Arunkumar Rathinam

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Research Interests

Computer Vision for Space Robotics, 6DoF Pose Estimation, Unsupervised Domain Adaptation, Space Situational Awareness (SSA), On-board AI/Edge Computing, Small Body Exploration, and Autonomous Relative Navigation.

Education

Ph.D. in Space Robotics — Oct. 2015 – May. 2019
UNSW Sydney — *Sydney, Australia*
- **Thesis:** Small Body Gravimetry using SLAM-based Autonomous Navigation.

M.Sc. in Space Science and Technology — Oct. 2012 – May. 2015
University of Würzburg — *Würzburg, Germany*
- **Thesis:** Design and development of UWE-4 CubeSat: Integration of electric propulsion, structural analysis, and orbital heating analysis.

B.E. in Mechanical Engineering — Aug. 2003 – May. 2007
Anna University — *Chennai, India*
- First Class with Distinction.

Experience

Research Experience

Research Scientist — Sep. 2024 – Present
SnT, University of Luxembourg — *Luxembourg*

Research Associate — Sep. 2021 – Aug. 2024
SnT, University of Luxembourg — *Luxembourg*

Research Associate — May 2019 – Sep. 2021
Surrey Space Center, University of Surrey — *United Kingdom*

Industry Experience

Product Engineer — Jan. 2011 – Sep. 2012
SKF Technologies Limited — *India*

Design Engineer — Dec. 2007 – Jan. 2011
TATA Consultancy Services (TCS) — *India*

Research and Project Experience

Project Roles at SnT

DIOSSA Project [ESA GSTP] Phase-1 (24M) & Phase-2 (18M) — 2022 – Present
Program Lead
- **Leading a team of Researchers** in developing **Deep Learning (DL)** solutions for spacecraft pose estimation.
- Managing full project lifecycle, including **Work Package execution**, monitoring, and progress reporting.
- Successfully delivered all **Phase 1 milestones** and defined the scientific roadmap for Phase 2.
- **Outcomes:** 3 successful **ESA reviews** and 5 conference publications.

Partnership Project with LMO — 2023 – Present
Technical Lead
- Guiding research strategy on **Unsupervised Domain Adaptation (UDA)** for spacecraft pose estimation, aligning academic research with industrial partner requirements.
- **Co-supervising PhD research** focused on UDA on 6D pose estimation.

SSA Lab [MECO] — 2024 - Present
Coordinator
- Driving SSA initiatives and defining the **strategic positioning** of the laboratory with research needs.
- Defining **equipment requirements** and coordinating procurement across different research groups.

MEET-A [FNR-Bridges], ENERGETIC [EU HORIZON] — 2022 – 2025
Researcher
- Provided simulation expertise across multiple research use cases, battery thermal simulation [Energetic], Spacecraft data simulation [MEET-A].

Previous Projects at Surrey

FAIR-SPACE 2019 – 2021
Researcher *University of Surrey, UK*

- Research: Developed DL algorithms for 6DoF spacecraft pose estimation in non-cooperative target scenarios.
- EdgeAI: DL algorithms were evaluated on edge hardware with Hardware-in-the-loop experiments.
- Tech Transfer: Developed ORVIS, an orbital simulation tool to generate training data for relative navigation.
- Output: 2 Journal publications; 1 Book chapter; 2 Conference publications; Supported 1 Start-Up initiative

Space Missions Experience

SnT-AI4SPACE Mission (Deployed) 2022 – 2023
CV and ML Lead *University of Luxembourg, Luxembourg*

- Developed and deployed an onboard AI anomaly detection system, validated on flight hardware.

AUDACITY Mission (Deployed) 2023
Simulation Lead *University of Luxembourg, Luxembourg*

- Designed and deployed an onboard AI algorithm for SSA spacecraft detection SSA in collaboration with LMO.

UWE-4 CubeSat Mission (Deployed) 2015
Student Researcher (Master's Thesis) *University of Würzburg, Germany*

- Developed mechanical design of CubeSat for electric propulsion integration, verified via structural and orbital thermal analysis.

