Author: I. GKOLIAS
Politecnico di Milano (Italy)
Title: *"Exploiting the dynamics near GEO for optimal end-of-life disposal manoeuvres"*

Abstract. The services provided by satellites in geosyncrhonous orbits are valuable in everyday life. However, the human space activity has made the geostationary ring densely populated. Apart from the operational satellites, the pieces of defunct spacecraft, upper stages and other smaller space debris add up to approximately 1200 catalogued objects. The future exploitation of the region heavily depends on the measures we will take to keep it clean. Moreover, action needs to be taken since there is no natural cleansing mechanism at this altitude. To this end, ESA requirements suggest that space systems operating in the Geostationary (GEO) protected zone should be disposed into graveyard orbits with less than 0.005 eccentricity and a minimum perigee altitude above the geostationary altitude.

An important role in applying these guidelines plays the understanding of the natural dynamics that govern the motion of satellites, not only at the exact geostationary altitude but also a few hundred kilometres above and below. In this region, the perturbations from the Earth's gravity field, the third body interactions with the Sun and the Moon and the solar radiation pressure (SRP) all become relevant to a higher degree. In this work, both high-fidelity, semi-analytical propagation tools and linearised methods are used to study the long-term evolution of the orbits near the GEO ring. In order to identify possible regions of the phase space that can serve as graveyard orbits, we compute dynamical stability maps, frequency maps and study their properties. We particularly focus on understanding the interplay between the tesseral, lunisolar and solar radiation pressure induced resonances in order to rigorously justify our findings. Finally, we exploit the computed maps to design fuel efficient manoeuvres to stable graveyard orbits that have minimum intersection with the GEO protected region.

Joint work with Camilla Colombo.