**Identification of bone displacement from a full-3D body shape**
Master 2 internship
at SAINBIOSE, Mines Saint-Etienne

## CONTEXT

This internship is part of the InORA (Insole Optimization for Rheumatoid Arthritis patients) project, funded by the Agence Nationale de la Recherche.

Rheumatoid arthritis is the most frequent chronic inflammatory joint disease with a prevalence rate around 0.5%. It is a peripheral polyarthritis compromising foot function with accompanying changes in plantar pressures and gait disturbances. The impact on patient is serious, involving foot pain and limitations in weight-bearing activities, decreasing quality of life. The impact of rheumatoid arthritis can possibly manifest in instability and difficulties in walking. Foot orthoses and therapeutic footwear are commonly used in the treatment of patients. Although the usage of insoles is usually associated with pain relief, the mechanisms involved within this treatment lack methodological assessment.

The InORA project aims at understanding the mechanisms of action of shoes and orthotic insoles through patient-specific computational biomechanical models in order to propose a rational approach to their design.

## POSITION DESCRIPTION

We are seeking a student compute lower limbs bone displacement during a gait cycle using markerless motion capture (Pagnon, D., Domalain, M., & Reveret, L. 2021. *Sensors.*). Gait kinematics will be captured using four 3D-cameras. Data processing will involve a combination of Python and OpenSim. The estimated bone displacements will subsequently serve as boundary conditions for a finite element model of barefoot.

## OBJECTIVES AND METHODOLOGY

**1. Literature Review:** Conduct a review of existing foot models, focusing on their assumptions and limitations.

**2. Model Conceptualization:** Based on the literature, determine which components should be included and how they should be modelled.

**3. Preliminary Implementation:** Perform initial acquisitions under static conditions and extract bone positions.

**4. Dynamic Implementation:** Using the tools developed during the preliminary implementation, execute the modeling routine under dynamic conditions.

**5. Bone Displacement Extraction:** Process the experimental data to achieve an automated identification of bone displacement during a gait cycle. These results will be compared to existing findings in literature.

## QUALIFICATIONS

Ongoing Laster's or Engineering degree in mechanical engineering, biomedical engineering, or related field.

A first experience in numerical modelling / motion capture would be a major plus.

Proficiency in programming (Python) for scripting and data analysis.

Fluent communication in an international background and ability to work in an interdisciplinary team.

## POSITION DETAILS

**Duration:** 6 months

**Expected starting date:** March-April 2025

**Location:** Mines Saint-Etienne, Centre Ingénierie et Santé – 10 rue de la Marandinière 42270 Saint-Priest en Jarez

Supervisor: Benoît Viguie, Sainbiose, Mines Saint-Etienne

## APPLICATION PROCEDURE

Candidates are invited to submit the following documents

- Detailed CV
- Cover letter highlighting relevant experiences and motivation

Applications should be sent to Benoît Viguie (benoit.viguie@emse.fr)

## SAINBIOSE

The SAINBIOSE (SAnté INgénierie BIOlogie Saint-Etienne) unit combines researchers from Jean Monnet University, Mines Saint-Etienne, the French Blood Establishment, and the Saint-Etienne University Hospital. Its research focuses on osteo-articular biology, soft tissue mechanobiology, and hemostasis-thrombosis. SAINBIOSE includes 48 permanent researchers and 37 technical staff, organized into two teams, and trains 58 PhD students. In the past five years, it has produced 100 publications annually, filed 6 patents, developed 3 software tools, and launched 2 startups. The "Soft Tissue Biomechanics" group, led by Prof. S. Avril, conducts numerical, clinical, and experimental studies on the mechanical behaviour of biological tissues and their interaction with medical devices.

The lab is equipped with experimental tools such as uni- and bi-axial tensile machines, optical field measurement systems, and microscopy devices.

SAINBIOSE collaborates with a strong academic network and partners with companies such as Thuasne, Sigvaris and Medtronic.