Deviation Patterns of the Orbital Trajectories of the Galilean Satellites

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This study of the Jovian system aims to determine the patterns of deviation magnitude produced from the orbital trajectories of the Galilean satellites based on three different parameters: theoretical orbital parameters (Model 1), SPICE (Spacecraft-Planetary Instrument C-Matrix-Events) actual positional data (Model 2), and the Jovian gravitational field (Model 3). Holding Model 2 as the control, the most accurate parameter to model the orbital trajectories of the Galilean satellites was determined by analyzing deviation patterns produced from deviation plots between Models 1 & 2 (Deviation Plot A) and Models 2 & 3 (Deviation Plot B). Deviation Plot A produced sinusoidal deviation patterns due to trajectorial micro-oscillations for each satellite caused by trigonometric construction of elliptical trajectories; Deviation Plot B produced linear deviation patterns because of the Eulerian integration algorithm simulating the Jovian gravitational field, causing sinusoidal fluctuations in both Models 2 & 3, resulting in linear increase in deviation. Because the p-value for each t-test performed between Deviation Plots A & B for each satellite was less than alpha (0.05), the null hypothesis (H0) was rejected, thus concluding that there is a statistically significant difference between the orbital trajectory deviations produced from Deviation Plots A & B. The Eulerian integration algorithm in Model 3 can accurately predict future orbital trajectories of the Galilean satellites and any other celestial bodies confined within the Kuiper Belt because the algorithm uses an initial position derived from SPICE which contains state vectors for nearly every celestial body within the Kuiper Belt.

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