Autoencoders for SAR imagery

Proposed by: Télécom Paris

Place: Télécom Paris, 19 place Marguerite Perey, 91 120 Palaiseau

Dates: Masters internship starting from February 2020

Supervisors: Florence Tupin, (Télécom Paris, florence.tupin@telecom-paristech.fr), Loïc Denis (Télécom Saint Etienne, loic.denis@univ-st-etienne.fr), Alasdair Newson, Emanuele Dalsasso

This internship subject can possibly be extended so to pursue a PhD.

Context SAR (Synthetic Aperture Radar) data are obtained by acquiring the electromagnetic field backscattered by the ground surface. This field appears under the form of a complex number, whose module is linked to the backscattering properties of the ground surface. This imaging mode is called "coherent". It allows, by combining several images, to retrieve a 3D reconstruction or detect fine displacements (of the order of few millimeters on buildings). However, differently from the usual incoherent imagery, it leads on the images to a strong noise (called speckle) characterized by high variations of grey-levels on physically homogeneous surfaces. SAR images present several specific characteristics: the noise, from one side, and their content, from the other one, strongly influenced by the physical characteristics of the scene.

Goal of the internship In the last few years, deep learning allowed great progress in image processing, whether it is a problem of denoising, segmentation, detection or recognition. Autoencoders, in particular, allow to reduce the image size up to few significant variables in the so-called latent space, which encodes the most significant information contained in the image. The goal of this internship is to study this space in the SAR framework. The main points that will be investigated are the following ones: the size of the latent space, its robustness to the noise, the relation between latent spaces encoding images acquired by different sensors with different resolution, the impact of the spatial correlation of SAR data in the latent space. This study will be carried on by making use of SAR images acquired by different sensors and of well-registered multi-temporal series. This study will allow to shed more light on the denoising approaches developed in the team [1, 2, 3] and based on a U-Net [4].

Internship development The internship will be prepared in the IMAGES team (Image, Modélisation, Analyse, Géométrie et Synthèse) of the IDS Department (Image, Données, Signal) of Télécom Paris, LTCI laboratory. It will be supervised by Florence Tupin, Alasdair Newson and Emanuele Dalsasso at Télécom Paris, and Loïc Denis at Télécom Saint-Etienne.
**Expected knowledge and skills** This topic requires good knowledge in image and signal processing and machine learning. Programming skills (Matlab/Python and/or C/C++) and familiarity with methods dealing with real data are necessary.

**References**


