Internship description

Title: Simulation and estimation of ocean wave heights for the SWOT satellite mission

Section: BU Environnement

Supervisor: Pierre Dubois (CLS)

Contract type: internship, monthly salary provided

Classification:

Work schedule: 35 h per week – 6 months

Starting date: between Mars and June 2020

Work place: CLS Toulouse, 11 rue Hermès, 31520 Ramonville St-Agne

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Title

Simulation et estimation des hauteurs de vagues pour la mission SWOT

Description

The satellite SWOT (Surface Water Ocean Topography) is planned to be launched in 2021 in a joint project including NASA and CNES, the French Space Agency. Its primary goal is to estimate elevations of water surfaces, oceans and inland waters such as rivers and lakes. The main instrument, KaRIn, is a Ka-band interferometric SAR radar that will provide 2D high-resolution observations of the Earth surface over two 60 km-wide swaths.

Regarding oceans, the main goal of the SWOT mission is to retrieve sea surface heights or ocean topography. For this reason, SWOT is called an “altimeter”. In addition to this, SWOT will be able to estimate other ocean parameters such as the “significant wave height” (SWH). This parameter characterizes the waves that take place on top of the topography. The SWH is essential for correcting the topography estimations provided by SWOT since waves are a source of bias in the topography estimation.

The CNES and CLS have built a KaRIn simulator (python, C++) of type End-to-End (E2E): the prototype simulates a variety of geophysical oceanic scenes and the respective interferometric SAR response. Then, it processes the signal and transforms it into ocean parameters. The algorithm for retrieving the topography information from the signal is ready, but the SWH retrieval is still an open field of research.
Algorithms for SWH retrieval and correction already exist and are operational in other altimeter missions. Because of the low resolution of these altimeters, the existing algorithms are suitable for mean wave statistics. However, SWOT will be the first altimeter to provide 2D data at much higher resolution (kilometric). In consequence, new SWH estimation algorithms must be designed that take into account the small scale variability of waves at tens of km.

The main parts of this internship are:

- Characterization of the waves statistics at a global scale: this research will be based on the analysis of simulation outputs (WW3) provided by the IFREMER, the French National Institute for Ocean Science, one of our partners. The candidate will identify a dataset representing the typical ocean conditions.
- Simulation of a wave field including the small scale variability
- Simulation of radar data
- Conception and development of a SWH estimator. The internship candidate will have to study how the SAR interferometric signal interacts with waves.

**Skills required**

- Master's degree in the field of signal processing, telecommunications and/or remote sensing
- Good programming skills in python and/or C++
- Knowledge on SAR/radar technology can be helpful
- Good teamwork skills
- Autonomous
- Proactive and dynamic
- Professional working proficiency in English and/or French

**The company**

CLS, a subsidiary of CNES, the French Space Agency, offers integrated solutions based on the latest satellite technologies (equipment, services and expertise). It provides satellite services and environmental data to a variety of institutions: governments, scientific institutions, companies...

CLS is in close cooperation with the biggest spatial agencies, such as the CNES, the ESA (European Space Agency) and the NOAA (National Oceanic and atmospheric Administration), as well as with Eumetsat, the European Meteorological Organization. CLS employs 750 people, around 350 at its headquarters in Toulouse (France) and in its 26 other sites around the world.