

# Paolo PANICUCCI, PhD

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## Summary

Paolo Panicucci is Assistant Professor of Space System at Politecnico di Milano. His research is focused on autonomous vision-based navigation, image processing, spacecraft autonomy, hardware-in-the-loop simulations, and the use of optical observables for scientific purposes. He is also involved in several research projects, acting as technical and managerial key personnel, for national and international sponsors. His main duties beside research include supervision of PhD and MSc students and support for proposal writing for national and international calls. He has been teaching assistant on several courses on AOCS, computer vision, and astrodynamics since 2018. He has published 9 journal papers and he has more than 30 conference works. He has supervised 13 MSc students and co-supervised 5 PhD students.

## Current Position

### Politecnico di Milano

Milano, Italy

#### ASSISTANT PROFESSOR (RTDA) OF SPACE SYSTEMS,

Mar. 2023 -

- Responsible and expert for autonomous vision-based navigation and computer vision at DART Lab.
- Team supervision (PhD and MSc students) and proposal conceptualization and writing (ESA, ASI, EC).
- Managerial and technical key personnel for research projects.

## Positions Held

### Politecnico di Milano

Milano, Italy

#### POSTDOCTORAL RESEARCH FELLOW

Apr. 2021 - Feb. 2023

- Design and development of two hardware-in-the-loop test-benches for autonomous vision-based navigation and image processing validation.
- Team supervision (PhD and MSc students) and proposal conceptualization and writing (ESA, ASI, MUR, EC).
- Managerial and technical key personnel for research projects.

### Airbus Defence And Space

Toulouse, France

#### IMAGE PROCESSING & COMPUTER VISION ENGINEER

Jan. 2018 - Mar. 2021

- Integration of image processing algorithms (model-based and feature-based computer vision algorithms) in navigation filters.
- Design, development and testing of SLAM and Shape from Silhouettes algorithms.

### ORCCA Lab, CU Boulder

Boulder, USA

#### VISITING SCHOLAR

Feb. 2019 - Aug. 2019

- Research on uncertainty quantification in small bodies' gravity field arising from a stochastic shape under the supervision of Prof. J. W. McMahon.

### Space Debris Modelling and Risk Assessment Office, CNES

Toulouse, France

#### ASTRODYNAMICS AND SPACE SITUATION AWARENESS INTERN

Apr. 2017 - Sep. 2017

- Final MSc internship on non-linear uncertainty propagation in space mechanics through surrogate models under the supervision of Ing. V. Morand.

### AVS Lab, CU Boulder

Boulder, USA

#### VISITING SCHOLAR

Jul. 2016 - Sep. 2016

- Research on rototranslational dynamics of a variable mass spacecraft under the supervision of Prof. H. Schaub. with ASI/CAIF funding.

### S<sup>5</sup>Lab, La Sapienza

Rome, Italy

#### STUDENT RESEARCHER

Nov. 2014 - Jul. 2015

- Contribution to the URSAMAIOR CubeSat (QB50 program) under the supervision of Prof. F. Santoni and Prof. F. Piergentili.

## Education

### ISAE-SUPAERO

Toulouse, France

#### PHD IN ASTROPHYSICS, SPACE SCIENCES, PLANETOLOGY WITH MINOR IN AUTOMATIC CONTROL AND ROBOTICS,

Jan. 2018 - Mar. 2021

- Thesis: "Autonomous vision-based navigation and shape reconstruction of an unknown asteroid during approach phase"
- Supervisors: Prof. E. Zenou (ISAE-SUPAERO), Dr. J. Lebreton (Airbus Defence & Space), Dr. M. Delpech (CNES), Prof. F. Simatos (ISAE-SUPAERO).
- Funding: CNES - Airbus Defence & Space.

### ISAE-SUPAERO

Toulouse, France

#### DOUBLE DEGREE IN AEROSPACE ENGINEERING,

Aug. 2015 - Nov. 2017

- Specialization: GNC and Signal Processing, Complex System Simulation and Modelling.

### Université Paris Saclay

Paris, France

#### RESEARCH MASTER IN CONTROL AND IMAGE PROCESSING,

Sep. 2016 - Nov. 2017

- Specialization: System Control & Image Processing for Space Applications.

## La Sapienza

MSC IN SPACE AND ASTRONAUTICAL ENGINEERING,

- Degree Grade: 110 cum laude/110.
- Thesis: "Uncertainty Propagation in Space Mechanics through Surrogate Model Techniques".

Rome, Italy  
Sep. 2014 - Nov. 2017

## La Sapienza

BSC IN AEROSPACE ENGINEERING,

- Degree Grade: 110 cum laude/110.

