Curriculum vitae di *Fabio Ferrari*

Sottosettori ERC primari: PE8_1 Aerospace engineering
Sottosettori ERC secondari: PE9_2 Solar system science

PERSONAL DETAILS

Family name, First name: Ferrari, Fabio

Birthdate: 18 December 1988

Researcher unique identifier(s) (such as ORCID, Research ID, etc. ...): ORCID: 0000-0001-7537-4996; Researcher ID: I-7600-2019; Scopus ID: 56732491300; Research Gate (https://goo.gl/Gtnuyk); Google Scholar (https://goo.gl/pfNU8W)

Web site: https://dart.polimi.it/

- **Education and key qualifications**

27/01/2017 PhD in Aerospace Engineering (Cum Laude)
Department of Aerospace Science and Technology, Politecnico di Milano, Italy
Name of PhD Supervisor (for junior members only): Prof. Michèle Lavagna

2013 Master of Science in Space Engineering (110/100 Cum Laude)
Politecnico di Milano, Italy

- **Current positions**

2024 – present Associate Professor
Department of Aerospace Science and Technology, Politecnico di Milano, Italy

2022 – present Visiting Professor
Physics Institute, University of Bern, Switzerland

- **Previous positions**

2022 – 2023 Assistant Professor
Department of Aerospace Science and Technology, Politecnico di Milano, Italy

2020 – 2022 Senior Research Associate
Physics Institute, University of Bern, Switzerland

2019 – 2021 Visiting Postdoctoral Research Fellow
NASA Jet Propulsion Laboratory, USA

2019 – 2020 Postdoctoral Research Fellow
Department of Aerospace Science and Technology, Politecnico di Milano, Italy

2019 (May-Jul) Visiting Scientist
Observatoire de la Côte d'Azur, CNRS, France

2018 – 2019 Postdoctoral Research Fellow
NASA Jet Propulsion Laboratory, USA

2017 – 2018 Postdoctoral Research Fellow
Department of Aerospace Science and Technology, Politecnico di Milano, Italy

RESEARCH ACHIEVEMENTS AND PEER RECOGNITION

Research achievements

As of July 2026, I have published **198 works** (source: Google Scholar), including **58 peer-reviewed journal articles**, papers and abstracts to international conferences, resulting into **83 overall papers** referenced in Scopus. Overall, my works have attracted 1894 citations, h-index=24 (Scopus); citations: 2910, h-index=29 (Google Scholar). My work has been recognised as widely **interdisciplinary**, as I have published in **17 different journals across different fields**: Aerospace/Mechanical Engineering, Astrodynamics, Nonlinear Dynamics, Planetary Science/Astronomy, as well as interdisciplinary journals such as Nature and Nature Communications.

Ten relevant publications/research achievements are highlighted here (citation source: Scopus, July 2026).

