Paper ID: 10075
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ASTRODYNAMICS SYMPOSIUM (C1)
Mission Design, Operations and Optimization - Part 2 (2)

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# DESATURATION MANEUVERS AND PRECISE ORBIT DETERMINATION FOR THE BEPICOLOMBO MISSION

**Abstract**

The purpose of this work is the analysis of the consequences that desaturation maneuvers can have in the precise orbit determination expected from the radioscience experiment (MORE) of the BepiColombo mission to Mercury. This is an ESA/JAXA joint project with very challenging objectives regarding geodesy, geophysics and fundamental physics.

Due to the intense radiation environment, the attitude of the Mercury Planetary Orbiter (MPO) has to be controlled by means of inertial wheels that absorb the solar radiation pression torques acting on the spacecraft. In this way the overall angular momentum is conserved until the wheels reach their maximum rotation state. Then it is required to apply a desaturation maneuver (DSM), which induces a residual acceleration on the probe, because of the mismatch and misalignment of the thrusters. To reach the scientific goals of the mission, such DSM have to be treated as 'solve for quantities'.

The orbit determination is performed on a set of observational arcs separated by intervals of time where the MPO is not visible. With the current baseline of two ground stations, these dark periods are 8 hours long and two DSM are performed per day, one during the observing session, the other in the dark.

We will show with numerical simulations that, under these hypotheses, it is possible to perform an extremely accurate orbit determination and parameter estimation, by connecting subsequent observational arcs in a smooth way, thanks to a specific procedure based on the deterministic propagation of the orbit. On the other hand, we will demonstrate that if only one ground station were available, the two DSM would take place in the dark making the motion of MPO very poorly constrained. Indeed, it is possible to derive values for the DSM and the non-gravitational accelerations acting on MPO, which compensate each other. This means that the MPO could have a behavior which we are blind to. In this unlucky case, all the experiments requiring an accurate knowledge of the MPO position and velocity over the entire duration of the mission would be seriously compromised.