

## 2022-04891 - PhD Position F/M DIGITAL TOOLS FOR ACCOMPANIMENT FOR SPORT FOR PEOPLE WITH DISABILITIES

Niveau de diplôme exigé : Bac + 5 ou équivalent  
Fonction : Doctorant

### A propos du centre ou de la direction fonctionnelle

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.

### Contexte et atouts du poste

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 is an **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 than 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 theoretical 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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### Mission confiée

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.

### Informations générales

- **Thème/Domaine** : Robotique et environnements intelligents  
Plateformes expérimentales logiciel (BAP E)
- **Ville** : Rennes
- **Centre Inria** : CRI Rennes - Bretagne Atlantique
- **Date de prise de fonction souhaitée** : 2022-10-01
- **Durée de contrat** : 3 ans
- **Date limite pour postuler** : 2022-07-03

### Contacts

- **Equipe Inria** : RAINBOW
- **Directeur de thèse** :  
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### A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3500 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 180 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

### L'essentiel pour réussir

- 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

### Consignes pour postuler

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

For more information, please contact [marie.babel@irisa.fr](mailto:marie.babel@irisa.fr)

#### Sécurité défense :

Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

#### Politique de recrutement :

Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

**Attention:** Les candidatures doivent être déposées en ligne sur le site Inria.

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.

## Principales activités

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

## Compétences

- 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)

## Avantages

- 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

## Rémunération

Monthly gross salary amounting to :

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