Post-doctoral position in the field of image registration

18 month contract (extensible by another 18 month).

Start: between February and May 2016

Monthly remuneration: 2914 € gross (2360 € net approximatively)

<table>
<thead>
<tr>
<th>Host laboratory</th>
<th>Centre de Recherche en Automatique de Nancy (CRAN) UMR 7039 CNRS/Université de Lorraine 2 avenue de la Forêt de Haye 54516 Vandœuvre-Lès-Nancy</th>
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<tbody>
<tr>
<td>Department of CRAN</td>
<td>Health Biology Signal (Santé Biologie Signal, SBS)</td>
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<td>Work context</td>
<td>Project from the French Research Agency (ANR): Multi-Modal Endoscopy for Inflammatory lesions of the Stomach (Endoscopie MultiModale pour les lésions Inflammatoires de l’Estomac, EMMIE)</td>
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<td>Project partners</td>
<td>- Laboratoire Electronique Informatique et Image (Le2i, Dijon, Université de Bourgogne).</td>
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<td>- Laboratoire Pluridisciplinaire de Recherche en Ingénierie des Systèmes, Mécanique et Energétique (PRISME, Orléans, Université d’Orléans).</td>
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<td>- Hôpital Ambroise Paré (Assistance Publique - Hôpitaux de Paris, Boulogne-Billancourt)</td>
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<td>- Institut Pasteur (IP, Paris)</td>
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<td>- Institut National de la Santé et de la Recherche Médicale (INSERM UMR 1173, Montigny-Le-Bretonneux)</td>
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Candidate profile:
- Candidate with a PhD (doctorate) in image processing/computer vision
  OR
- Candidate with a PhD (doctorate) in applied mathematics with a significant experience in the field of image processing/computer vision.

Required skills
- Strong scientific capacities, able to conduct innovative research work
- Good writing skills with regard to scientific publications
- The candidate must be willing and able to program in C++ language (significant experience in programming)
- Familiarity with Matlab

Valued skills
- Experience in the field of image registration and/or optical flow.
Work context

The ANR project “EMMIE” aims at the development of a complete endoscope prototype (multimodal gastroscope, software, as well as signal and image processing algorithms) facilitating the diagnosis and follow-up of stomach inflammatory lesions. This multidisciplinary project gathers scientists with complementary skills. The project partners will deal with different scientific and technical topics which will contribute to the development of the multimodal endoscopic system:

- Light-tissue interaction modelling to understand and to optimize the differentiation of healthy stomach mucosa tissue and tissue parts affected by various degrees of inflammations.
- Design and integration into a gastroscope (endoscope used during a gastroscopy) of a system for the “simultaneous” acquisition of a white light image sequence and of sequences acquired at different wavelength (multispectral image sequences).
- The multimodal real-time registration of the white light and multispectral images.
- Real-time detection of the inflammatory lesions using spectrum analysis and classification methods.
- Offline cartography of the white light images to increase the limited field of view of the endoscope.

The work to be done in the frame of this post-doctorate position relates to the last topic, namely the development of cartography algorithms based on the mosaicing of images acquired under the white light modality. The aim of mosaicing algorithms is to register the images of video-sequences visualizing the pyloric antrum of the stomach. (see figure 1(b)). These mosaics with an extended field of view will allow for a second diagnosis after the endoscopic examination, will facilitate the follow-up of lesion evolution (with the comparison of white light maps built for different examination and on which spectral information is superimposed) and will allow for data archiving which is currently not performed in gastroscopy. More generally, the mosaics will lead to the improvement of the examination and treatment traceability.

![Figure 1](image-url)

*Figure 1 – Bi-dimensional (2D) mosaics built with the algorithms of the CRAN laboratory. (a) Registration of a 200 image sequence of the bladder. (b) First registration tries of the stomach antrum region.*
Work description

The recruited researcher will develop image registration and mosaicing algorithms for the pyloric antrum. The registration of such images is a real challenge since few homologous textures are visible in the images and both the illumination and the viewpoint changes can be important (see figure 1(b)).

The recruited researcher will propose 2D registration methods which are notably based on optical flow techniques [1-4]. He will also examine other registration approaches adapted to the data to be treated. The goal is to conceive algorithms for the registration of images pairs with the best compromise between computation speed, robustness and accuracy. Although the robustness and accuracy criteria are by far the most important, the real-time mosaic computation would be a real asset of the endoscopic system.

The dense correspondence between homologous points (for instance obtained with optical flow methods) will be used to determine the (non-linear) geometrical transformations required for superimposing consecutive and non-consecutive images of the video-sequences on the one hand, and for building the mosaics on the other hand. Optimization methods for the correction of textures and colour discontinuities in the mosaics are also a part of this work.

While 2D cartography represents the most important part of the work in the EMMIE project, the feasibility of 3D mosaicing will also be assessed by the end of the project. Approaches for instance based on SLAM (simultaneous localization and mapping) will notably be adapted to the endoscopic data.

Work environment

The scientific work and the related developments will be mentored by researchers from the image processing field belonging to the CRAN laboratory. The programs will be successively written with Matlab and in C++ under the supervision of the research engineer responsible for the mosaicing software at CRAN.

The CRAN laboratory has a long experience in the field of cystoscopic image registration (see the mosaic given by figure 1(a), built with endoscopic images of the inner bladder wall). The recruited researcher can take the developments of the CRAN laboratory in the fields of endoscopic data registration/mosaicing [5-7] and optical flow [1-4] as starting point of his work.

Publications du CRAN dans le domaine


**Application file**

The application file must include:

- A letter of motivation
- A *Curriculum Vitae*
- A synthetic description of the past research activities
- A publication list
- Any documents deemed to be useful for the (letter of recommendation, etc.)

**Postal and electronic addresses for application:**

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