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Estimation of Earth- and satellite-related parameters in radiation pressure modeling from space-borne accelerometry

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Space-borne accelerometers measure the sum of all non-gravitational forces, which interact with the surface of a spacecraft. For low Earth orbit satellites, the atmospheric drag is the largest non-gravitational force. With increasing satellite altitude, the acceleration due to the Earth radiation pressure becomes less relevant, whereas the effect of the Solar radiation pressure becomes prevalent. Accurately modeled non-gravitational forces are necessary for precise orbit determination, satellite gravimetry, or thermospheric density estimation.

In this study, we apply an inverse procedure with the aim to overcome remaining limitations in state-of-the-art radiation pressure force models. We estimate corrections of limiting parameters such as the satellite's thermo-optical material properties or systematic errors in Earth radiation data sets. We define different parameterizations and analyse their estimability in terms of rank deficiency and condition numbers. Correlation analyses between estimated parameters will help to detect and overcome multicollinearity. The results are expected to improve the estimation of certain physical radiation pressure model parameters from satellite accelerometer data. Here, the inverse modeling is based on calibrated accelerometer measurements from the satellite mission Gravity Recovery and Climate Experiment (GRACE).