CREATIS

# PhD offer (2018-2021 / EEA doctoral school)

**Title:** **Statistical learning of interactions between shape and deformation**

**Host institution :** CREATIS lab, Université Lyon 1, at the DOUA scientific campus (Lyon, France)
**Supervision** : N. Duchateau (Associate Professor), P. Clarysse (CNRS Research Director)
**Keywords** : machine learning, data fusion, cardiac imaging, computer-aided diagnosis

**Background:** Cardiac imaging modalities such as ultrasound and magnetic resonance allow evaluating changes of the failing heart, and notably shape and deformation abnormalities. Computational anatomy provides rigorous tools to represent such complex descriptors of the cardiac function within a population, via statistical atlases and manifold learning [1]. These techniques notably provide a space of lower dimensionality to better characterize a given population and compare new individuals to this population. Nonetheless, these methods suffer a major limitation: they only consider a single type of descriptor at once (e.g. either shape or deformation), while these can be highly complementary.

**Project and objectives:** We have recently explored an extension of these techniques to mix several heterogeneous and high-dimensional descriptors (multiple kernel learning [2], applied to cardiac imaging data [3]). In this PhD, we would like to go beyond these approaches to better consider the interactions between the input descriptors. The PhD will contain both a technical component around the design of new machine learning algorithms, and an applicative component around the better characterization of heart failure via multiple descriptors, a key component of clinical analysis.

**Context:** The position will be funded by a grant from the EEA doctoral school, and will be done within team #1 at CREATIS ("modeling and imaging of vessels, thorax and brain"). It will highly benefit from our well-established collaborations with clinical experts, notably at CHU St Etienne for the study of myocardial damage due to ischemia, and CHU Nice for the study of abnormal hearts with pressure and volume overload.

**Skills:**

- MSc (master 2 type EEA) student with a solid background in image processing and/or machine learning, with a strong interest for medical imaging.
- Good knowledge in applied mathematics would be appreciated.
- Solid programming skills (MATLAB or Python, eventually C/C++)

**How to apply?** Send CV, motivation letter and academic record to Nicolas Duchateau
nicolas.duchateau@creatis.insa-lyon.fr

**Salary** ~1400€ per month, starting October 2018. The candidate will have to defend his/her relevance and motivation for the PhD proposal in May 2018 for the EEA doctoral school.

**References:**

[1] Duchateau N, De Craene M, Piella G et al. Constrained manifold learning for the characterization of pathological deviations from normality. *Med Image Anal* 2012;16:1532-49.
[2] Lin YY, Liu TL, Fuh CS. Multiple kernel learning for dimensionality reduction. *IEEE T Pattern Anal Mach Intell* 2011;33:1147-60.
[3] Sanchez S, Duchateau N, Erdei T, et al. Characterization of myocardial motion patterns by unsupervised multiple kernel learning. *Med Image Anal* 2017;35:70-82.