problems.

Kathleen Howell

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Giacomo Lari (Università di Pisa)

Results of the Juno radio science experiment obtained with the Orbit14 software

NASA's Juno space mission is orbiting around Jupiter since 2016, collecting different kinds of data which have been crucial to improve our knowledge of the planet. In particular, the radio science experiment provides extremely accurate observations of the position and velocity of the Juno spacecraft, and precise orbit determination allows to estimate several physical and dynamical parameters of Jupiter. In this talk, we first introduce the orbit determination software Orbit14 and we describe the precise dynamical and observation models we implemented in the code. Then, we show the results of the fit of the Juno's radio science data and we present the obtained estimation of the gravitational field, tidal response and spin-axis precession of Jupiter.

Christoph Lhotka (Università Tor Vergata)

Spatial distribution of dust and debris in planetary systems

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Xiadong Lu (Politecnico di Milano)

Reachable domain analysis for analytical design of end-of-life disposal

The interest towards post mission disposal for spacecrafts is increasing among both academic and industrial sectors due to the growing number of space debris. The analysis of dynamical behaviour of spacecraft orbits is a vital part in the design of post mission disposal. In this research, the analytical expression of the double averaged disturbing potential due to and lunisolar perturbations is obtained, in both geocentric equatorial frame and geocentric ecliptic frame. Pros and cons of the two frames for orbital perturbation problem is discussed. Assuming a circular Earth's orbit and a circular Moon's orbit, the phase space representation of the dynamics is formulated. It follows that the dynamical behaviour in the phase space of Keplerian elements is analysed and a reachable domain analysis of a single impulsive manoeuvre is carried out in the phase space using Gauss equations of finite-difference form. Based on the reachable domain analysis, analytical schemes for computing end-of-life disposal manoeuvres could be developed targeting a specific phase space region. A case study of Highly Elliptical Orbits (HEO) could then be carried out, in which the end-of-life disposal is targeting an atmospheric re-entry and the target region in phase space is defined by re-entry condition of the eccentricity.

Marcelo Domingos Marchesin (UFMG, Belo Horizonte)

A Family of Linear Stable Equilibria in the Sun-Earth-Sail Problem

The collinear libration point of the Sun-Earth Circular Restricted Three-Body Problem (CR3BP), L_3 is located opposite to the Earth with respect to the Sun. Whereas several space missions have been launched to the other two collinear equi- librium points, i.e., L_1 and L_2, the region around L_3 is so far unexploited essentially because of the severe communication limitations caused by Sun's blocking location. By using an adequate size, location and attitude of a solar sail, the equilibrium point can be displaced from its original location to allow direct communication between the satellite and Earth. This paper presents several families of artificial equilibria located on the semi-space which is permanently opposite to Earth in relation to the Sun, but which allows direct communication with Earth. We present a family of such equilibria which are linearly stable and therefore very useful for space missions.

Catello Leonardo Matonti (Politecnico di Torino)

Design and Comparison of Relative Dynamics Models about Cislunar Near Rectilinear Halo Orbits

This work presents a comparison between relative models of the Earth-Moon non-Keplerian dynamics regimes, in the perspective of modeling the close relative dynamics between two orbiting objects and of designing Guidance, Navigation and Control algorithms for space debris avoidance operation of future space exploration missions on cislunar Near Rectilinear Halo Orbits. According to the Artemis missions program, NASA will bring back humankind to the Moon in the next years thanks to the Gateway space station. In the Earth-Moon three body environment near the L1-L2 lagrangian points, the classic two body relative models are no more suitable, since the Moon gravitational influence is about 25-40% of the total one acting on a spacecraft. This raises the necessity of developing different relative models for space debris monitoring and safety applications. The work is distinguished for formulating a common benchmark for comparison of Restricted Three Body Problem (R3BP) and Restricted Two Body Problem (R2BP) relative models, showing the range of applicability and their limitations analyzed in terms of displacement with respect to an ephemeris propagation. Quantitative results are then provided to verify models performance at different space debris avoidance location along the orbit. Furthermore, a new R2BP relative model is developed with an innovative strategy which use local osculating Keplerian trajectories respect to a fictitious planet, showing an optimal trade-off between dynamics simplicity and relative errors accuracy. Finally, since the evolution of the relative geometry between Sun, Earth and Moon has a non-negligible influence, an epoch sensibility analysis is conducted by comparing several propaga-