Orbit Design and Precise Orbit Determination for Next Generation Gravimetry Missions
by
Duncan Eddy

The measurement and characterization of Earth’s gravity field is the means by which Earth scientists are able to observe and understand the dynamics that govern our planet. There is an urgent need for current, high-resolution measurements of the changing gravity field as it is the most efficient means of tracking changing glacier heights and detection of sub-surface resources. It is possible to take timely, global measurements by observing the effect of the gravity anomalies on satellite orbits. To provide state-of-the-art gravity field reconstruction it is necessary to have an exactly repeat orbit and precisely recover the satellite’s true position to within 1 cm level accuracy post-facto. Typical strategies for repeat-orbit selection using analytical calculus do not account for the non-linearity of the problem and introduce unacceptable deviations over the mission lifetime; therefore a combination of numerical perturbation analysis and sequential optimization is adopted instead. Furthermore, the requirements of centimeter-level position knowledge drive the development a modern precise-orbit determination scheme involving advanced GNSS technology integration and high-order modeling of empirical accelerations.