

# ATHIP THIRUPATHI RAJ

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## EDUCATION

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### University of Arizona

Tucson, AZ

Ph.D., Aerospace and Mechanical Engineering

December 2026

Minor: Electrical and Computer Engineering

Dissertation: *Modular Architectures in Space: In-Space Assembled Multi-Purpose Platform for ISAM Operations*

Advisor: Dr. Jekan Thangavelautham

GPA: 3.818/4.0

### University of Michigan Ann Arbor

Ann Arbor, MI

M.Eng., Space Engineering

December 2017

Advisor: Dr. Nilton Renno

GPA: 3.669/4.0

### National Institute of Technology Trichy

Tiruchirappalli, India

B.Tech., Mechanical Engineering

May 2016

GPA: 7.8/10

## RESEARCH AND PROFESSIONAL EXPERIENCE

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### University of Arizona

Tucson, AZ

*Graduate Research Assistant, Aerospace and Mechanical Engineering*

February 2021 – Present

1. Led the design of AOSAT, a CubeSat centrifuge for studying asteroid behavior in microgravity. Managed a team of 10 students and co-authored NASA proposals, reaching the final selection round twice (2021, 2022).
2. Headed the Small Satellite docking team, developing autonomous docking systems with 10 times more initial rotational misalignment tolerance than competing designs. Managed 25 undergraduate researchers over 3 years.
3. Designed space construction architectures using autonomous small sat docking for In-Space Assembly and Manufacturing (ISAM).
4. Designed and constructed the Spacecraft Workings and On-orbit Robotics using Drones (SWORD) Facility, a 20' x 15' x 8' calibrated Low Earth Orbit and Deep Space Lighting Environment Simulator for testing satellite operations.
5. Created standards for satellite external lighting and developed machine learning-based attitude estimation algorithms.

6. Invented a deployable SCT telescope design for CubeSats, reducing stowed volume by 66% compared to deployed state.
7. **Secured 7 provisional patents, authored 44 papers, and delivered 16 conference presentations on the above-mentioned projects.**

### **Agnikul Cosmos Private Limited**

Chennai, India

*Space Systems Engineer*

October 2018 – August 2019

1. Led design, development, and testing of India's first Additively Manufactured Semi-Cryogenic Liquid Rocket Engine.
2. Performed 3D Modeling and developed verification methods for DMLS and MJP manufactured parts.
3. Developed a thrust stand test facility to test the developed engine.
4. Led systems engineering and documentation for SAR (Small AgniBaan Rocket) and AgniBaan projects.
5. Established frameworks for requirements management, version control, process flow, and documentation.

### **University of Michigan Ann Arbor**

Ann Arbor, MI

*Graduate Research Assistant, Space Engineering*

August 2016 – December 2017

1. Biology lead for the NASA X-Hab Challenge winning team (2016) designing urine-to-plant nutrient conversion system for deep space missions. Prototype reviewed at Kennedy Space Center (2017).
2. Designed Orbital ATK Cygnus vehicle modification for deep space plant growth habitat, including a semi-autonomous Bio-regenerative Life Support System (BLSS).
3. Systems Engineer for the NASA Exploration Habitat Challenge project developing reusable 3D-printed plant substrate for microgravity plant growth. Passed System Design Review at Kennedy Space Center (2017).
4. Served as Systems Engineer for a high-altitude weather balloon mission, capturing 2K resolution imagery and dust concentration profiles up to 30 km over Michigan (2017).

## **TEACHING EXPERIENCE**

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### **University of Arizona**

Tucson, AZ

*Teaching Assistant, Aerospace and Mechanical Engineering*

August 2024 – Present

1. Developed course material and lesson plans for Robotics for AME 352 – Dynamics of Machinery for 90 students. Presented material and proctored exams.
2. Teaching Assistant for graduate level AME 550 (Advanced Dynamics), AME 400 (Senior Mechanical Engineering Laboratory) AME 300 (Instrumentation Laboratory), AME 250 (Dynamics).

## **NASA MIRO Program**

Tucson, AZ

*MIRO Scholar and Mentor*

February 2021 – August 2024

1. Mentor at Space and Terrestrial Robotic Exploration lab, supporting underrepresented students in STEM.
2. Guided 40+ students from the University of Arizona, Pima Community College, and the University of Puerto Rico.
3. Provided research opportunities, industry-specific skills, and workforce preparation for the space sector.
4. Mentees successfully secured internships and positions at notable companies and institutions.
5. **Won NASA Space Tech Catalyst prize (\$25,000) recognizing my work in this mentorship program.**

## **University of Michigan Ann Arbor**

Ann Arbor, MI

*Teaching Assistant, Space Engineering*

May 2017 – August 2017

Teaching Assistant for CLIMATE 105 – Our Changing Atmosphere course for 100 students. Proctored exams and presented material to the students.

