

Postdoctoral fellowship: development of embedded methodologies to assess 3D kinematics and drag parameters in elite swimming

Keywords: Motion capture, inertial sensors, optoelectronic systems, drag and propulsion evaluation

Are you considering an experience as a researcher with application in top-level sport? The University of Rennes 2 and the Ecole Normale Supérieure de Rennes are looking for a postdoctoral candidate to undertake research on motion analysis and evaluation of hydrodynamic resistances in very high-level swimmers. This is an exciting opportunity for a motivated PhD to carry out this research while being integrated into the French national research agency program "Sport de Très Haute Performance" aiming at optimizing performances towards the 2024 Olympic and Paralympic Games (OPG). In this framework, the NEPTUNE Project («Swimming and Para-Swimming, United for Our Elites») benefits from multiple competences through an important consortium involving eleven research institutions and two sports federations (Fédération Française de Natation and Fédération Française Handisport).

Context

The objective of the NePTUNE project is to provide the French coaches and swimmers with quantitative tools and methods (1) to evaluate the key performance factors (stroke rate/stroke length ratio, velocity, water resistance, force, gliding efficiency, motor coordination, etc), (2) to identify the different performance profiles in order to individualize training, (3) to perform physical models in order to optimize performance. Thus, one of the issues developed in the framework of this project concerns the optimization of movement in world class swimming (swimmers potentially eligible for medals at the OPG) and in particular the links between hydrodynamic resistances and swimming technique. Based on innovative approaches, we propose to evaluate the previous key factors in experimental situations, from which knowledge can be transferred to coaches for the monitoring of swimmers. To achieve these objectives, we propose a research focus mixing biomechanics and fluid mechanics.

Environment

The M2S laboratory (<http://m2slab.com>) is interested in the effects of sports and physical activity on performance and health. The M2S lab pursues this goal using multidisciplinary approaches, specifically coupling movement analysis and synthesis based on both experimental data and digital human models. To do so, the laboratory can rely on an exceptional ImmerMove technical platform that includes a virtual reality room (12x4x4 m) and a sports hall (30x20x10 m) dedicated exclusively to the analysis of the movement. This platform includes various motion analysis equipments such as optical and inertial motion capture systems, external force evaluation and electromyographic systems for measurements in terrestrial and aquatic environments

Mission (scientific project)

The main objective will be to define biomechanical criteria for minimizing active drag in swimming situations based on the development of methods for evaluating hydrodynamic parameters and motion analysis, in particular by developing underwater motion capture methods (optoelectronics and Inertial Measurement Units - IMUs). One of the main responsibilities of the recruited researcher will be the development of a biomechanical model based on IMUs in aquatic environment in order to evaluate the kinematics of human joints but also to develop methods to evaluate swimming drag using an electromechanical device that allows towing the swimmer. The combination of the two approaches should allow an intra-cycle analysis of the propulsion characteristics aiming at optimizing movement.

These developments should serve as a decision support tool for coaches. The successful candidate will receive support from the M2S research team and the INRIA Mimetic team as well as from the performance optimization departments of the French Swimming Federation and the French Federation of Disability Sport. This project will be conducted within the M2S laboratory (University of Rennes 2 - Ecole Normale Supérieure de Rennes) in collaboration with ENPC (Ecole des Ponts ParisTech).

Required Profile

Ideally, the candidate will hold a PhD in mechanics, electronics or sports sciences with skills in biomechanics of motion or dynamic measurement. A good knowledge of the issues associated with high performance sport and an ability to interact with external partners are important assets (extensive interactions with the academic and federal communities are expected throughout the research program).

The applicant must have good knowledge in one or more of the following areas:

- Motion capture (inertial sensors and/or optoelectronic systems)
- Analysis of human movement and swimming performance
- Mechanical modelling (e.g. kinematics and dynamics of multi-body systems, fluid mechanics)
- Electromechanical instrumentation and sensors
- Programming, especially using MATLAB.

How to apply?

Please send the following documents by email to Nicolas BIDEAU (nicolas.bideau@univ-rennes2.fr), Guillaume NICOLAS (guillaume.nicolas@univ-rennes2.fr), Charles PONTONNIER (charles.pontonniere@ens-rennes.fr):

- A Curriculum Vitae and a cover letter showing your interest, clearly indicating the qualifications required for the position
- A list of your major works (max. 2 pages): scientific publications, patents and other scientific productions
- The names of two professional references
- Letters of recommendation (not mandatory)
- A copy of your PhD diploma¹

Further information

Duration: one year renewable (up to two years)

Salary: approx. 3000€ gross monthly

Job starting date: as soon as possible

¹ Pour les docteurs diplômés d'un établissement français, un lien vers la thèse dans le [SUDOC Catalogue](#) ou le portail officiel français [Theses.fr](http://theses.fr) est suffisant.