Rome, Italy  
Sep. 2011 - Nov. 2014

## Research projects

### Participation to research projects

Jan. 2023 -



#### STAR Nav (Star Tracker Autonomous Relative Navigation)

STAR Nav is an ESA-funded activity aiming at enabling star tracker as a competitive sensor for navigation. P. Panicucci's duties are:

- Support of the proposal writing vis-à-vis hardware-in-the-loop testing and vision-based navigation.
- Leading the technical team providing support for the VBN algorithm design and for the algorithm testing in the hardware-in-the-loop facility.
- Preparation of technical deliverables to the ESA.

Dec. 2022 -



#### COSMICA (Close-proximity Operations for Small-body Missions with Interplanetary Cubesats in Autonomy)

The MUR-funded COSMICA aims at enabling CubeSats with autonomous guidance, navigation, and control in close proximity operations. P. Panicucci's duties are:

- Leading the proposal writing and the project conceptualization.
- Providing the managerial and technical support to the project.
- Leading of the technical team involved in the design of the vision-based navigation algorithm and the robotic-arm hardware-in-the-loop facility design.

Sep. 2022 - Sep. 2023



#### LUMIO (Lunar Meteoroid Impacts Observer) - Phase B

LUMIO is an ESA-funded CubeSat lunar mission to a quasi-halo orbit at L2 point gathering information of the lunar meteoroid environment and performing an autonomous limb-based navigation experiment. P. Panicucci's duties were:

- Leading the AOCS team (3 individuals) and managing the related deliverables to the European Space Agency.
- Supervision and conceptualization of the AOCS design and related analyses.
- Design, implementation, validation, and testing of the autonomous navigation experiment.

Apr. 2022 - Sep. 2023



#### SENSE - A Sensor for Autonomous Navigation in Deep Space

The ERC-funded proof-of-concept SENSE aims at putting forward up to TRL 4 nanoSENSE, an autonomous navigation sensor for interplanetary trajectory. SENSE has received funding from the ERC Proof of Concept. P. Panicucci's duties were:

- Team supervision and preparation of the technical documents for the European Commission.
- Management of the proof-of-concept validation procedure and execution of the hardware-in-the-loop tests

Apr. 2021 -



#### EXTREMA (Engineering Extremely Rare Events in Astrodynamics for Deep-Space Missions in Autonomy)

The ERC-funded EXTREMA aims at enabling CubeSats with autonomous GNC in deep space. EXTREMA is divided in three research pillars (autonomous navigation, autonomous guidance and control, computational astrodynamics). Paolo Panicucci's duties are:

- Leading the pillar dealing with autonomous navigation, including supervision of two PhD students.
- Development of the hardware-in-the-loop optical navigation test bench, the design and validation of the deep space rendering engine, the design and management of interfaces with other project parts.
- Technical and managerial document preparation for the European Commission.

## Mission Experience

### Scientific Implication in Past, Future and Present Space Missions

Nov. 2022 - Nov 2023



#### DART (Double Asteroid Redirection Test)

DART is a NASA-funded science mission aiming at increasing the knowledge of the asteroid population and to test kinetic impactor technology for planetary protection purposes. P. Panicucci is external collaborator to the Ejecta Working Group supporting ejecta properties estimation release from the Didymos's binary system after DART impact. He was involved in the estimation of ejecta mass and size-frequency distribution by rendering images of the impact to emulate the Hubble Space Telescope observations.

Jul. 2022 -



#### LUMIO (Lunar Meteoroid Impacts Observer)

LUMIO is a ESA-funded CubeSat mission to a quasi-halo orbit at Earth-Moon system L2 Lagrangian point, that complements Earth based observations on the lunar nearside, to provide global information on the lunar meteoroid environment and contribute to Lunar Situational Awareness (LSA). P. Panicucci is member of the Lunar Environment & Engineering Working Group, Meteoroid Characterization Working Group, and Observation Working Group. He focuses its research on photometric impact modeling, synthetic image generation, and autonomous GNC testing.

## Other Experiences

Mar. 2019

Caltech Space Challenge, Caltech

Pasadena, USA

Nov. 2018

Post-Alpbach Summer School Event, ESA Education Training Centre

Transinne, Belgium

Jul. 2018

Alpbach Summer School, Hauptschule

Alpbach, Austria

## Academic Services

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### Teaching Activity

- 2024 **Fundamentals of Aerospace Engineering II**, Teaching Assistant
- 2021 - 2023 **Spacecraft Attitude Dynamics and Control**, Teaching Assistant
- 2018 - 2021 **Space Mechanics**, Teaching assistant & Lecturer
- 2018 **Space and Mathematics**, Teaching Assistant
- 2018 **Computer Vision Experimental Project**, Laboratory and Project Tutor