## **PROVISIONAL PATENTS AND INVENTION DISCLOSURES**

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1. PCT/US2024/017398 - Sequential control of electromagnets for CubeSat docking attitude alignment (September 6, 2024)
2. PCT/US2024/017433 - Utilization of swarms for sample return and multipoint observation using inflatables (November 14, 2024)
3. UA24-191 - Reconfigurable Space Telescope for Long Duration Observations (August 1, 2024)
4. UA24-189 - Small Spacecraft & Small Robot Lighting System for Navigation, Identification and Communications (August 1, 2024)
5. UA24-188 - Small Satellite Docking Adapter for Power Transfer and Structural Applications (August 1, 2024)
6. UA24-144 (US 20250313349 A1) - A Robotic Space Station System for a Modular Surveying Telescope (December 19, 2024)
7. UA25-018 - Scheduling Architectures for Distributed Observation Systems (December 9, 2024)

## **PUBLICATIONS**

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1. Thirupathi Raj, A., Bouskela, A., Thangavelautham, J. (2024) "Design and Development of a Robotic Space Station for Near Earth Asteroid Detection," AIAA ASCEND. <https://doi.org/10.2514/6.2024-4848>

2. Gross, N., Thirupathi Raj, A., Thangavelautham, J. (2024) "Power, Data, and Fuel Transfer with a Two-Stage CubeSat Docking Adapter," AIAA ASCEND. <https://doi.org/10.2514/6.2024-4875>
3. Thirupathi Raj, A., Thangavelautham, J. (2024) "A Comparative Analysis of Scheduling Algorithms for Distributed Observation Systems for Cislunar Traffic Management," AIAA ASCEND. <https://doi.org/10.2514/6.2024-4820>
4. Thirupathi Raj, A., Sturgeon, C., Bennett, M., Thangavelautham, J., "Exploration of Lighting Sequences of LEDs inside a controlled environment for accurate depiction of LEO Lighting conditions for GNC Applications," AAS Guidance, Navigation and Control Conference, 2024.
5. Cutler, R., Thirupathi Raj, A., Thangavelautham, J., "Vision Sensor Aided Autonomous Mobility and Navigation for a Flatworm-Inspired Robot in Planetary Extreme Environments," AAS Guidance, Navigation and Control Conference, 2024.
6. Thirupathi Raj, A., Rickel, J., Adhikari, R., Thangavelautham, J. "Machine Learning based Attitude Estimation Using Active Lighting Cues Applied to CubeSat Proximity Operations," AAS Guidance, Navigation and Control Conference, 2024.
7. Gross, N., Raj, A. T., & Thangavelautham, J. (2024). Thermal and structural analysis of autonomously In-Space and lunar assembled truss modules. Earth and Space 2021, 1006–1024. <https://doi.org/10.1061/9780784485736.089>
8. Thirupathi Raj, A., & Thangavelautham, J. (2024). A Case for Space Platforms: A Comparative Analysis of Spacecraft Architectures for Deep Space Observation. AIAA SCITECH 2024 FORUM. <https://doi.org/10.2514/6.2024-1149>
9. Muniyasamy, S., & Thangavelautham, J. (2024). Evaluating the Response of a Network of Autonomous Robots to Emergency Scenarios Inside a Lunar Base. AIAA SCITECH 2024. <https://doi.org/10.2514/6.2024-2543>
10. Thirupathi Raj, A., & Thangavelautham, J. (2023). Autonomous Logistics and Inventory Management in a Modular, Robotic and Extensible Space Station. AIAA ASCEND. <https://doi.org/10.2514/6.2023-4683>
11. Vilvanathan, V., Thirupathi Raj, A., Vance, L., Enikov, E. T., & Thangavelautham, J. (2023). Sequential Control of Electromagnets for CubeSat Docking Attitude Alignment. AIAA ASCEND. <https://doi.org/10.2514/6.2023-4667>
12. Zhang, A. L., Thirupathi Raj, A., & Thangavelautham, J. (2023). Generation of Functional Modular Space Station Configurations using Genetic Algorithms. AIAA ASCEND. <https://doi.org/10.2514/6.2023-4722>
13. Kang, M. S., Thirupathi Raj, & Thangavelautham, J., (2023). Power Analysis for Optimum Illumination Conditions Using Lunar Operations Tower for Surface Activity. AIAA ASCEND 2023. <https://doi.org/10.2514/6.2023-4685>

