

Computer Vision Internship in Cardiac Cellular Imaging

Context:

Heart valve diseases are common pathologies and the only treatment currently available is open heart surgery. Understanding the biological mechanisms involved in the development of these diseases is therefore essential to identify possible therapeutic targets.

Correlative microscopy is a particularly interesting approach to decipher the fundamental mechanisms of heart valve dysfunction. It makes it possible to combine different scales of observations and different types of content, functional and morphological, thanks to all microscopy technologies available for the life sciences, which have grown phenomenally in recent years (e.g. Nobel Prize in 2015 and 2017). Correlative microscopies rely crucially on a step of registration of the images observed, prior to a relevant fusion of the data available.

The objective of this project, funded by the National Agency for Research (ANR), is to develop adapted methods of registration between two images observed by microscopy to study the biological mechanisms involved. We wish to develop an original approach of computer vision that takes into account the estimation of confidence in the registration to acquire and analyze the microscopy data, on an animal model developed by the team which is carrying a genetic mutation identified in the valvulopathies [1, 2]. The methods developed can be applied more widely and distributed via the software platform developed by the team [3]. This project is a collaboration between the Thorax Institute, the MicroPICell platform (SFR Santé Bonamy), and the Jean Leray Mathematics laboratory.

Objective:

One of the first steps of this project is to work on the extraction of points of interest from different image modalities, and descriptors adapted to multimodal and multi-scale registration.

The trainee will have access to an image database in which points and elements of interest are manually annotated in different modalities (microCT, fluorescence microscopy, electron microscopy, atomic force microscopy). The objectives of the internship will be to set up the evaluation framework of the available algorithms, then to identify the most relevant algorithms on the data (machine learning, ad-hoc approaches). The results of the internship will complement an open source software platform developed by the team.

A PHD position is funded in the continuity of the internship from September 2019.

Required profile

Master's degree or end-of-study internship from "Ecole d'ingénieur", in the field of computer science, applied mathematics and biomedical engineering.

The candidate should demonstrate an interest in biology and its medical applications, and be able to work in a highly multidisciplinary environment (scientific curiosity and sense of organization), and for research. Ideally, the candidate plans to pursue in a PhD program (funded PhD thesis available from September 2019). English is necessary (ongoing collaborations with several institutes abroad and in France).

Terms & other key points

Place: Institut du Thorax, Institute of Health Research, 8 quai Moncousu 44000 NANTES FRANCE

Period: Beginning between January and March 2019 for a period of 4 to 6 months.

Other : A laptop will be provided with a docking station. Gratuity of legal internship (about 550 euros per month). Possible thesis (acquired funding) from September 2019.

Contact

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Keywords

Image processing, computer vision, cardiac and cellular imaging

References

1. Le Tourneau, T., et al., *New insights into mitral valve dystrophy: a Filamin-A genotype-phenotype and outcome study*. Eur Heart J, 2017.
2. Dina, C., et al., *Genetic association analyses highlight biological pathways underlying mitral valve prolapse*. Nat Genet, 2015. **47**(10): p. 1206-11.
3. Paul-Gilloteaux, P., et al., *eC-CLEM: flexible multidimensional registration software for correlative microscopies*. Nat Methods, 2017. **14**(2): p. 102-103.