Job offer: research engineer for markerless motion analysis

Project description

Markerless motion capture systems are revolutionizing motion analysis, opening the door to systems that can be easily transposed to the field and no longer require specific equipment for study participants. This analysis opens up extremely exciting prospects for use outside the laboratory, whether in the study of work-related stress, the optimization of sports performance in the field, or clinical studies and disability rehabilitation in hospitals.

As these systems only provide movement information, subsequent analysis cannot go beyond kinematic aspects. Understanding the internal forces generated by the human being in the various situations described above, which is fundamental to fully analyzing the movements performed, requires us to estimate the actions he exerts on his environment (floor, tools, etc.). Instrumenting interfaces with force transducers is a major obstacle to the use of these tools for dynamic analysis outside the laboratory, which is why methods for estimating external actions have emerged in recent years. Most of these methods rely on recorded motion to solve the inverse dynamic equilibrium problem (Morin et al. 2024) or learn ground forces from experimental data. A few studies have also attempted to learn from video data (Liu et al. 2022). These methods are not mature enough to be deployed massively (de Freitas et al. 2024). Indeed, these different approaches require i) that the subject is moving ii) assumptions about the dynamic behavior of the interface. Inertial measurement units (IMUs) are widely used in other sports to gauge the training load by applying specific models (Johnson et al. 2020).

IMUs or accelerometers can also be placed on the equipment, as done in structural health monitoring to reconstruct the loads applied on a structure. When the structure mechanical properties aren't fully known, neural networks (NN) can be used to reconstruct the load. To this end, Long Short-Term Memory (LSTM) NNs show good performances thanks to their ability to predict long time dependent series (Zhou et al. 2019, Hsu et al. 2022, Pucheu et al. 2025).

The Combo team aims at developing new tools for markerless analysis, especially by introducing physical priors into computer vision tools for 3D reconstruction. The ultimate goal is to recover biomechanical quantities from visual observations. At least two PhD students are involved in this topic. The aim of the job offer is to contribute, alongside with research engineers of the team, to the architecture of the data analysis platform, including:

- Participation to the acquisition of specific data at Immermove platform (https://m2s.recherche.univ-rennes2.fr/facilities/immermove)
- Collection and organization of database, possibly using the Rudi catalogue platform software (https://blog.rudi.bzh/presentation-du-projet/)
- Development of automatic analysis pipeline, leveraging existing work such as pose2sim (https://github.com/perfanalytics/pose2sim) and other computer vision off-the-shelf tools
- Development of rendering platform for demos, possibly relying on blender (https://www.blender.org/) or unreal engine

Department/Research unit:

ComBO is a joint project-team from Inria and the Universities of Rennes (including Université de Rennes, École normale supérieure de Rennes) and Rennes 2, studying human-system biomechanical interaction. The project-team integrates the eponymous team of the IRISA UMR6074 and relies on the eponymous team of the M2S EA7470 research unit.

The ComBO project team aim to develop biomechanical models and numerical methods for analyzing and simulating human-system interaction in field, with a large application spectrum to sports, ergonomics and clinics. We define ourselves as digital biomechanicians, which is a unique skill within Inria, while having strong connections with the fields of robotics and virtual reality.

Location

It is expected that the candidate will spend time between the two Combo location, both located in Rennes:

Irisa - INRIA, Campus de Beaulieu, 35042, Rennes, France

And Université Rennes 2 - ENS Rennes - Laboratoire Mouvement, Sport, Santé, 14 Av. Robert Schuman, 35170 Bruz

Duration: 18 months

Skills Requirements

Technical Skills: Computer science, Programming (python)

Required Languages: Good written and spoken English

Additional skills: database management, deep learning, biomechanics

Scientific writing

Soft skills: autonomy, communication, team-spirit

Apply

Please send your resume and motivation letter to Pierre Hellier (pierre.hellier@inria.fr) and Laurent Guillo (laurent.guillo@irisa.fr)