Industry-Academic PhD position in data fusion

Topic: **A.I. data fusion tools for space missions**

Objectives:

Develop, optimize, and implement state-of-the-art machine learning data fusion tools for the Sentinel 2 and 3 missions of the European Copernicus programme and the James Webb Space Telescope.

Sub-topics:

- Remote imaging & sensing of the Earth
- Imaging and spectroscopy for astrophysics
- Neural Networks (Deep Learning)

Profile PhD candidate:

The applicant should have an MSc related to computer/data science or physical sciences and be familiar with some of the following:
- Coding (python)
- Machine Learning / Deep Learning
- Remote sensing (space) observations (either Earth Observations or astrophysics)

Skills:
- Inquisitive, analytical, and critical thinker
- Independent mindset
- Strong communication skills
- Good level of English (oral and written)

Project Summary

Current space missions have highlighted a critical need for the development of new tools capable of processing and analysing Big Data from space. Moreover, recent missions, benefiting from technological progresses, have raised the level of collected data to unprecedented levels. Advances in observation systems and instruments require equal advances in data management and analysis. In this framework, Artificial Intelligence (AI) is a powerful tool that is becoming more common across a wide range of fields, including planetary sciences and Earth Observations.

Space missions for astronomical or Earth observations now carry multiple spectro-imaging instruments. A main challenge for their exploitation is the combination of data sets from different instruments to produce quality images and spectra. The focus of this project is to develop data fusion tools for the Sentinels 2 and 3 missions from the EU Copernicus program. This will then also be applied to the JWST Mid-InfraRed Instrument (MIRI).

- The European Copernicus programme is the most ambitious Earth observation program in the world, providing satellite data to improve environmental management, understand and mitigate the effects of climate change, and ensure civil security. To achieve this ESA is developing and operating the Sentinels satellites, which are equipped with a wide range of instruments for monitoring the Earth, oceans and atmosphere.

- The James Webb Space Telescope (launch 2021) will be the major space observatory of the next decade accessible to the world community and will enable considerable progress to be made on the biggest questions in astrophysics: the first lights of the Universe, the birth of stars and planets, the origins of life, etc.

The goal of this project is to use neural networks or similar techniques to reconstruct spectral images from incomplete spatial and/or spectral data, especially for observations where each pixel contains information from different sources. For instance, be able to reproduce the high spatial resolution of Sentinel 2 using Sentinel 3 images, as well as to reconstruct the high spectral information from Sentinel 3 for Sentinel 2 images. Similarly, for JWST the goal is to reconstruct the high spectral information, from the MIRI spectrograph using the MIRI imager.

Context and Supervision

The project is part of an **ANR LabCom project** that combines the expertise in imagery+spectroscopy and A.I.+inverse problem solutions of ACRI-ST and the Institut d'Astrophysique Spatiale (IAS). This project includes about 20 people from both institutions and started in May 2021.

The PhD is framed in the context of a French **CIFRE** agreement (convention industrielle de formation par la recherche) between ACRI-ST and the IAS and will follow CIFRE remuneration guidelines. The candidate will be based at ACRI-ST and obtain a PhD from the Université Paris-Saclay to which the IAS belongs. The student will be located in the recently inaugurated site at CERGA (Grasse, south of France) which hosts the activities in astrophysics and New Space of ACRI-ST, and it is close to its headquarters in Sophia-Antipolis. It is expected that the student will interact actively with the IAS

Sentinel 2 and 3 data is readily available thanks to ACRI-ST participation to the ground-segment of these missions. Both ACRI-ST and the IAS are part of an awarded JWST Early Release Program, which data will be used for the project.

How to Apply?

Send a CV, a letter of motivation, and arrange a reference/s to be sent to Dr. Jeronimo Bernard-Salas (jeronimo.bernard-salas@acri-st.fr) and do not hesitate in contacting him for more information on the position.

Applications received by June 28th will be fully considered. Position is open until filled. Expected start is in September or October 2021.

About the partners

ACRI-ST (www.acri-st.fr) is an independent space SME based in France and specialised in scientific research, engineering and operations. With a long history and experience in the field of Earth observation, ACRI-ST is now extending its involvement in the sciences of the Universe (planetary sciences and astrophysics, www.astro.acri-st.fr). ACRI-ST works in close collaboration with national and European research institutes and organisations to support the scientific community in the development of end-to-end instrument simulators, data processing pipelines, calibration, validation, archiving and distribution of data, development and deployment of environmental services using space data. ACRI-ST leads and plays a key role in the Sentinel 3 and Sentinel 2 mission performance centers respectively.

The IAS (https://www.ias.u-psud.fr) is one of the major French and European space laboratories whose main objective is the development and exploitation of scientific instruments for space missions, a major axis completed by laboratory experimentation and modelling activities in synergy with the scientific exploitation of space instruments. IAS is involved in all phases of space experiments: upstream R&D, proposals to agencies, instrument production (design, development, tests, calibrations, etc.), scientific operations and then data processing and scientific exploitation (modelling, numerical simulations, laboratory experiments, etc.) as well as their dissemination to the community. The laboratory has made major contributions to several of ESA's mission instruments for astrophysics, solar physics and planetary sciences.