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Europa Gravity Field Estimation from a Reanalysis of Galileo Tracking Data

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NASA's Galileo spacecraft was dedicated to the study of the Jupiter system, including the central planet, its magnetosphere and the satellites. A large portion of the mission was devoted to the study of Europa discovering, among other results, a global ocean under its ice crust.
Galileo's umbrella-like High Gain Antenna (HGA) failed to correctly deploy, therefore the spacecraft was able to operate using only the low-gain antenna at S-band, instead of X-band using the main HGA. Therefore, the spacecraft downlink data rate was significantly reduced, limiting the mission science-return, and spacecraft tracking was carried out using the noisier S-band link.
During its mission, Galileo performed eleven flybys of Europa, among which only four had coherent two-way Doppler data throughout the closest approach that could be used for the gravity field determination of the Galilean satellite. Moreover, most of the flybys were nearly equatorial, making difficult to obtain a good accuracy in the estimation of the J_2 gravity coefficient.
Despite that, three different analyses of Europa's gravity field were carried out, two of them by the radio science team of the Galileo project (Anderson 1997, Anderson 1998), and another one by the spacecraft navigation team (Jacobson 1999). These analyses followed two different approaches: a weighted mean of the single-arc estimates, and a global orbit determination fit, respectively. In both cases the hydrostatic constraint $(J_2/C_{22} = 10/3)$ was applied, due to the poor global coverage.
Given the new knowledge of the Jupiter environment provided by the Juno spacecraft, we present an updated analysis of the radiometric Doppler data acquired by the Deep Space Network during the Galileo mission. We used a local multi-arc approach without applying the hydrostatic equilibrium constraint. In addition, models of the Io Plasma Torus, derived by Juno radio occultations, have been used to identify the potential S-band data corrupted by the dispersive media of the Jovian environment. Additionally, the possible accelerations induced by Europa's plumes were considered.
This talk will present our preliminary independent estimate of the Europa's quadruple gravity field which is compatible with a body in hydrostatic equilibrium. Also, we will show the implications of the new J_2 and C_{22} coefficients in terms of Europa's interior modeling.