Thesis subject

Name of the laboratory: Institut Fresnel

Thesis advisor: Christelle Eyraud
Email and address: christelle.eyraud@fresnel.fr, 04 13 94 54 85
Institut Fresnel, Equipe HIPE - Campus de Saint-Jérôme, F13397 Marseille, France, (http://www.fresnel.fr/spip/spip.php?article1469)

Co-advisor: Amélie Litman, Hervé Tortel

Subject's title: Inner structure imaging of small solar bodies

Subject description:

In November 2014, the Rosetta mission of the European Space Agency's met with Comet 67P/Churyumov-Gerasimenko. One instrument of this mission is the CONSERT experiment. The CONSERT experiment has explored the nucleus of this comet using electromagnetic waves in the radiowave regime exploiting a bistatic configuration. One of its scientific aims is to contribute to a better understanding of the composition of the cometary core and of its internal structure. The first measurements with CONSERT were made immediately after the landing of the lander Philae on the comet and have already shown the ability of such electromagnetic techniques to explore the comets. CONSERT was the first instrument of this type and, as a result, new missions are being prepared to better understand the internal structure of comets and asteroids. Indeed, these small bodies are an unique opportunity for a better understanding of the primitive solar system and its evolution.

The field scattered by a target depends on its physical characteristics, it is thus possible - in theory - to retrieve the structure of this target and its electromagnetic characteristics thanks to the resolution of an inverse scattering problem. For the application case of a comet or an asteroid, the main difficulties are due to the very large size of the target and to the limited number of available measurements.

In this PhD thesis, we will seek to develop new imaging procedures adapted to the case of study (based on existing imaging procedures), in order to extract information on the internal structure of comets and asteroids. It will have to be done from data that can be measured in the reality of space experiments. For this purpose, studies will be carried out on the choice of input parameters, on the most relevant information that can be introduced into these imaging procedures (especially provided by other sensors), on the modelization and the choice of the reconstructed quantities. Experiments will also be conducted in the laboratory, in an anechoic chamber, to study the interaction of an electromagnetic wave with analogues of these targets. Indeed, the rigorous modeling of the propagation of an electromagnetic wave through such large targets is not trivial. To remedy this problem, "experimental

simulations" of the field will be conducted. The imaging procedures will be tested on experimental data.

This work will combine theoretical / numerical work with experimental work. The candidate must have good knowledge in physics, in particular with regard to electromagnetic fields. Competence in the specificities of microwave regime would be a plus.

Bibliography:

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