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PhD: Continuous learning of kinematic walking models with inertial signals to improve the navigation of people with disabilities

Do you have a heart for the contribution of artificial intelligence in the construction of physical models, to address the challenges and needs of new mobility services? The inmob joint laboratory on the Nantes campus of the Gustave Eiffel University of France could be the next step in your career.

CONTEXT

Research at the Geoloc Laboratory of the Gustave Eiffel University focuses on the development of dynamic positioning methods and systems for travellers. It owns a wide range of skills in the design and programming of beaconless positioning and navigation algorithms with original testing facilities. The Okeenea Digital company is an innovative company from the Okeenea group, specialised for 26 years in the design and supply of accessibility solutions to improve mobility in situations of disability. These two organisations have joined forces in the joint laboratory inmob (disability mapping with INertial signal to facilitate MOBility) to improve the mobility of people with disabilities.

Our ambition is to design new approaches based on artificial intelligence to build physical models that describe the individual specificities of movement of people with disabilities and thus individualise the positioning approaches. This research will increase the performance of current geolocation technologies, which are still insufficient to assist a blind or hearing-impaired person throughout his or her route in complete safety without depending on a very dense network of beacons. To strengthen the labcom team and contribute to the work in artificial intelligence for improved mobility services, we are looking for a research engineer or postdoc, ideally with complementary skills in physics/mathematics and artificial intelligence.

RESEARCH TOPIC

Geolocation on smartphones is considered functional by mobility service operators, but there is no sufficiently powerful solution to serve the needs of people with disabilities (PWDs). Beacon networks are being deployed and applications marketed to geolocate in buildings. These technologies pose problems of coverage, continuity of service, maintenance and cost. A lot of research has been carried out to avoid the use of beacons

They map radio signals' propagation, rely on collaborative approaches or consider biomechanical data fused with inertial signals recorded by our wearable devices to estimate our movements. The performance of these "autonomous" approaches has stagnated in recent years because they do not take into account the specificities of individual human gait to personalise localization algorithms. As a result, they do not consider the nature of the disability in the solutions, whereas connected tools should enable the individualization of these approaches. This observation is at the origin of this proposed research. The processing of the singularity of mobility profiles should allow improving the estimation of walking tracks without deploying any beacon.

RESEARCH OBJECTIVES

Research aims at continuous learning the walking gait and integrating the disability profiles into the core of learning. Novel processing of inertial data collected by a handheld smartsensor will be studied to improve the self-contained solution localization performance. We will first focus on the dimensions and specificity of the kinematic model using inertial signals, to reach stability over time for the same individual. A second challenge lies in the semi-supervised learning of this model with the data collected daily by a smartphone. The high noise level of the smartphone's sensors and the lack of a precise labels for daily movements are two other challenges. Finally, the research outcomes will have to be transferred to a smartphone for real-time operation in order to guide visually impaired people. Signal degradation and computational capacity limitations will have to be integrated.

COMPETENCES

- MSc/Eng Degree in signal processing, geomatics, artificial intelligence or computer science
- Knowledge of signal processing, data mining, applied mathematics, machine learning methods and statistics
- Knowledge of multi-sensor fusion positioning and estimation theory
- Strong programming skills in Python, Matlab and TensorFlow (cpp preferred)
- Experience of working with machine learning applied to physics
- Proven ability to integrate large-scale data
- Understanding of connected object technologies and Android programming
- Ability to effectively integrate research results into publications and intellectual property
- Creativity and openness to innovation
- Enthusiasm, responsibility and excellent collaboration skills
- Passion for producing high quality data
- Strong oral and written skills in English

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HOW TO APPLY?

Contract Type	3 years full time (37h/week) with a start in October 2021
Location	GEOLOC Laboratory, Gustave Eiffel University, Nantes, France
Application	Send all documents (cover letter, CV, diplomas, list of productions / publications, references) in a single pdf document to valerie.renaudin@univ-eiffel.fr