Laboratory Experience

Zero-G Lab 2022 - Present
Operations Lead (for CVI^2) *University of Luxembourg, Luxembourg*

- Manage end-to-end data-collection campaigns, including req. gathering, test-plan development and execution.
- Coordinate project collaborations with other research groups to streamline workflows and align objectives.
- Coordinate research strategy with equipment and procurement needs, ensuring timely acquisition of resources.
- Outcomes: 3 major 6D Pose datasets, 4 partner data-acquisition campaigns, and 2 journal articles.

Computer Vision Lab 2022 - Present
Coordinator *University of Luxembourg, Luxembourg*

- Overseeing lab setup, project demos, and equipment procurement.
- Setting up and maintaining CVI^2 GPU Servers within the research group

Orbital Robotics Testbed @ STARLAB Jan. 2020 - May. 2021
Researcher and Coordinator *University of Surrey, UK*

- Coordinated the testbed development for the experimental validation of relative navigation algorithms. link

Floatsat Testbed Jan. 2020 - May. 2021
Research Assistant *University of Würzburg, Germany*

- Designed and implemented a testbed on spherical air bearings for experimental validation of CubeSat ADCS.

Proposals, Research Guidance & Teaching

Grant Proposals & Funding

- **Co-Author:** FNR Bridges U-ADAPT (2025) – **[Funded]**
- **Co-Author:** ESA Proposal DIOSSA Phase-2 (2024) – **[Funded]**
- **Lead Author:** FNR-Junior CORE Sentient-3D (2022) – [Not Funded]
- **Contributor:** FNR CORE DA-GAP (2023); EDF REAL-AI (2022)

Research Guidance & Supervision

- **PhD Co-Supervision:** Nidhal E. Chenni (2024–Present)
  Topic: Domain Adaptation for 6DoF Pose Estimation. Output: 2x Conf. (A) Under Review.*
- **PhD Co-Supervision:** Ala Souissi (2025–Present)
  Topic: Leveraging Event Sensing for 6DoF Pose Estimation and Tracking.
- **Master Thesis:** Haytam Qadadri (2023)
  Topic: Spacecraft Pose Estimation using Neuromorphic Sensors. Output: 1x Conf. (A) Publication.*

Teaching Experience

Computer Vision and Image Analysis (CVIA) 2022 – Present
Course Project & Lab Coordinator *Uni. of Luxembourg*

- Coordinating course projects for MICS & MSTB Master's programs and MSTB lab sessions.

ELEC3106: Engineering Course 2018 – 2019
Teaching Assistant *UNSW Sydney, Australia*

- Facilitated laboratory sessions and exam evaluations for undergraduate engineering students.

Professional Activities

Scientific Event Organization & Service

- **Co-Organizer:** AI4SPACE Workshop @ **CVPR** (2026, 2024), **ECCV** (2022).
- **Lead Organizer:** SPARK Challenge @ **CVPR** (2026, 2024), **ECCV** (2022).
- **Session Chair:** EUVIP 2026.
- **External Advisor:** Neuromorphic Hackathon (2024) @ FORTISS Munich.
- **Program Committee:** IGNSS Conference (2016, 2017).

Peer Review Activities

- **Conferences:** NeurIPS ('25), CVPR ('26, '24), ECCV ('24, '22), ICRA ('26, '25), WACV('25), IROS ('23), AI4SPACE Workshop('26, '24, '22), NEVI workshop ('24).
- **Journals:** Int. Journal of Robotics Research (**IJRR**), IEEE Robotics and Automation Letters (**RA-L**), IEEE Signal Processing Letters (**SPL**), IEEE Trans. on Aerospace and Electronic Systems, Advances in Space Research (**ASR**).

Speaker @ Invited Talks

- **Oct 2023:** ESA CleanSpace Industry Days, ESTEC, Netherlands.
  "DL-based spacecraft pose estimation: Opportunities and challenges for future in-orbit servicing missions."
- **Sep 2020:** Fairspace Workshop, Liverpool, UK.
  "On-orbit relative pose estimation of a non-cooperative target using convolutional neural networks."
- **Oct 2018:** 17th Space Generation Congress, Bremen, Germany.
  "Reusable CubeSat constellation for asteroid rover navigation and communication."
- **Sep 2017:** 3rd Off Earth Mining Forum, UNSW Sydney, Australia.
  "Autonomous spacecraft navigation near an asteroid."