### Co-Supervision of PhD Students

- 2023 - 2026 **Pietro Califano**, Autonomous vision-based navigation for CubeSats in asteroid close proximity
- 2023 - 2026 **Andrea Pizzetti**, Autonomous vision-based navigation with limited-resources star trackers
- 2023 - 2025 **Fabio Ornati**, Hardware-in-the-loop testbench design and calibration for vision-based navigation algorithm validation
- 2021 - 2024 **Felice Piccolo**, Autonomous vision-based navigation for CubeSats in asteroid close proximity
- 2021 - 2024 **Eleonora Andreis**, Autonomous vision-based navigation for CubeSats in deep-space cruise

### Supervision of MSc Students

- 2024 **Davide Lanza**, Image Processing for Autonomous Asteroid Detection
- 2023 **Elena Pilo**, GNSS-aided vision-based landing at the Moon
- Silvia Della Torre**, Hardware-in-the-loop simulations of limb-based navigation
- Eugenio Gianferrari**, Pulsar-based interplanetary navigation
- Davide Zonzini**, Dual camera configuration for deep space navigation

### Co-Supervision of MSc Students

- 2023 **Federico Caputo**, Autonomous AI-aided navigation in Earth orbit
- 2022 **Fabio Ornati**, EXTREMA hardware-in-the-loop navigation test bench
- Davide Perico**, EXTREMA processor-in-the-loop navigation algorithm
- David Reina**, EXTREMA high-fidelity rendering engine
- Claudia Balossi**, LUMIO navigation hardware-in-the-loop simulations
- 2021 **Salvatore Borgia**, LUMIO vision-based navigation design
- Lorenzo Beccari**, Asteroid close proximity feature tracking and matching
- 2019 **Sergi Segura Muñoz**, Taylor Differential Algebra library for GNC and trajectory design applications

## Services to the Scientific Community

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### Reviewer activity

He performs regularly reviewing activity for: The Journal of Spacecraft and Rockets, The Journal of Guidance Control and Dynamics, IEEE Transactions on Aerospace & Electronic Systems, Advances in Space Research, Celestial Mechanics and Dynamical Astronomy, IFAC Journal of Systems and Control.

### Membership

- 2024 - **Associazione Italiana Di Aeronautica e Astronautica**
- 2019 - **American Astronautical Society**
- 2018 - 2019 **IPPW Student Organization Committee**

### Public Outreach

- 2021 - 2023 **Festival della Scienza**, Milano IT
- 2018 - 2019 **European Researchers' Night**, Toulouse, FR
- 2018 **CNES Summer School Universpace at ENAC**, Toulouse, FR

## Honors & Awards

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### Grants (Selected)

- 2022 **Switch2Product | Innovation Challenge**, 30000€ PoliHub  
4 grants awarded over 25 teams to increase the technology readiness level of innovative proof-of-concept
- 2019 **Visiting Scholar Research Grant**, 5500€ ISAE-SUPAERO & Fondation ISAE-SUPAERO  
Grant awarded to support research secondment for proficient PhD students
- 2018 **CNES Doctoral Fellowship**, 80000€, 1 grants awarded CNES  
Fellowship awarded to support PhD research for 3 years
- 2017 **Visiting Scholar Research Grant**, 2500€ Fondazione Roma Sapienza  
1 grant awarded to support MSc thesis internship for proficient MSc students

2016	<b>Visiting Scholar Research Grant</b> , 9000€, , 3 grants awarded over more than 100 participants to support internships in the top-ranked American university	ASI & CAIF
2015	<b>Double Degree Travel Grant</b> , 10000€, 1 grants awarded 1 grants awarded to finance double degree program at ISAE-SUPAERO	La Sapienza
2014	<b>Full tuition remission as “Excellent Undergraduate Student”</b> , 2500€, 3 grants awarded for undergraduate students with excellent academic records	La Sapienza

## Awards

2018	<b>IPPW Outstanding Student Presentation Poster - First Place</b>
2014	<b>Excellent Undergraduate Student Award</b> , 3 grants awarded

## Publications

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### PhD Thesis

1. **P. Panicucci**, “Autonomous vision-based navigation and shape reconstruction of an unknown asteroid during approach phase”, PhD Thesis, *Institut Supérieur de l’Aéronautique et de l’Espace (ISAE-SUPAERO)*, March 2021, <https://www.theses.fr/2021ESAE0011>.

