-supervision

Supervisors

- Dr. Armin Nurkanović, University of Freiburg
- Thomas Passer Jensen, Sensor Fusion Lead, Rokoko

Conditions

The thesis is carried out at the University of Freiburg. A monthly allowance is provided, and the student is welcome to spend part of the project on-site at our office in Copenhagen.

Interested? Get in touch with Dr. Armin Nurkanović – armin.nurkanovic@imtek.uni-freiburg.de