2020-02399 - PhD Position F/M Shape 
servoing based on visual information using 
RGB-D sensor for dexterous manipulation of 
3D compliant objects

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

The candidate will work in the RAINBOW team in the Inria 
research center located in Rennes, France. Inria is amongst the 
leading research centers in Computer Science in France. 
The RAINBOW team is internationally recognized in the fields 
of robotics and sensor-based control.

Mission confiée

A major challenge in robotics is the interaction with deformable objects. Indeed, 
nowadays most of the robot control framework are built for rigid objects observed in 
the scene. Therefore, in order to expand robot manipulation capabilities, we expose in 
this thesis to investigate on a new kind of visual servoing approach that will allow a 
robot to deform soft materials towards a desired shape in an efficient closed-loop way. 
Manipulation of soft materials (as for example food tissues) is a research problem that 
recently took the robotic community attention. A couple of research studies has been 
conducted towards this objective using dynamic model of the object. Controlling the 
deformation of these materials requires the knowledge of how displacements of the 
robotic manipulator are translated into material deformation. This relationship can be 
expressed by dynamic models based on viscoelastic properties of the object.

Recently, the control of soft robots made of compliant material has also become a 
new area of research. We can mention for example the research on inverse model of 
deformable robots. The proposed solutions are usually based on numerical 
simulations using finite element model (FEM) that have the drawbacks to be time 
consuming, to require complex models of the scene and also an accurate initialization 
of their boundary conditions and mechanical parameters. Unlike this work, we will 
focus mainly on the interaction between rigid robots and soft objects. The PhD 
candidate is expected to explore new solutions that do not rely on the need of an 
accurate numerical model of the considered deformable object and that are 
compatible with robotic application in terms of computation cost.

This thesis takes place in the context of a research collaborative project called “GentleMAN” 
whose main objective is to develop a novel framework for robotic 
manipulation of 3D compliant objects. The project stems from a highly 
interdisciplinary consortium composed of many well-established entities: SINTEF 
(Norway), NTNU (Norway), NMBU (Norway), MIT CSAIL (USA), Inria (France), and QUT 
(Australia).

Principales activités

In this thesis, the candidate will propose a new methodology to control one or several 
robots interacting with a soft object for deforming it towards a desired shape. The 
envisioned methodologies will rely on the use of visual observation provided by a RGB-
D sensor and data generated by tactile sensors. This latter aspect on tactile 
perception will be studied by other research partners in GentleMAN.

The PhD candidate will develop a new approach based on visual servoing that will rely 
on the determination of a so-called “deformation interaction matrix” linking the 
variation of the object deformation to the velocity of the robot contact tools. The 
study will concern the determination of this “deformation interaction matrix” from 
observations (RGB-D images, contact position between the tools and the soft objects) 
and the elaboration of a robotic closed-loop control law based on this matrix.

The PhD candidate is also expected to collaborate with the other PhD, PostDoc and 
researchers participating in the GentleMAN project for contributing to a final joint 
demonstrator leading to at least one joint publication with other research partners.

The robotic platform, which will be common for all research partners, is composed by 
a Panda Franka Emika 7-DOF robotic arm, intel RealSense 435 RGB-D sensor, Reflex 
Taiktile2 hand in a tri-manual setup as illustrated in the following figure.

Informations générales

- Thème/Domaine : Robotique et environnements intelligents
- Ville : Rennes
- Centre Inria : CRI Rennes - Bretagne Atlantique
- Date de prise de fonction souhaitée : 2020-10-01
- Durée de contrat : 3 ans
- Date limite pour postuler : 2020-04-30

Contacts

- Equipe Inria : RAINBOW
- Directeur de these : Krupa Alexandre / alexandre.krupa@inria.fr

A propos d’Inria

Inria, est l’Institut national de recherche dédié aux sciences et technologies du 
numerique. Il emploie 2600 personnes. Ses 200 équipes-projets agiles, en 
général communes avec des partenaires académiques, impliquent 
plus de 3500 chercheurs et ingénieurs 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 contribuent à faire émerger et grandir 
des projets scientifiques ou entrepreneuriaux qui impactent le monde.

Consignes pour postuler

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

For more information, please contact paolo.robufo.giordano@inria.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.
Compétences
The candidate must have an excellent track of records and a Master Degree (or equivalent) in robotics and computer vision.

The candidate must have the following qualifications:
- Strong background in robotics
- Experience with computer vision, physical robots, or 3D simulation
- Excellent programming skills in C++
- Excellent written and oral English
- Ability to perform experimental validations
- Ability to work independently as well as collaboratively

Please also send your list of marks (even preliminary) of your Master 2 or engineer formation with your CV and letter of motivation.

Avantages
- Subsidized meals
- Partial reimbursement of public transport 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 2085 euros for the third year.