14. Gross, N., Thirupathi Raj, A., & Thangavelautham, J. (2023). Shape Memory Alloy Based Hard Docking Mechanisms for two-stage CubeSat Docking. AIAA ASCEND. <https://doi.org/10.2514/6.2023-4734>
15. Rickel, J., Thirupathi Raj, A., & Thangavelautham, J. (2023). Low Power LEDs for CubeSat Attitude estimation and VLC during proximity operations. AIAA ASCEND. <https://doi.org/10.2514/6.2023-4730>
16. Biella, M., Verma, V., Vance, L., Thirupathi Raj, A., Muniyasamy, S., & Thangavelautham, J. (2023). Advancing Utilization of Spacecraft Swarms for Sample Return, Multipoint Observation and Space Traffic Management Using Inflatables. AIAA ASCEND. <https://doi.org/10.2514/6.2023-4634>
17. Thirupathi Raj, A., Fuhrman, C., Vance, L., & Thangavelautham, J. (2023, February). Decentralized Coordination of a swarm of nanospacecraft for efficient sample return using Visible Light Communication (VLC). Advances in Astronautical Sciences, Breckenridge, United States.
18. Huie, R., Thirupathi Raj, A., & Thangavelautham, J. (2023, February). Towards standardizing Lighting Cues for small spacecraft communication and swarm control. Advances in Astronautical Sciences, Breckenridge, United States.
19. Zhang, A., Thirupathi Raj, A., & Thangavelautham, J. (2023, February). Coordination of Modular, Extensible spacecraft swarm through the use of Machine Learning. Advances in Astronautical Sciences, Breckenridge, United States.
20. Thirupathi Raj, A., Sturgeon, C., Wildridge, M., Baniszewski, A., Zhang, A., & Thangavelautham, J. (2023, February). Design and development of a Lighting and Environment Simulation facility for a small spacecraft. Advances in Astronautical Sciences, Breckenridge, United States.
21. Thirupathi Raj, A., Qiu, J., Biella, M., Matheson, I., & Thangavelautham, J. (2023, February). The Impact of GNC on Small Satellite Mission Concepts to Near Earth Asteroids. Advances in Astronautical Sciences, Breckenridge, United States.
22. Gitten, R., Greaves, B., Krawec, N., Raj, A. T., Szefi, D., Arteaga, A., ... & Moldwin, M. (2023). Wastewater to Plant Nutrient System.
23. Thirupathi Raj, A., & Thangavelautham, J. (2022). High-Speed Docking and Applications for Small Spacecraft. ASCEND 2022. <https://doi.org/10.2514/6.2022-4331>
24. Vilvanathan, V., Thirupathi Raj, A., & Thangavelautham, J. (2022). Using Small Satellites to Remove Non-Cooperative Space Debris. ASCEND 2022. <https://doi.org/10.2514/6.2022-4222>
25. Thirupathi Raj, A., & Thangavelautham, J. (2022, October). Visible Light Communication Algorithms for Small Spacecraft Formation Flying and Swarm Control. International Astronautical Congress 2022, Paris, France.

26. Qiu, J., Thirupathi Raj, A., Vance, L., & Thangavelautham, J. (2022, October). Asteroid Impactor Sample Return Mission Concept. International Astronautical Congress 2022, Paris, France.
27. Thirupathi Raj, A., Zhang, A., & Thangavelautham, J. (2022, October). Extensible, Transformative Spacecraft using CubeSats as Modular Building Blocks. International Astronautical Congress 2022, Paris, France.
28. Qiu, J., Thirupathi Raj, A., Vilvanathan, V., Xu, Y., & Thangavelautham, J. (2022, October). Establishing Distributed Control Networks in Smart Lunar Bases. International Astronautical Congress 2022, Paris, France.
29. Boyala, G., Gremm, A., Gungor, A., Taghipour, A., Biella, M., Qiu, J. J., ... & Richards, L. (2022). Project Khepri: Feasibility Study of Mining Asteroid Bennu.
30. Frost, E., Boyala, G., Gremm, A., Gungor, A., Taghipour, A., Biella, M., ... & Cue, M. (2022). Project Khepri: Mining Asteroid Bennu for Water.
31. Thirupathi Raj, A., Qiu, J., Vilvanathan, V., Asphaug, E., & Thangavelautham, J. (2022, April). Systems Engineering of Using Sandbags for Site Preparation and Shelter Design for a Modular Lunar Base. ASCE Earth and Space Conference, Denver, United States.
32. Thirupathi Raj, A., Qiu, J., Vilvanathan, V., Xu, Y., & Thangavelautham, J. (2022, April). Examination of Smart Sandbags for Semi-Permanent Structures on the Lunar Surface. ASCE Earth and Space Conference, Denver, United States.
33. Thirupathi Raj, A., Sturgeon, C., & Thangavelautham, J. (2022, February). Design and Experimentation of Geometric Mating Pairs for Small Spacecraft Docking. Advances in Astronautical Sciences, Breckenridge, United States.
34. Diaz-Flores, A., Nichols, B., Raj, T. A., & Thangavelautham, J. (2024). ON-ORBIT CRYO-CENTRIFUGE PROTOTYPE FOR ADVANCING THE LUNAR ARK CONCEPT. In Springer eBooks (pp. 1845–1857).  
[https://doi.org/10.1007/978-3-031-51928-4\\_105](https://doi.org/10.1007/978-3-031-51928-4_105)
35. Thirupathi Raj, A., Dinkel, A., & Thangavelautham, J. (2022, February). Laboratory Experimental Validation of Lighting Cues for On-Orbit Rendezvous and Docking for Small Spacecraft. Advances in Astronautical Sciences, Breckenridge, United States.
36. Thirupathi Raj, A., Vilvanathan, V., Biella, M., & Thangavelautham, J. (2022, February). Evaluation of Non-Contact Autonomous Docking for Small Satellites. Advances in Astronautical Sciences, Breckenridge, United States.
37. Thirupathi Raj, A., Nichols, B., Biella, M., & Thangavelautham, J. (2022, February). Modelling Gravitational Anomalies For Low Altitude Small Spacecraft Science Missions. Advances in Astronautical Sciences, Breckenridge, United States.
38. Smith, J., Thirupathi Raj, A., Cervantes, J., & Thangavelautham, J. (2022, February). Laboratory Evaluation of Docking Capabilities of Small Spacecraft

