

Self-supervised multi-modal 2D and 3D image registration

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Image registration refers to the problem of aligning two or more images having similar content, transformed by an unknown geometric transformation (a rotation, an homography, or a more complex displacement field). In multi-modal image registration the images to be registered correspond to different modalities. Examples are aligning an RGB image with a thermal image, or a computer tomography scan with a magnetic resonance image. Multi-modal image registration is a challenging long standing problem with several applications in computer vision and medical image analysis. Neural networks have demonstrated great potential for image registration, yet they require large training datasets where the ground truth transformation between the images has to be known. Unsupervised training methods are appealing as they enable training when the ground truth transformations are unknown. Several unsupervised methods have been proposed for registering images of the *same modality*, but unsupervised multi-modal registration has remained largely unexplored. Recently, a fully unsupervised registration method has been proposed in the context of multi-spectral satellite images [1] by one of the supervisors and colleagues. The goal in this thesis is to extend this method for its application in 2D and 3D medical imaging (for example by training voxelflow in a multi-modal dataset using the proposed technique). If successful, the outcome of the masters thesis could be part of a scientific publication.

[1] Nguyen, Ngoc Long, Jérémy Anger, Axel Davy, **Pablo Arias**, and Gabriele Facciolo.

"L1BSR: Exploiting Detector Overlap for Self-Supervised Single-Image Super-Resolution of Sentinel-2 L1B Imagery." In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pp. 2012-2022. 2023. ([project webpage](#))

[2] Balakrishnan, Guha, Amy Zhao, Mert R. Sabuncu, John Guttag, and Adrian V. Dalca.

"Voxelmorph: a learning framework for deformable medical image registration." *IEEE Trans. on Medical Imaging* 38, no. 8 (2019): 1788-1800. ([arxiv link](#))