1. **F. Ferrari**, A. Tasora, P. Masarati, M. Lavagna. N-Body Gravitational and Contact Dynamics for Asteroid Aggregation. **Multibody System Dynamics**, Jan. **2017**, Vol. 39, 1, pp 3–20. [doi: 10.1007/s11044-016-9547-2]. This work describes the **first version of the GRAINS code**, including proof-of-concept and feasibility of its new paradigm, This idea awarded me a **Marie Skłodowska-Curie (MSCA) Global Fellowship** (the GRAINS project). GRAINS relied on a **cutting-edge** encounter between planetary science and mechanical engineering, with the goal to create a new realistic tool to address gravitational aggregation problems by combining techniques of astronomical N-body codes with DEM granular mechanics codes. **GRAINS** proved to enhance greatly the realism of previous simulation tools and **set a new paradigm for N-body simulations of gravitational aggregates**, where irregular fragments are used instead of spherical particles. **This work marks the starting point of my own independent research line**.	cit: 30
2. **F. Ferrari**, M. Lavagna, E. Blazquez. A parallel-GPU code for asteroid aggregation problems with angular particles. **Monthly Notices of the Royal Astronomical Society**, Feb. **2020**, Vol. 492, 1, pp 749-761. [doi: 10.1093/mnras/stz3458]. This work provides a fundamental **validation of the GRAINS code** for high-N systems and for the case of rubble-pile asteroid problems. Compared to its first version, the GRAINS code is upgraded to include a computationally efficient gravity module, through the implementation of a GPU-parallel algorithm, and more realistic contact models, through viscoelastic treatment of contact interactions between particles. This provides **evidence of the capabilities of the GRAINS code** and its suitability to perform **realistic simulations.**	cit: 26
3. **F. Ferrari**, P. Tanga. The role of fragment shapes in the simulations of asteroids as gravitational aggregates. **Icarus**, Nov. **2020**, Vol. 350. [doi: 10.1016/j.icarus.2020.113871]. This paper addresses the problem of how parameters at the microscopic scale affect the macroscopic behaviour of gravitational aggregates. We use the GRAINS code to investigate the effect of particle shape on the global properties of the aggregate and **demonstrate quantitatively the importance of particle-scale effects in granular asteroid problems**. The work **sets a new paradigm in the field of N-body/granular simulations of asteroid aggregates**, where using irregular fragments is indispensable. The results provide a **fundamental conceptual step in the definition of the methodology that later awarded me the TRACES ERC project,** whose fundamental hypothesis states that the realism of simulations is improved by precise modelling of local-scale effects. Datasets related to the results of this work are available: [doi: 10.5281/zenodo.3944129], [doi: 10.5281/zenodo.3952096], [doi: 10.5281/zenodo.3952131].	cit: 32
4. **F. Ferrari**, P. Tanga. Interior of top-shaped asteroids with cohesionless surface. **Icarus,** May **2022,** Vol. 378. [doi: 10.1016/j.icarus.2022.114914] This paper addresses the extremely challenging problem posed by in-situ observations of asteroids Bennu and Ryugu, top-shaped rubble piles with irregular surface features. Simulation-based studies (using spherical particles) show that cohesion is required to maintain such surface features. However, interaction of the spacecraft with the asteroids' surface reported no cohesion. Using the GRAINS code, we demonstrate that no cohesion is needed when realistic fragment shape is used. This work **demonstrates the potential breakthrough arising from enhancing the particle-scale realism of numerical simulations**. In this case, the higher realism enabled new dynamical solutions, which were not attainable with the simpler spherical particle model. This provides **evidence to support TRACES' methodological approach** aimed at increasing the realism by precise modelling of local-scale effects.	cit: 24

5. **F. Ferrari**, M. Lavagna. Periodic motion around libration points in the Elliptic Restricted Three-Body Problem. **Nonlinear Dynamics**, Jul. **2018**, Vol. 93, 2, pp 453-462. [doi: 10.1007/s11071-018-4203-4]. This high-impact work (citations well above the journal and field average values) addresses the problem of predicting the dynamical properties and transitions between qualitatively different regimes of a chaotic nonautonomous system using Floquet theory.	cit: 60
6. **F. Ferrari**, M. Lavagna. Ballistic landing design on binary asteroids: the AIM case study. **Advances in Space Research**, Oct **2018**, Vol. 62, 8, pp 2245-2260. [doi: 10.1016/j.asr.2017.11.033]. During my PhD years I participated to ESA's Asteroid Impact Mission (AIM) as mission analyst, and developed a novel strategy to design the release of AIM's lander. This strategy employed three-body problem ballistic arcs and became ESA's nominal one due to its higher success rate compared to traditional flyby releases.	cit: 25
7. **F. Ferrari**, V. Franzese, M. Pugliatti, C. Giordano, F. Topputo. Preliminary mission profile of Hera's Milani CubeSat. **Advances in Space Research**, **2021**, 67(6), pp. 2010–2029. [doi: 10.1016/j.asr.2020.12.034]. This paper investigates the complex dynamical environment near the Didymos binary asteroid system to addresses the challenging problem of finding suitable trajectory options to host Hera's Milani CubeSat. **Didymos chaotic dynamical environment is precisely modelled** in terms of asteroid's irregular gravity field (using shape-based models) and non-gravitational effects (e.g., Solar Radiation Pressure). This is one of the outputs of my involvement in ESA's **Hera** Mission (**overall** contribution: **7** journal papers).	cit: 71
8. J. Wimarsson, **F. Ferrari**, M. Jutzi. The diverse shapes of binary asteroid satellites born from sub-escape-velocity moonlet mergers. **Astronomy and Astrophysics**, Dec **2025**, Vol. 704. [doi: 10.1051/0004-6361/202555914]. This is one of the outputs of my **SNSF Ambizione Fellowship**, whose idea was based on extending the dynamical range of phenomena covered by N-body simulations, by making GRAINS interact with the Bern-SPH code, the world's lead Smooth Particle Hydrodynamics code developed at the University of Bern. This is **groundbreaking as extends the capability of the new hybrid code well beyond the limitations** of N-body (well suited for particle dynamics, not for thermodynamics) and SPH (well suited for multi-physics, not for granular dynamics) codes. This publication demonstrates the capability of such code to reproduce scenarios in agreement with the observations of NASA's DART mission. **Related publications**: Wimarsson et al., 2024 (Icarus).	cit: 3
9. **F. Ferrari** et al. Morphology of ejecta features from the DART impact on Dimorphos and their implications. **Nature Communications**, Feb **2025**, 16, 1601. [doi: 10.1038/s41467-025-56551-0]. This paper provides a dynamical interpretation of the features observed after the DART impact on Dimorphos. A novel approach was developed to derive properties of ejecta and their evolution, by comparing observations with numerical simulations. This is one of the outputs of my involvement in NASA's **DART** Mission (**overall** contribution: **28** journal papers, including 4 Nature, 8 Nature Communications, 1 Nature Astronomy).	cit: 6
10. **F. Ferrari**, E. M. Alessi. A new method for identifying dynamical transitions in rubble-pile asteroid scenarios. **Astronomy and Astrophysics**, Apr **2023**, Vol. 672. [doi: 10.1051/0004-6361/202244540]. This paper provides the proof-of-concept of the methodology used in **TRACES**. Techniques from chaos theory and nonlinear system dynamics are used in combination with high-fidelity numerical simulations to predict and characterize the behavior of rubble-pile asteroids modelled as granular systems. **Related publications**: Fodde and Ferrari, 2025 (Astronomy and Astrophysics); Vaghi et al., 2025 (Multibody System Dynamics); Fodde et al, 2026 (Monthly Notices of the Royal Astronomical Society).	cit: 5

