

Report Research Activity

Óscar Rodríguez del Río, Assegnista di Ricerca dell'Università di Pisa
oscar.rodriguez@dm.unipi.it

This report summarises the activities carried out by the research fellow during the first six months of activity, from November 25th 2020 to May 24th 2021.

The research activity is supervised by Prof. Giovanni F. Gronchi and Phd Giulio Baù and it is related to techniques for Initial Orbit Determination (IOD) of space objects from observations. In particular it is focused computation of several asteroid orbits with the observations of the Isolated Tracklet File (ITF) available at the Minor Planet Center and the application of the IOD to asteroids and space debris.

This activity belongs to the European project Stardust-R and it is founded by an MSCA-ITN-ETN - European Training Networks (see <http://www.stardust-network.eu/> for more information).

Developments and work in progress:

As in the first months of the project, we have mainly followed the work presented in the research papers of Orbit Determination with the two-body integrals I, II, III ([1] [2] [3]) and the book by A. Milani and G. F. Gronchi [5]. In particular, our work was focused on the use of the polynomial method (see [3]) with the aim of identify whether if two tracklets belong to the same observation and to construct a preliminary orbit (link2 problem) and similarly on the use of the method introduced in [4] with the aim of identify whether if three tracklets belong to the same observation and to construct a preliminary orbit (link3 problem).

To this purpose we have made use of the software Orbfitter (<http://adams.dm.unipi.it/orbfit/>), introducing improvements in the implementation of said methods. In addition, thanks to the datasets provided by Robert Jedicke, these methods have been tested and analysed in various controlled conditions. We made some improvements in the implementation of these methods and we are trying to use different techniques in order to recover lost solutions. For these datasets, we have found quite good results in terms of the total number of real identifications obtained.

An exploration of the ITF was done using a strategy combining the link2 and link3 methods mentioned previously.

In addition we analyse the work [6] of Mossotti for the orbit determination problem and we construct a topocentric version of the method that produces better results. The preliminary results of these methods can be found in [4].

Virtual Secondment:

Due to the current COVID-19 emergency the secondment in the University of Belgrade was virtual. Under the supervision of Prof. Bojan Novakovic and the collaboration of Phd Marco Fenucci we try to characterise some properties related to the Yarkovsky effect [7] in a set of asteroids.

We aimed to develop a model to constrain the physical characteristics of the surface of rotating near-Earth asteroids, and in particular, the thermal conductivity and with this purpose we used different statistical techniques to develop and analyse the results, as for example, the estimation of mixture distributions.

We are writing the results in order to publish them.

Activities:

I have attended to the following schools and workshops:

- Barcelona UB-UPC Dynamical Systems Group Seminar.
- I-CELMECH Seminars.
- MATLAB and Python connected, 23 February.
- Stardust-R Training School III, Iasi, Romania, 15-19 March 2021.
- International School - Dynamical Systems & Applications, Universidade Federal do Rio de Janeiro, course taught by Prof Gemma Huguet 11-20 May 2021.

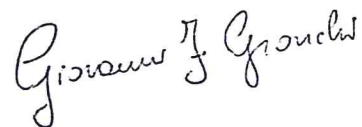
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- [5] Milani, A., Gronchi, G.F.: *The Theory of Orbit Determination*. Cambridge University Press, Cambridge (2010)
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Óscar Rodríguez



Giovanni F. Gronchi

