Offer #2022-04891

PhD Position F/M DIGital Tools for accompaniment for Sport for people with disabilities

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria Rennes - Bretagne Atlantique Centre is one of Inria's eight centres and has more than thirty research teams. The Inria Center is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc.

Context

Wheelchair sports such as soccer, basketball are becoming increasingly popular for athletes with disabilities. In France, the perspective of the 2024 Paralympic Games highlights these sporting disciplines that nowadays appear much more accessible. Sport plays an important role in the well-being of individuals: it is known to improve the self-esteem and the autonomy of people with disabilities, as well as the social inclusion [1]. Practising sport has also a positive impact on rehabilitation and motivation.

The proposed PhD aims then to offer technological tools to improve performances of users of power wheelchairs: analysis of sessions, training aid, rehabilitation tools through sport. To this aim, we propose to design solutions compatible with the virtual reality power wheelchair simulator developed at INSA Rennes as part of the European Interreg ADAPT project. Simulators have already been proven to be efficient in the context of rehabilitation [2] [3] and we want to extend the study of the possibilities offered by these platforms to sport situations. Concretely, our project seeks to play virtual or acquired soccer game scenarios on the simulator for training and rehabilitation sessions. Thus, the idea is to be able to replay game sequences for the analysis and improvement of individual performances.

To do this, it is necessary to detect the static and dynamic elements of the environment and to locate them relatively to the wheelchair. Several kinds of system acquisition will be considered such as motion capture systems in order to provide motion models for virtual scenarios. To get information from all players during a match in a collective game, it is necessary to also consider vision to detect players, ball and equipment. It will be also required to add vision sensors on the wheelchair when possible to get the point of view of the player for feedback. The robustness of the solution with respect to the vibrations of the chair in action should be evaluated.

Specific demands have been raised by soccer trainees for people using a wheelchair of the team of Rennes (http://www.handisport-rennes-club.org/) and we will focus on those use cases. They asked for some **feedback** tools so they can study afterwards the vision field of each player depending their disabilities during a match. This a **augmented reality application** that requires **wheelchairs tracking, identification and localisation in 3D**. They also need video analysis to improve player placement during specific game phases. As far as virtual scenarios are concerned, they need training tools to help players to control the ball for example. As a specific powered wheelchair is used as shown in Figure 1, it is tiring, discouraging in the worst case, to play efficiently when beginning. Let note such powered wheelchairs as the Strike force model are a lot faster that the ones used in everyday life and have a different design.

This work is funded by **EUR Digisport** and will enable to validate strong scientific knowledge on computer vision and robotic on a societal issue. It allies theoritical and practical skills to be evaluated by simulation and experimentations.

Bibliography:
[1] : "De la physique à la pratique physique : la promotion du sport chez les personnes en situation de handicap", Lemahieu Laura, Thèse de doctorat dirigée par Géminard Jean-Christophe, Lyon 2020
[2] : "A meta-analysis and systematic literature review of virtual reality rehabilitation programs", Matt C. Howard, Computers in Human Behavior, vol70, pp 317 – 327, 2017
[3] « ViEW, a wheelchair simulator for driving analysis »,Y. Morere, G. Bourhis, K. Cosnuau, G. Guilmois, E. Rumilly, and E. Blangy. . In Assistive Technology , pages 1–11. Taylor & Francis, 2018
[Olivier12] « Minimal predicted distance: A common metric for collision avoidance during pairwise interactions between walkers »,Olivier, A. H., Marin, A., Crétual, A., & Pettré, Gait & posture, 36(3), 399-404,2012
[Cao19] « OpenPose: Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields », Z. Cao and G.

Hidalgo Martinez and T. Simon and S. Wei

Collaboration:

The thesis will be conducted within a multidisciplinary team combining skills in robotics, image analysis, virtual reality, haptics, mechanics and electronics, and will be based on the recommendations and clinical expertise of the Pôle Saint Hélier. The recruited person will be in close connection with a local team of soccer players with powered wheelchairs (Handisport Rennes Club).

Supervision:

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Assignment

The augmented reality application to display the field of view of each player requires to fuse occluded body pose estimation and precise wheelchair tracking and localization. It will be the core of the PhD thesis.

This work requires to tackle the issue of modeling power wheelchair behaviour during a game using the work previously done in the Interreg ADAPT project. The motion capture system will be used to evaluate the validity of the approach.

The candidate will improve the state-of-the-art detectors as YOLO or OpenPOSE. It requires building a dedicated database (images with localisation of the wheelchair) with players on wheelchairs. The motion capture system will be used to provide the ground-truth. Let note that such a database could be made public to ease action recognition of disabled people with wheelchair in other contexts.
The obtained detectors will then help to provide a tracker for all players in a game sequence. The output of such a tracker will be used to provide 3D data for an immersive replay using the local IMMERSIA platform (https://www.irisa.fr/immersia/services/).

As presented, a local team of soccer players with powered wheelchairs is involved to get realistic data and scenarios (Handisport Rennes Club). The methodology used in the Interreg ADAPT project will be adapted to settle experimentations with the help of the research team of the rehabilitation center Pôle Saint Hélier. They are qualified to manage experiments with disabled people with a relevant methodology and handle the process to get the agreement to proceed such experiments.

Main activities

The PhD applicant will have to :

- Analyze the scientific literature
- Propose relevant solutions compliant to user needs
- Conduct experiments with users
- Write scientific articles on the results of the research
- Collaborate on joint studies with partners
- Write research reports
- Communicate with the project partners

Skills

- Master 120 ECTS in intelligent systems, cognitive science, robotics or similar
- C/C++ programming, Matlab, Python
- Capacity to efficiently work in a scientific environment, passion for experimental research, capacity to connect psychology and physical phenomena
- Analytical mind, excellent oral and written communication
- Capacity to conduct independent work within a team
- Interdisciplinary skills
- Excellent level in French and/or English (C1 or equivalent)

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs

- Leave: 7 weeks of annual leave + 10 extra days off due to RTT
- Possibility of teleworking (90 days per year)
- Social, cultural and sports events and activities
- partial payment of insurance costs

Remuneration

Monthly gross salary amounting to :

- 1982 euros for the first and second years and
- 2085 euros for the third year

General Information

- **Theme/Domain** : Robotics and Smart environments
  Software Experimental platforms (BAP E)
- **Town/city** : Rennes
- **Inria Center** : Centre Inria de l'Université de Rennes
- **Starting date** : 2022-10-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2022-07-03

Contacts

- **Inria Team** : RAINBOW
- **PhD Supervisor** :
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About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

The keys to success

- Interest for assistive technologies
- Previous experience with image analysis robotics
- Self-initiative and collaborative spirit
- Facility to communicate with various stakeholders (e.g. health professionals, visually impaired persons, participants in human studies, administration...)
- Autonomy and ownership of the PhD topic

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Please submit online : your resume, cover letter and letters of recommendation eventually

For more information, please contact marie.babel@irisa.fr

Defence Security :
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST).Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :
As part of its diversity policy, all Inria positions are accessible to people with disabilities.