

2022-04675 - PhD Position F/M Markerless 3D localization of surgical tool in a per-operative context

Type de contrat : CDD

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

Today, according to Global Market Insights, the orthopedic medical device (MD) market is growing rapidly and will be worth more than \$22.4 billion by 2025. Joint replacement (hip, knee, extremities) represents nearly 37% of the market share. These devices include conventional ancillary instruments, custom-made guides, navigation systems, and robotic systems. More recently, augmented reality (AR) navigation systems have been developed. They are recognized for their accuracy, low cost, ease of use, as well as clinical added value. It is in this context that the ANR MARSurg project [2021-2025] aims to implement an innovative surgical navigation solution with high scientific, technological and clinical potentials.

Mission confiée

This thesis will be done at Inria and Irisa in Rennes in collaboration with ISIR (Sorbonne Université) in the scope of this ANR MARSurg project. The goal will be to improve the state-of-the-art regarding accurate and robust localization, pose estimation and visual tracking of markerless 3D objects using RGB-D images. These topics are very relevant in various applications, including industry (e.g., objects handling and grasping) and automotive vehicles (e.g., localization, navigation, ...) but also in computer-assisted medical interventions (CAMI).

Tracking and pose estimation are very important research subjects in a real-time augmented reality context. The main requirements for trackers suitable for AR systems are high accuracy, robustness and little latency. The tracking of objects in the scene amounts to calculating the 3D pose between the camera and the objects. Virtual objects can then be projected into the scene using the pose.

Principales activités

The objective of this thesis is to develop robust methods for detection, localization and tracking of objects (without markers) in RGB-D image sequences. Using deep neural network-based approaches, we aim to detect, classify and initialize a pose computation process for surgical instruments present in the images (eg, [Rad 2017]). Then, model-based tracking and localization approaches using both contours and depth maps provided by the RGB-D camera will be proposed [Marchand, 2016, Trinh, 2018]. The complexity of the surgical instruments under consideration requires the development of GPU (Graphics Processing Unit) based approaches to ensure a fast and complete projection of the model into the images [Petit 2014]. As the camera is itself mobile, the position of the objects in a fixed reference frame (in which the anatomical landmarks will also be expressed) requires the localization of the camera w.r.t. the environment that will be done using Visual Inertial SLAM methods assisted by an IMU (Inertial Measurement Unit). Moreover, to deal with fast movements, the prediction of object position, integrating inertial data, will be managed thanks to particle filters on SE(3). To validate the system, an estimation of the measurement error will be performed by an external system giving the ground truth (either by mounting the camera on a robot or by using a Vicon 3D measurement system).

Compétences

- Knowledge in computer vision and image processing, vSLAM, machine learning
- Mathematics, optimization, linear algebra
- Excellent programming skills in C ++

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (90 days per year) and flexible organization of working hours
- partial payment of insurance costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours)
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération

Monthly gross salary amounting to :

- 1982 euros for the first and second years and

Informations générales

- **Thème/Domaine** : Robotique et environnements intelligents
Système & réseaux (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** : 2022-07-01

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

- Methodological developments will be carried out using the C ++ ViSP software library (<https://visp.inria.fr>) and will be validated via experiments on real image sequences and mockup.

Consignes pour postuler

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

For more information, please contact claudio.pacchierotti@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. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

- 2085 euros for the third year