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Dynamic and Reduced-Dynamic LEO Orbit Determination

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The two GRACE satellites belong to a series of dedicated satellite missions for the precise high resolution determination of the Earth gravity field and its variation over time. Especially designed for these goals, LEOs (Low Earth Orbiters) circulate in orbits of just 300 to 500 kilometers above the surface of the Earth. Since the launch of these missions high-precision dynamic orbit models gained much importance. Therefor, a high quality force field, which contains all relevant conservative forces, was modeled for the orbit integration. Orbital arcs over different time intervals were integrated and compared with precise reference ephemeris, based on GPS measurements. The orbit approximation achieves accuracies within meters for arcs of 2 hours and differences precise solution of below 100 meters over 24-hours, which is already a very good a priori solution. In a further step the dynamic model has been adjusted to laser distance measurements. Hereby the boundary values as well as various dynamic parameters can be estimated. To compensate for deficiencies of the dynamic model pseudo-stochastic parameters are introduced. These parameters can be instanteanous velocity changes (pulses) or piecewise constant accelerations. This reduced-dynamic orbit model exploits both the advantages of the force field and the geometric strength of the observations, which leads to a considerably improved precise orbit determination. In summary, this presentation gives an overview of the quality of dynamic and reduced-dynamic orbit solutions under the inclusion of GPS data, as it is the current status of orbit determination at the Technical University Vienna.