Technical Skills

- **Deep Learning:** PyTorch, PyTorch Lightning, TensorFlow, Hydra, OpenCV, NumPy.
- **Robotics & Simulation:** ROS, PANGU (ESA), Unreal Engine 4, Blender.
- **Programming:** Python, C++, MATLAB, Julia.
- **Embedded AI:** NVIDIA Jetson (Nano / Xavier NX), Arduino, Edge Inference Optimization.
- **Mechanical Engineering: CAD:** Creo, CATIA V5, SolidWorks, Inventor; **FEM/FEA:** NASTRAN, COMSOL.
- **DevOps & Tools:** Git, Docker, Windchill PDM, Nginx, Gunicorn.

Honors & Awards

- **Winner, Move an Asteroid Technical Paper Competition (2018)**
  Space Generation Advisory Council (SGAC), Bremen.
- **IAC Travel Grant / Sponsorship (2017)**
  Awarded by the National Space Society of Australia to attend the International Astronautical Congress.
- **UNSW Departmental PhD Scholarship (2015)**
  Full tuition coverage plus living stipend for duration of candidature.
- **Erasmus Mobility Grant (2013)**
  Competitive grant for Master's exchange year.
- **Top Achiever Award — SKF (2012)**
  Ranked 1st in performance assessment during tenure at SKF India.

Research Publications

- Full list available in the **Google Scholar** → `link`
- Conference Ranking based on **International CORE Conference Rankings** → `link`
- Journal Ranking based on **Scimago Journal Rankings** → `link`

Journal Articles

1. A. Shabayek, **A. Rathinam**, M. Ruthven, D. Aouada, and T. Amietszajew, "AI-enabled thermal monitoring of commercial (PHEV) Li-ion pouch cells with Feature-Adapted Unsupervised Anomaly Detection," *Journal of Power Sources*, vol. 629, p. 235 982, 2025, **Rank** → $Q1$.
2. **A. Rathinam**, L. Pauly, A. E. R. Shabayek, V. Gaudilliere, and D. Aouada, "Hybrid Attention for Robust RGB-T Pedestrian Detection in Real-World Conditions," *IEEE Robotics and Automation Letters (RA-L)*, 2024, **Rank** → $Q1$.
3. J. Thoemel et al., "Lean demonstration of on-board thermal anomaly detection using machine learning," *Aerospace*, vol. 11, no. 7, 2024, **Rank** → $Q2$.
4. M. Olivares-Mendez et al., "Zero-g lab: A multi-purpose facility for emulating space operations," *Journal of Space Safety Engineering*, vol. 10, no. 4, 2023, **Rank** → $Q3$.
5. L. Pauly, W. Rharbaoui, C. Shneider, **A. Rathinam**, V. Gaudillière, and D. Aouada, "A survey on deep learning-based monocular spacecraft pose estimation: Current state, limitations and prospects," *Acta Astronautica*, 2023, **Rank** → $Q1$.
6. L. Pauly et al., "Lessons from a space lab: An image acquisition perspective," *International Journal of Aerospace Engineering*, 2022, **Rank** → $Q3$.
7. R. Ashith Shyam et al., "Autonomous robots for space: Trajectory learning and adaptation using imitation," *Frontiers in Robotics and AI*, vol. 8, 2021, **Rank** → $Q2$.
8. Z. Hao, R. A. Shyam, **A. Rathinam**, and Y. Gao, "Intelligent spacecraft visual GNC architecture with the state-of-the-art ai components for on-orbit manipulation," *Frontiers in Robotics and AI*, vol. 8, 2021, **Rank** → $Q2$.
9. **A. Rathinam** and A. G. Dempster, "Octree-based mascon model for small body gravity fields," *Journal of Guidance, Control, and Dynamics*, vol. 42, no. 11, pp. 2557–2567, 2019, **Rank** → $Q1$.