### Book Chapter

1. G. Di Domenico, E. Andreis, A. C. Morelli, G. Merisio, V. Franzese, C. Giordano, A. Morselli, **P. Panicucci**, F. Ferrari, F. Topputo, “The ERC-Funded EXTREMA Project: Achieving Self-Driving Interplanetary CubeSats”, In: *Fasano, G., Pintér, J.D. (eds) Modeling and Optimization in Space Engineering. Springer Optimization and Its Applications*, vol 200. Springer, Cham. [https://doi.org/10.1007/978-3-031-24812-2\\_6](https://doi.org/10.1007/978-3-031-24812-2_6)

### Journal Papers

1. N. Chabot, et al. (including **P. Panicucci**), “Achievement of the Planetary Defense Investigations of the Double Asteroid Redirection Test (DART) Mission”, *The Planetary Science Journal*, 5, 49 (2024), <https://doi.org/10.3847/PSJ/ad16e6>
2. D. C. Richardson, et al. (including **P. Panicucci**), “The Dynamical State of the Didymos System Before and After the DART Impact”, *The Planetary Science Journal*, Under Review
3. E. Andreis, **P. Panicucci**, and F. Topputo, “An Autonomous Vision-Based Navigation Algorithm for Interplanetary Navigation”, *Journal of Guidance, Control, and Dynamics*, Under Review
4. **P. Panicucci**, J. Lebreton, R. Brochard, E. Zenou, and M. Delpech, “Vision-Based Estimation of Small Body Inertial State During the Approach Phase”, *Acta Astronautica*, 213 (2023): 177-196. <https://doi.org/10.1016/j.actaastro.2023.08.046>.
5. F. Moreno, A. Campo Bagatin, G. Tancredi, J.-Y. Li, A. Rossi, F. Ferrari, M. Hirabayashi, E. Fahnestock, A. Maury, R. Sandness, A. S. Rivkin, T. L. Farnham, S. Soldini, C. Giordano, G. Merisio, **P. Panicucci**, M. Pugliatti, A. J. Castro-Tirado, E. Fernandez-García, I. Perez-García, S. Ivanovski, L. Kolokolova, J. Licandro, O. Munoz, Z. Gray, J. L. Ortiz,1 and Z.-Y. Lin, “Characterization of the ejecta from NASA/DART impact on Dimorphos: observations and Monte Carlo models”, *The Planetary Science Journal*, 4, 138 (2023) <https://doi.org/10.3847/PSJ/ace827>.
6. **P. Panicucci**, J. Lebreton, R. Brochard, E. Zenou, and M. Delpech, “Shadow-Robust Silhouette Reconstruction for Small-Body Applications”, *Journal of Spacecrafts and Rockets*, 60.3 (2023): 812-828. <https://doi.org/10.2514/1.A35444>.
7. **P. Panicucci** and F. Topputo, “The Hardware-In-The-Loop Vision-Based Navigation Facility TinyV3RSE”, *Sensors*, 22.23 (2022): 9333. <https://doi.org/10.3390/s22239333>.
8. A. Deutsch, **P. Panicucci**, L. I. Tenelanda Osorio, V. Da Poian, Y. Cho, C. Venigalla, T. Mathanlal, E. Castillo Specia, G. González Peytaví, A. Guariello, O. Gunasekara, L. Jones, M. Krasteva, J. Pouplin, N. Villanueva, and S. Zaref, “The ETNA Mission Concept: Assessing the Habitability of an Active Ocean World”, *Frontiers in Astronomy and Space Sciences*, 9 (2022): 1028357. <https://doi.org/10.3389/fspas.2022.1028357>.
9. O. Gassot, **P. Panicucci**, G. Acciarini, H. Bates, M. Caballero, P. Cambianica, M. Dziewiecki, Z. Dionnet, F. Enengl, S.-B. Gerig, F. Hessinger, L. Kissick, M. Novako, C. Pellegrino, A. Pontoni, T. Ribeiro, C. Riegler, N. Berge, N. Huber, R. Hynek, B. Kędziora, A. Kiss, M. Martin, and J. Navarro Montilla, “Calathus: A Sample-Return Mission to Ceres”, *Acta Astronautica*, 181 (2021): 112-129. <https://doi.org/10.1016/j.actaastro.2020.12.050>.
10. **P. Panicucci**, B. Bercovici, E. Zenou, J. McMahon, M. Delpech, J. Lebreton, and K. Kanani, “Uncertainties in the gravity spherical harmonics coefficients arising from a stochastic polyhedral shape”, *Celestial Mechanics and Dynamical Astronomy*, 132 (2020): 1-27. <https://doi.org/10.1007/s10569-020-09962-8>.
11. B. Bercovici, **P. Panicucci**, and J. McMahon, “Analytical Shape Uncertainties In The Polyhedron Gravity Model”, *Celestial Mechanics and Dynamical Astronomy*, 132 (2020): 1-32. <https://doi.org/10.1007/s10569-020-09967-3>.
12. **P. Panicucci**, C. Allard and H. Schaub, “Spacecraft Dynamics Employing a General Multi-tank and Multi-thruster Mass Depletion Formulation”, *Journal of the Astronautical Sciences*, 65 (2018): 423-447. <https://doi.org/10.1007/s40295-018-0133-0>.

