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The Determination of Mercury's Rotational state with BepiColombo

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The BepiColombo mission will start its one year nominal in-orbit operation phase at Mercury in January 2024. More than forty years after Mariner 10 discovered the presence of an intrinsic magnetic field, the study of Mercury's core still remains a fascinating objective and in-orbit investigations are a privileged condition for doing this. Since the strict connection existing between core and rotational state, measurements of Mercury's obliquity and librations at unprecedented accuracies became one the main purposes of MORE (Mercury Orbiter Radio science Experiment) rotation experiment.
The rotation experiment avails of the employment of precise orbit determination data and high resolution images provided by HRIC, part of the SYMBIO-SYS payload. The correlation of surface landmarks extrapolated by two images of the same area taken at different epochs provides their displacement in time and hence constitutes an observable to be fed into an estimation process for deriving Mercury's rotation parameters. An end-to-end simulator has been built up employing the camera images as the primary observables with the final aim of defining their optimal acquisition scheduling. An extensive simulation campaign has been performed leading to the identification of the most favorable observational strategy and location of the landmarks on the surface so as to fulfill accuracies lower than 1 arcsecond for both obliquity and libration estimation. Finally, the full rotation experiment has been implemented in a global multiarc solution where both optical and radiometric simulated observables are processed by the filter in order to evaluate the science capabilities in terms of Mercury Orientation Parameters. The results also account for the effects of the onboard accelerometer (ISA) error model.
The talk will focus on the description of the end-to-end simulator, illustrating the results obtained in terms of the optimal selection of the observations. Next, full simulations results, obtained from implementing the experiment observables in the orbit determination code, are presented, along with a sensitivity analysis to the main error sources.