Offre de Stage IPSL 2024

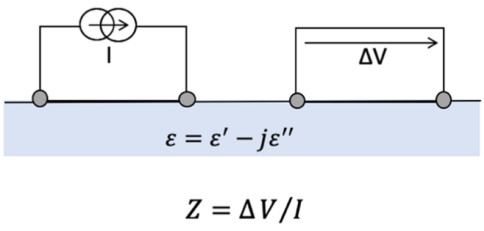
(soutenu par le programme EUR IPSL-*Climate Graduate School)*

Titre du sujet de stage : **Chaîne de mesure du capteur DIEL pour la mission Dragonfly: analyse de sensibilité et dimensionnement / Data acquisition for the DIEL Sensor from the Dragonfly mission : sensitivity analysis and optimisation of design parameters**

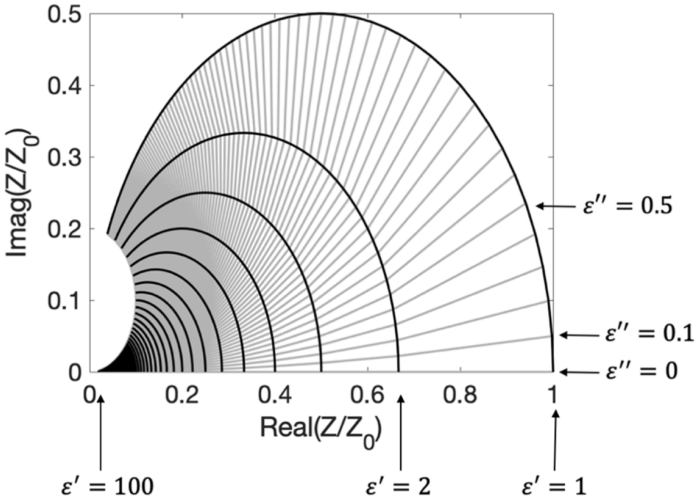
Description du sujet :

Starting operations in 2034, Dragonfly will visit a variety of locations on Titan, from a dune field to the rim of a young impact crater, and sample materials in different geologic settings. Its permittivity probe experiment, called DIEL, on board the Geophysical and Meteorological package (DraGMet) will measure the complex dielectric constant, or permittivity, of the ground at low frequencies thus providing insights on the composition, moisture and porosity of the near-subsurface of Titan as well as on the spatial and temporal variations of such properties. [1]

DIEL is a Mutual-Impedance Probe (MIP) with a pair of electrodes mounted on each skid of the drone. A sinusoidal low frequency: (10 Hz-10 kHz) current I is injected between 2 transmitting electrodes and the induced potential difference ΔV between 2 receiving electrodes is measured. The ratio $Z = \Delta V/I$ of the received potential difference and the injected current gives access to both the real and imaginary parts of the complex permittivity.



$$Z = \Delta V/I$$



From an existing simulation design of the electrodes, the goal of the internship is to link this model to the various parameters of the electronic circuit. First, using surrogate models already used successfully for various complex electromagnetic problems [2,3], the work aims at accurately predicting the permittivity measure regarding the variation of the design parameters in the data acquisition block. Due to the complexity of such numerical models and their inherent computation time, one cannot simply use a direct approach for the computation of such a metamodel and adequate sampling strategy is needed

[4]. In a second time, the various design parameters will be optimized to constrain the accuracy of the permittivity measure. The case of single permittivity layer will be investigated first and with enough time a multi layer structure.

References: [1] Lethuillier A. Characterization of planetary subsurfaces with permittivity probes: analysis of the SESAME-PP/Philae and PWA-MIP/HASI/Huygens data (Doctoral dissertation, Université Paris-Saclay (ComUE)).
[2] Kersaudy P, Sudret B, Varsier N, Picon O, Wiart J. A new surrogate modeling technique combining Kriging and polynomial chaos expansions–Application to uncertainty analysis in computational dosimetry. Journal of Computational Physics. 2015 Apr 1;286:103-17.
[3] Lebensztajn L, Marretto CA, Costa MC, Coulomb JL. Kriging: A useful tool for electromagnetic device optimization. IEEE Transactions on Magnetics. 2004 Mar;40(2):1196-9.
[4] Lagouanelle P, Freschi F, Pichon L. Adaptive sampling for fast and accurate metamodel-based sensitivity analysis of complex electromagnetic problems. IEEE Transactions on Electromagnetic Compatibility. 2023 Oct 12.

Responsable du stage (Nom/prénom/statut) : Lagouanelle Paul Post-doctorant

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Equipe de recherche concernée (si pertinent) ou autre participant à l'encadrement du stage: Département PLANETO, Alice Le Gall

Niveau du stage (M1, M2, internship) : M2

Thème scientifique de l'IPSL concerné : SAMA (Statistics for Analysis, Modelling and Assimilation)

Durée du stage : 4 mois

Période : 01/01/2024-29/07/2023

Rémunération de l'ordre de 580 euros par mois

Est-il prévu une thèse dans le prolongement du stage ? Non.