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Accelerometer measurements are crucial to derive the Earth’s gravity field from satellites, as is done by GRACE and GRACE-FO. In the final phase of the GRACE mission, the accelerometer of GRACE-B was turned off to reduce power consumption. Similarly, during the early days of the GRACE-FO mission, GRACE-C showed elevated noise levels, rendering the measurements unusable for gravity field determination. To bridge this gap, a transplant has been introduced, which replaces the malfunctioning accelerometer. Various transplants exist, each with its own strategy and modeling approaches. This study examines how different modeling assumptions affect the quality of the obtained accelerations. We focus on the impact of the aerodynamic model, which can be either a constant drag coefficient, panel methods, or Direct Simulation Monte Carlo (DSMC). The latter two do not only model drag but also consider lift and side force effects. To validate the model, we compare accelerometer measurements with transplanted accelerations when the accelerometers of both satellites were operating nominally. We use 2003 as a reference year as it is characterized by high solar activity and thus high atmospheric density, leading to accelerations dominated by aerodynamic forces. Our results show that replacing a constant drag coefficient aerodynamic model with more advanced panel or DSMC force coefficients significantly reduces transplant acceleration errors, highlighting the importance of accurate aerodynamic modeling during the transplanting process.
Presentation file
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