

Precise orbit determination (POD) of the Global Satellite Navigation System (GNSS) is especially important in light of the emerging of new global, and regional navigation systems such as the American GPS or Russian GLONASS, European Galileo, Chinese BeiDou, Japanese Quasi-Zenith Satellite System (QZSS), and Indian NavIC, which gives, in total, over 100 navigation spacecraft in the sky.

All satellites of the new emerging systems, as well as GLONASS satellites, are equipped with Laser Retroreflector Arrays (LRA) for the Satellite Laser Ranging (SLR) SLR observations to GNSS satellites are typically used for the validation of the GNSS-based orbit products. However, SLR observations to GNSS satellites can also be used for an independent determination of the GNSS orbit parameters. This study provides the boundary conditions for the precise GNSS orbit determination using solely SLR data. This study presents the assessment of the so-called Blue-Sky effect which results from the different sensitivity to the weather conditions of optical SLR and microwave GNSS observations.

Based on the Galileo metadata the analytical box-wing model has been composed for the evaluation and absorption of the non-gravitational perturbing forces, i.e., SRP, albedo or Earth's infrared radiation. The box-wing model can absorb up to 97% of the direct SRP. This study presents the assessment of the non-gravitational perturbing forces acting on the Galileo satellites, as well as indicates the most suitable POD strategy allowing for the determination of the Galileo orbits with the accuracy of 25 mm in terms of SLR observation residuals.