### Conference Proceedings

1. C. Balossi, F. Piccolo **P. Panicucci**, M. Pugliatti, F. Topputo, and F. Capolupo, “Moon Limb-based Autonomous Optical Navigation using Star Trackers”, 46th Annual AAS Guidance, Navigation and Control Conference, Breckenridge, Feb. 1-7, 2024.
2. F. Piccolo, C. Balossi, **P. Panicucci**, M. Pugliatti, F. Topputo, and F. Capolupo, “Resource-Constrained Vision-Based Relative Navigation about Small Bodies”, 46th Annual AAS Guidance, Navigation and Control Conference, Breckenridge, Feb. 1-7, 2024.
3. **P. Panicucci**, F. Piccolo, A. Rizza, G. Merisio, F. Topputo and R. Walker, “Vision-Based Navigation for the LUMIO CubeSat Mission”, 46th Annual AAS Guidance, Navigation and Control Conference, Breckenridge, Feb. 1-7, 2024.
4. F. Ornati, **P. Panicucci**, A. Andreis, and F. Topputo, “RETINA: a highly-versatile optical facility for camera-in-the-loop testing of spaceborne Vision-Based Sensors”, 46th Annual AAS Guidance, Navigation and Control Conference, Breckenridge, Feb. 1-7, 2024.

