



Spectroscopy analysis of the single satellite GRACE-1

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One of the studies, which is usually made before the launch of gravimetric satellites, is their sensitivity to the gravity field of the Earth, by simulations. However, as soon as the satellite is launched it would be possible to perform “sensitivity analysis”, or “spectroscopic analysis” for the satellite’s observations by its real data. In this paper, we have used 11 months observations of the GRACE during the year 2003 (Feb. 1st till Dec. 30th), in terms of gravitational potential by using “energy integral equation” technique. The result of this study could show the obtainable sensitivity if only one GRACE satellite were used like the situation we had with CHAMP. To set-up the observation equations, spherical harmonic expansion to degree and order $n_{\max} = 60$ is considered. This degree and order of expansion is associated with the spatial resolution of $2\pi R/n_{\max} \doteq 670km$ at the surface of the reference sphere $R = 6400km$ and results in $180^\circ/n_{\max} = 3^\circ$ as the minimum sampling interval, based on Nyquist sampling theorem. Since this sampling interval was granted by the coverage made by the aforementioned 11 months of the GRACE-1 satellite observations, we proceeded into the set-up of the observation equations. In this way, 464064 observation equations are set-up for the computation of 3717 spherical harmonic coefficients to degree and order 60, excluding the coefficients of the degrees and orders 1 and 0. Having computed the coefficient matrix A of the observation equations, the covariance matrix $C_x = (A^T A)^{-1}$ is computed with 460347 degrees of freedom. Next, the geopotential model EGM96 is used as an indicator of size of the spherical harmonic coefficients and any coefficient with the size smaller than 3 times of its corresponding standard deviation, obtained from the covariance matrix C_x , is considered insensitive with %99 probability level. Using this technique we found the single satellite GRACE-1 insensitive to the coefficients larger than degree and order 33.