

Ph.D. research topic

- Title of the proposed topic: Development of machine learning methods to identify dynamical asteroid families
- Research axis of the 3iA: Core elements of AI + AI for Smart and Secure Territories (space observation)
- **Supervisor (name, affiliation, email):** Vincent Vandewalle (Professor UCA/Inria) Vincent.vandewalle@inria.fr
- Co-supervisor (name, affiliation): Benoit Carry (Astronomer, OCA, Lagrange Laboratory) benoit.carry@oca.eu

The laboratory and/or research group: MAASAI Inria joint team-project with LJAD & OCA, Lagrange Laboratory

Apply by sending an email directly to the supervisor.

The application will include:

- **Letter of recommendation of the supervisor indicated above**
- Curriculum vitæ.
- Motivation Letter.
- Academic transcripts of a master's degree(s) or equivalent.
- At least, one letter of recommendation.
- Internship report, if possible.

⇒ **All the requested documents must be gathered and concatenated in a single PDF file named in the following format: LAST NAME of the candidate_Last Name of the supervisor_2024.pdf**

- Description of the topic:

The asteroids between Mars and Jupiter are the remnants of planetesimals that accreted to form the planets. Their orbital, size, and compositional distributions still holds the prints of the different stages of the formation of our Solar System, from the accretion of solid in the disk to planetary migrations. However, 4 billion years of dynamical and collisional evolution have left their mark, blurring this information. In particular, asteroids destroy each other in catastrophic collisions, ejecting numerous fragments. The groups formed by these fragments are called asteroid families. Correctly identifying these families is critical for tracing back in time and determining the original distribution of asteroids in the main belt.

Currently, two methods are used in the community to classify asteroids within families. More than 200 families have been identified using these methods, allowing for the study of various aspects of asteroid evolution. However, these two methods have several limiting factors that hinder our understanding of which asteroids are primordial among those resulting from past collisions.

The goal of this co-supervised doctorate, between the MAASAI team of Inria with expertise in developing model-based clustering approaches and the Observatoire de la Côte d'Azur, is to develop a new method, based on modern clustering techniques in machine learning, to identify asteroid families. This tailor-made clustering method will build upon current knowledge of the evolution of asteroid families over time under the Yarkovsky non-gravitational effect to include the physical knowledge of the considered phenomenon.

WHO YOU ARE

Education:

- Master degree in statistics, machine learning, astronomy or equivalent

Skills:

- Strong expertise in scripting Python language required
- Strong personal organization skills are required
- Excellent verbal and written communication skills and proficient in English, basic knowledge of French is an advantage

Additional considerations:

- Experience in artificial intelligence and deep learning methods would be helpful
- Ability to troubleshoot problems, and provide possible solutions
- Capable of conveying technical information in a clear and thorough manner
- Excellent interpersonal and teamwork skills