5. F. Piccolo, C. Buonagura, A. Rizza, A. Martinelli, S. Borgia, **P. Panicucci**, G. Merisio, C. Giordano, V. Franzese, F. Ferrari, and F. Topputo, "The LUMIO Lunar CubeSat: Mission Overview and Optical Navigation Experiment", 13th European CubeSat Symposium 2023, Leuven, Dec. 11-13 2023.
6. A. Rizza, F. Piccolo, **P. Panicucci**, S. Borgia, G. Saita, G. Merisio, F. Topputo, and L. Provinciali, "Design, Analysis and Validation of the ADCS for the LUMIO mission", 74th International Astronautical Congress, Baku, Oct. 2-6 2023.
7. D. Giudici, F. Gerace, P. Guccione, M. Stasi, P. Falcone, A. M. Guarnieri, S. Tebaldini, F. Topputo, and **Paolo Panicucci**, "Multiple AperTure swaRm for enhanced SAR Imaging (in X-band)", 6th ESA Cubesat Industry Days, Leiden, Sep. 12-14 2023.
8. **P. Panicucci**, E. Andreis, F. Ornati, and F. Topputo, "Towards Validation and Verification of Autonomous Vision-Based Navigation for Interplanetary Spacecraft", 12th International Conference on Guidance, Navigation & Control Systems, Sopot, Jun. 12-16 2023.
9. **P. Panicucci**, F. Piccolo, S. Borgia, A. Rizza, V. Franzese, and F. Topputo, "Current Status of the LUMIO Autonomous Optical Navigation Experiment", 12th International Conference on Guidance, Navigation & Control Systems, Sopot, Jun. 12-16 2023.
10. F. Ferrari, G. Merisio, M. Pugliatti, **P. Panicucci**, C. Giordano, S. Soldini, S. Raducan, M. Jutzi, J.-Y. Li, E. Fahnestock, and DART & LiciaCube Teams, "Long-range ejecta features from dynamic simulations and synthetic imaging", DART Investigation Team Meeting, Laurel, May 16-18 2023.
11. F. Topputo, F. Ferrari, G. Merisio, S. Borgia, C. Buonagura, F. Piccolo, A. Rizza, C. Giordano, **P. Panicucci**, A. Morselli, A. Cervone, V. Franzese, A. G. Pancalli, G. Pilato, D. Labate, E. Ammannito, E. Lhome, D. Koschny, R. Moissl, R. Walker and the LUMIO Team, "Current status of the LUMIO CubeSat mission", 4th Europlanet Workshop on Fireballs/Lunar Impact Flashes, Virtual, May 12-13 2023.
12. A. Morselli, G. Di Domenico, E. Andreis, A. C. Morelli, A. Mannocchi, G. Merisio, C. Giordano, **P. Panicucci**, V. Franzese, and F. Topputo, "Current Status of the EXTREMA Simulation Hub: First Steps Toward Deep-Space Missions with Autonomous CubeSats", 5th COSPAR Symposium, Singapore, Apr. 16-21 2023.
13. G. Merisio, F. Ferrari, S. Borgia, C. Buonagura, F. Piccolo, A. Rizza, C. Giordano, **P. Panicucci**, A. Morselli, A. Cervone, V. Franzese, F. Topputo, A. G. Pancalli, G. Pilato, D. Labate, E. Ammannito, E. Lhome, D. Koschny, R. Moissl, R. Walker and the LUMIO Team, "Phase B Design of LUMIO Lunar CubeSat: Report from Science and Payload Working Groups", 5th COSPAR Symposium, Singapore, Apr. 16-21 2023.
14. F. Topputo, F. Ferrari, G. Merisio, V. Franzese, C. Buonagura, C. Giordano, A. Morselli, **P. Panicucci**, F. Piccolo, A. Rizza, S. Borgia, A. Cervone, D. Koschny, E. Ammannito, R. Moissl, D. Labate, M. Pancalli, G. Pilato, E. Lhome, R. Walker and the LUMIO Team, "LUMIO: a CubeSat to Detect Meteoroid Impact on the Lunar Farside", 8th IAA Planetary Defense Conference, Wien, Apr. 3-7 2023.
15. F. Ferrari, F. Topputo, G. Merisio, V. Franzese, C. Buonagura, C. Giordano, A. Morselli, **P. Panicucci**, F. Piccolo, A. Rizza, S. Borgia, A. Cervone, D. Koschny, E. Ammannito, R. Moissl, D. Labate, M. Pancalli, G. Pilato, E. Lhome, R. Walker and the LUMIO Team, "The LUMIO CubeSat: Detecting Meteoroid Impacts on the Lunar Farside", 54th Lunar and Planetary Science Conference, The Woodlands, Mar. 13-17, 2023.
16. **P. Panicucci**, A. Andreis, V. Franzese, F. Topputo, "An Overview of the EXTREMA Deep-Space Optical Navigation Experiment", 3rd Space Imaging Workshop, Atlanta, Oct. 10-12, 2022.
17. E. Andreis, **P. Panicucci**, V. Franzese, F. Topputo, "A Vision-Based Navigation Algorithm for Autonomous Deep-Space Cruise", 3rd Space Imaging Workshop, Atlanta, Oct. 10-12, 2022.
18. F. Piccolo, **P. Panicucci**, F. Topputo, "Simultaneous Localization, Mapping and Characterization around a Small Body using a Monocular Camera", 3rd Space Imaging Workshop, Atlanta, Oct. 10-12, 2022.
19. A. Mitchell, **P. Panicucci**, V. Franzese, F. Topputo, R. Linares, "Improved Detection of a Near-Earth Asteroid from an Interplanetary CubeSat Mission", 3rd Space Imaging Workshop, Atlanta, Oct. 10-12, 2022.
20. A. Rizza, F. Piccolo, M. Pugliatti, **P. Panicucci**, F. Topputo, "Hardware-in-the-loop validation for Milani CubeSat vision-based GNC", 73rd International Astronautical Congress, Paris, Sep. 18-22, 2022.
21. A. Morselli, G. Di Domenico, E. Andreis, A. C. Morelli, G. Merisio, V. Franzese, C. Giordano, **P. Panicucci**, F. Ferrari, F. Topputo, "The EXTREMA Orbital Simulation Hub: A facility for GNC testing of autonomous interplanetary CubeSats", 4S Symposium, Vilamoura, May 16-20, 2022.
22. **P. Panicucci**, M. Pugliatti, V. Franzese, F. Topputo, "Improvements and Applications of the DART Vision-Based Navigation Test-Bench TinyV3RSE", 44th Annual AAS Guidance, Navigation and Control Conference, Breckenridge, Feb. 3-9, 2022.
23. E. Andreis, **P. Panicucci**, V. Franzese, F. Topputo, "A Robust Image Processing Pipeline for Planets Line-of-Sight Extraction for Deep-Space Autonomous CubeSats Navigation", 44th Annual AAS Guidance, Navigation and Control Conference, Breckenridge, Feb. 3-9, 2022.
24. F. Piccolo, M. Pugliatti, **P. Panicucci**, F. Topputo, "Toward Verification and Validation of the Milani Image Processing Pipeline in the Hardware-In-the-Loop testbench TinyV3RSE", 44th Annual AAS Guidance, Navigation and Control Conference, Breckenridge, Feb. 3-9, 2022.
25. M. Pugliatti, **P. Panicucci**, V. Franzese, F. Topputo, "TinyV3RSE: The DART Vision-Based Navigation Test-bench", AIAA Scitech Forum, San Diego, Jan. 3-7, 2022.
26. G. Di Domenico, E. Andreis, A. C. Morelli, G. Merisio, V. Franzese, C. Giordano, A. Morselli, **P. Panicucci**, F. Ferrari, F. Topputo, "Toward Self-Driving Interplanetary CubeSats: The ERC-funded project EXTREMA", International Astronautical Congress, Dubai, Oct. 25-29, 2021.
27. S. A. Bella, E. Andreis, V. Franzese, **P. Panicucci**, F. Topputo, "Line-Of-Sight Extraction Algorithm for Deep-Space Autonomous Navigation", 2021 AAS/AIAA Astrodynamics Specialist Conference, Big Sky, Virtual, Aug. 9-11, 2021.
28. **P. Panicucci**, R. Brochard, J. Lebreton, R. Lefez, E. Zenou, M. Delpech, "Localization and Mapping Merging Silhouettes Information and Feature Tracking for Small Body Applications", 11th International ESA Conference on Guidance, Navigation & Control Systems, Virtual, Jun. 20-25, 2021.
29. **P. Panicucci**, R. Brochard, J. Lebreton, E. Zenou, M. Delpech, "Vision-Based Navigation and Shape Reconstruction for Asteroid Exploration During Approach", Asteroid Exploration And Exploitation - Stardust-R Global Virtual Workshop I, Sep. 7-10, 2020.