Peer recognition

- **Personal grants awarded**: including **Marie Skłodowska-Curie (MSCA) Global Fellowship** and **ERC StG** from the European Commission, and **Ambizione Fellowship** from the Swiss National Science Foundation. Overall, I have been awarded ~**3M€** of research grants as **PI**.
- **Involvement in space missions**:
  - **NASA's DART**: I was part of the Investigation Team and member of WG Dynamics
  - **ESA's Hera**: I am Core Member of the Science Team, and the PI of the NavCam on board the Milani CubeSat.
  - **ESA's RAMSES**: I am Core Member of the Science Team, Chair of WG1 "Surface Science Modeling and Experiments", and PI of the HORUS camera on board the Farinella CubeSat.
  - **ESA's LUMIO**: I am the Science Lead of the Mission.
- **Asteroid 31960 Fabioferrari** (2000 GC142) was named in recognition of my contribution to the DART and Hera missions.
- **Elected member of societies:**
  - Associate member of PlanetS (National Centres of Competence in Research, Switzerland)
  - Individual member of International Astronomical Union.
- **Invited talks** at several international institutions, including NASA/JPL, Observatoire de la Cote d'Azur, ISSI-Bern, University of Bern, Centre National d'Etudes Spatials (CNES).
- **Italian National Scientific Habilitation** (ASN) for the role of Full Professor (Sector 09/A1 – INGEGNERIA AERONAUTICA, AEROSPAZIALE E NAVALE). December 2023.

ADDITIONAL INFORMATION

Other contributions to the research community and institutional roles

- **Lab management and supervision**: I am the **co-coordinator** of the DART (Deep-space Astrodynamics Research and Technology) Lab at the Department of Aerospace Science and Technology, Politecnico di Milano. As of July 2026, the **DART Lab** has **48** researchers.
- **Teaching activities**: Chair of **Aerospace Mechanics II** (2022-present), Co-Chair of **Space Mission Analysis Laboratory** (2024-present) at Politecnico di Milano.
- **Responsible of Graduations for Aerospace Engineering B.Sc. and M.Sc.** at Politecnico di Milano.
- **Reviewer/Board member** for fellowships (funded by European Commission, NASA and other European national agencies), PhD committees, journals (awarded excellent reviewer for JGCD and ASR).
- **Outreach activity**: local/national newspapers, including RAI, and radio interviews.