Conference Proceedings

1. **A. Rathinam**, H. Qadadri, and D. Aouada, "SPADES: A Realistic Spacecraft Pose Estimation Dataset using Event Sensing," in *ICRA*, 2024, **Rank** → A*.
2. I. P. Singh, E. Ghorbel, A. Kacem, **A. Rathinam**, and D. Aouada, "Discriminator-free unsupervised domain adaptation for multi-label image classification," in *WACV*, 2024, **Rank** → A.
3. V. Gaudillière, L. Pauly, **A. Rathinam**, A. G. Sanchez, M. A. Musallam, and D. Aouada, "3D-aware object localization using gaussian implicit occupancy function," in *IROS*, 2023, **Rank** → A.
4. M. A. Mohamed Ali, **A. Rathinam**, V. Gaudilliere, M. Ortiz Del Castillo, and D. Aouada, "CubeSat-CDT: A Cross-Domain Dataset for 6-DoF Trajectory Estimation of a Symmetric Spacecraft," in *ECCV Workshops*, 2022.
5. **A. Rathinam**, V. Gaudilliere, L. Pauly, and D. Aouada, "Pose estimation of a known texture-less space target using convolutional neural networks," in *73rd International Astronautical Congress (IAC)*, 2022.
6. **A. Rathinam** and Y. Gao, "On-orbit relative navigation near a known target using monocular vision and convolutional neural networks for pose estimation," in *International Symposium on Artificial Intelligence, Robotics and Automation in Space (iSAIRAS)*, 2020.
7. **A. Rathinam** and A. G. Dempster, "Vision based state estimation using a Graph-SLAM approach for proximity operations near an asteroid," in *69th International Astronautical Congress (IAC)*, 2018.

8. **A. Rathinam** and A. G. Dempster, "3D reconstruction of an asteroid shape using visual SLAM for autonomous navigation," in *17th Australian Space Research Conference (ASRC)*, 2017.
9. **A. Rathinam** and A. G. Dempster, "Monocular vision based simultaneous localization and mapping for close proximity navigation near an asteroid," in *68th International Astronautical Congress, Adelaide, Australia*, 2017.
10. **A. Rathinam** and A. G. Dempster, "Effective utilization of space service volume through combined gnss," in *ION GNSS+*, 2016.
11. **A. Rathinam** and A. G. Dempster, "Geometrical assessment of multi-gnss prospects for space service volume," in *16th Australian Space Research Conference (ASRC)*, 2016, pp. 199–206.
12. **A. Rathinam** and A. G. Dempster, "Multi-gnss for space service volume," in *International Global Navigation Satellite Systems (IGNSS) 2016*, 2016.
13. **A. Rathinam**, P. Bangert, D. Bock, M. Pietzka, M. Tajmar, and K. Schilling, "Structural Design, Integration of Micro Propulsion units and Thermal Analysis of UWE (University of Wurzburg's Experimental Satellites) Platform," in *6th European Conference for Aero-Space Sciences (EUCASS)*, 2015.

Books and Chapters

1. **A. Rathinam**, Z. Hao, and Y. Gao, "Autonomous visual navigation for spacecraft on-orbit operations," in *Space Robotics and Autonomous Systems: Technologies, Advances and Applications*, IET, 2021, p. 125.

Datasets

1. **A. Rathinam**, M. A. Mohamed Ali, V. Gaudilliere, and D. Aouada, *SPARK 2024: Datasets for Spacecraft Semantic Segmentation and Spacecraft Trajectory Estimation*, 2024.
2. **A. Rathinam**, V. Gaudilliere, M. A. Mohamed Ali, M. Ortiz Del Castillo, L. Pauly, and D. Aouada, *SPARK 2022 Dataset : Spacecraft Detection and Trajectory Estimation*, 2022.
3. **A. Rathinam**, V. Gaudilliere, L. Pauly, and D. Aouada, *AKM Dataset: Textureless Space Target Dataset*, 2022.