30. **P. Panicucci**, J. McMahon, E. Zenou, M. Delpéch, J. Lebreton, K. Kanani, "Polyhedral Shape From Silhouettes for Small Body Characterization", 43rd Annual AAS Guidance, Navigation and Control Conference, Breckenridge, Jan. 30 - Feb. 5, 2020.
31. **P. Panicucci**, E. Castillo Specia, Y. Cho, V. Da-Poian, A. N. Deutsch, G. González Peytaví, A. Guariello, O. Gunasekara, L. Jones, M. Krasteva, T. Mathanlal, J. Pouplin, L. Tenalanda-Osorio, C. Venigalla, N. Villanueva, S. Zaref, "Assessing the Habitability of an Active Ocean World: the Etna Mission Concept to Enceladus' Tiger Stripes", Planetary Exploration - Horizon 2061, Toulouse, Sep. 11-13, 2019.
32. G. Acciarini, H. Bates, N. Berge, M. Caballero, P. Cambianica, M. Dziewiecki, Z. Dionnet, F. Enengl, O. Gassot, S. B. Gerig, F. Hessinger, N. Huber, R. Hynek, B. Kędziora, L. Kissick, A. Kiss, M. Martin, J. Navarro Montilla, M. Novak, **P. Panicucci**, C. Pellegrino, A. Pontoni, T. Ribeiro, C. Riegler, "The Calathus Mission Concept to Occator Crater at Ceres: Science, Operations and Systems Design", Planetary Exploration - Horizon 2061, Toulouse, Sep. 11-13, 2019.
33. **P. Panicucci**, J. McMahon, E. Zenou, M. Delpéch, "Variational Lambert Problem with Uncertain Dynamics", 2019 AAS/AIAA Astrodynamics Specialist Conference, Portland, Aug. 11-15, 2019.
34. **P. Panicucci**, V. Morand and D. Hautesserres, "Perturbed Lambert's Problem Solver based on Differential Algebra Optimization", International Astronautical Congress, Bremen, Oct. 1-5, 2018.
35. **P. Panicucci**, C. Allard and H. Schaub, "Spacecraft Dynamics Employing a General Multi-tank and Multi-thruster Mass Depletion Formulation", AAS Guidance, Navigation and Control Conference, Breckenridge, Feb. 2-8, 2017.
36. F. Piergentili, L. Arena, T. Cardona, G. Sciré, F. Angeletti, F. Curianó, G. De Zanet, M. Gaeta, V. Lamarca, **P. Panicucci**, A. Pellegrino, V. Vilona, B. Betti, M. Arras, M. Piccion, G. Coppotelli, M. Balucani, F. Nasuti and F. Santoni. "Design, Manufacturing and Test Of the Cubesat UrsaMaior", International Astronautical Congress, Jerusalem, Oct. 12-16, 2015.

## Posters

1. E. Andreis, A. C. Morelli, **P. Panicucci**, A. Morselli, and F. Topputo, "Integration of Onboard Autonomous Guidance and Navigation Algorithms for Interplanetary Transfer", 12th International Conference on Guidance, Navigation & Control Systems, Sopot, Jun. 12-16 2023.
2. F. Ferrari, C. Giordano, G. Merisio, **P. Panicucci**, M. Pugliatti, F. Topputo, S. Soldini, S. D. Raducan, M. Jutzi, E. G. Fahnestock, J.-Y. Li, A. F. Cheng, J. D. Prasanna Deshapriya, T. L. Farnham, P. H. Hasselmann, M. Hirabayashi, S. Ivanovski, R. Nakano, A. Rossi, D. J. Scheeres, A. Campo Bagatin, B. W. Barbee, E. Dotto, L. Kolokolova, J. Lyzhoft, P. Michel, F. Moreno, D. C. Richardson, S. R. Schwartz, G. Tancredi, C. A. Thomas, A. Zinzi, A. S. Rivkin, N. L. Chabot and the DART Investigation Team, "Dynamical Interpretation of Observed Ejecta Features Following NASA'S DART Impact on Dimorphos", 8th IAA Planetary Defense Conference, Wien, Apr. 3-7 2023.
3. F. Ferrari, F. Topputo, G. Merisio, V. Franzese, C. Buonagura, C. Giordano, A. Morselli, **P. Panicucci**, F. Piccolo, A. Rizza, S. Borgia, A. Cervone, D. Koschny, E. Ammannito, R. Moissl, D. Labate, M. Pancalli, G. Pilato, E. Lhome, R. Walker, and the LUMIO Team, "The LUMIO CubeSat: Detecting Meteoroid Impacts on the Lunar Farside", XVIII Congresso Nazionale di Scienze Planetarie, Perugia, Feb. 6-10, 2023.
4. J. Lebreton, R. Brochard, K. Kanani, M. Baudry, A. Berjaoui, A. Masson, **P. Panicucci**, C. Robin, "Image simulation for space applications with the SurRender software", 11th International ESA Conference on Guidance, Navigation & Control Systems, Sopot, Jun. 20-25, 2021.
5. L. Kissick, G. Acciarini, H. Bates, N. Berge, M. Caballero, P. Cambianica, M. Dziewiecki, Z. Dionnet, F. Enengl, O. Gassot, S. B. Gerig, F. Hessinger, N. Huber, R. Hynek, B. Kędziora, A. Kiss, M. Martin, J. Navarro Montilla, M. Novak, **P. Panicucci**, C. Pellegrino, A. Pontoni, T. Ribeiro, C. Riegler, "Sample Return from a Relic Ocean World: The Calathus Mission to Occator Crater, Ceres", 51st Lunar and Planetary Science Conference, The Woodlands, Mar. 16-20, 2020.
6. C. Venigalla, A. N. Deutsch, **P. Panicucci**, G. González Peytaví, J. Pouplin, L. Tenalanda-Osorio, A. Guariello, E. Castillo Specia, Y. Cho, V. Da-Poian, O. Gunasekara, L. Jones, M. Krasteva, T. Mathanlal, N. Villanueva, S. Zaref, "Assessing the Habitability of an Active Ocean World: the Etna Mission Concept to Enceladus' Tiger Stripes", 51st Lunar and Planetary Science Conference, The Woodlands, Mar. 16-20, 2020.
7. G. Acciarini, H. Bates, N. Berge, M. Caballero, P. Cambianica, M. Dziewiecki, Z. Dionnet, F. Enengl, O. Gassot, S. B. Gerig, F. Hessinger, N. Huber, R. Hynek, B. Kędziora, L. Kissick, A. Kiss, M. Martin, J. Navarro Montilla, M. Novak, **P. Panicucci**, C. Pellegrino, A. Pontoni, T. Ribeiro, C. Riegler, "Sample Return from a Relic Ocean World: The Calathus Mission to Occator Crater, Ceres", International Planetary Probe Workshop, Oxford, Jul. 8-12, 2019.
8. **P. Panicucci**, E. Zenou, M. Delpéch, J. Lebreton, K. Kanani, "Current and future researches at ISAE-SUPAERO in autonomous operations orbiting an unknown asteroid through imagery", International Planetary Probe Workshop, Boulder, Jun. 8-15, 2018.

## Invited Seminars and Events

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|--------------|---|---------------------------------------|
| 07 Sep. 2023 | <b>Design and Validation of Autonomous VBN Algorithms for Interplanetary Missions,</b>  | <i>ISAE-SUPAERO, Toulouse, France</i> |
|              | Talk about CubeSats vision-based navigation algorithms and their validation to research staff and PhD students.   |                                       |
| 14 Apr. 2023 | <b>Pegasus Round Table,</b>   | <i>La Sapienza, Rome, Italy</i>       |
|              | Participation to a round table during the 50th Pegasus Council e the 19th Pegasus Student Conference, discussing about novel methodology and future trends for space engineering teaching and research. The round table was composed of 2 senior researchers and 2 representative of leading aerospace industry, beside P. Panicucci. |                                       |
| 02 Feb. 2023 | <b>Autonomous Vision-Based Navigation for Deep-Space CubeSats: Algorithms and Validation,</b>   | <i>Virtual</i>                        |
|              | Talk about CubeSats vision-based navigation algorithms and their validation given during the V&V Seminar Series organized by the European Space Agency.   |                                       |
| 30 Jun. 2021 | <b>Simultaneous Localization And Mapping for Asteroid Approach,</b>   | <i>Virtual</i>                        |
|              | Talk given during the CU Boulder Researchpalooza for the Asteroid Day 2021 to research staff and students to presented novel research related to asteroid exploration.  |                                       |
| 20 Aug. 2019 | <b>Asteroid Gravity Field Uncertainties and Spacecraft Vision-based Navigation,</b>   | <i>CU Boulder, Boulder, USA</i>       |
|              | The seminar was given to research staff and students about asteroid gravity field uncertainties and vision-based navigation.  |                                       |