Using a Stewart Platform. *Advances in Astronautical Sciences*, Breckenridge, United States.

39. Diaz-Flores, A., Thirupathi Raj, A., & Thangavelautham, J. (2022, February). Rotisserie Mechanism and Digital Controller Design For Generating Artificial Gravity Onboard of Blue Origin Launcher. *Advances in Astronautical Sciences*, Breckenridge, United States.
40. Thirupathi Raj, A., Diaz-Flores, A., & Thangavelautham, J. (2022). Catalyst: An Orbit Platform for Accelerating the Advancement of the Cislunar Economy. *AIAA SCITECH 2022 Forum*. <https://doi.org/10.2514/6.2022-2516>
41. Vance, L., Thirupathi Raj, A., & Thangavelautham, J. (2022). An Exploration of Sample and Return from Rubble Pile Asteroids via Capture of Ejected Particles. *AIAA SCITECH 2022 Forum*.
42. Thirupathi Raj, A., & Thangavelautham, J. (2021, October). Active Lighting and Cues to Facilitate Cooperative On-Orbit Two-Stage Docking by Small Satellites. *International Astronautical Congress 2021, Dubai, UAE*.
43. Diaz-Flores, A., Pedersen, C., Raj, A. T., & Thangavelautham, J. (2021). First Steps towards the Lunar Ark Concept: Saving Life on Earth from a Future Catastrophe. In *Accelerating Space Commerce, Exploration, and New Discovery Conference (ASCEND)*, AIAA (2021-4240) (pp. 1-14).
44. Diaz-Flores, A., Pedersen, C., Thirupathi Raj, A., & Thangavelautham, J. (2021, September). Cryopreservation of Organisms in Space in Preparation for Interstellar Travel. *Interstellar Research Symposium 2021, Tucson, United States*.

## **PRESENTATIONS**

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1. Chauhan, K., Thirupathi Raj, A., Thangavelautham, J. (2024, May). Enabling Deep Space Exploration Using Inspectors Accompanying Small Spacecraft System of Systems Architecture. *Interplanetary Small Satellite Conference*.
2. Bouskela, A., Thirupathi Raj, A., Thangavelautham, J. (2024, May). Cislunar spacecraft assembly for near earth surveying. *Interplanetary Small Satellite Conference*.
3. Gross, N., Thirupathi Raj, A., Thangavelautham, J. (2024, May). Power and Data Transfer with a Two-Stage CubeSat Docking Adapter. *Interplanetary Small Satellite Conference*.
4. Cutler, R., Thirupathi Raj, A., Thangavelautham, J. (2024, May). Vision Sensor Aided Autonomous Mobility and Navigation for a Flatworm-Inspired Robot in Planetary Extreme Environments. *Interplanetary Small Satellite Conference*.
5. Kang, M., Thirupathi Raj, A., Thangavelautham, J. (2024, May). Localization and Pose Estimation of Planetary Surface Assets Using Active Lighting Cues. *Interplanetary Small Satellite Conference*.

6. Thirupathi Raj, A., Thangavelautham, J. (2023, November). Cislunar Space Domain Awareness Using a Robotic Space Station. NASA STEM Better Together Conference.
7. Thirupathi Raj, A., & Thangavelautham, J. (2023, May). CubeSat swarms in Cislunar space to identify, analyze, and characterize events of interest. Interplanetary Small Satellite Conference.
8. Gross, N. C., Thirupathi Raj, A., & Thangavelautham, J. (2023, May). Shape Memory Alloy Based Hard Docking Mechanisms for two-stage CubeSat Docking. Interplanetary Small Satellite Conference.
9. Rickel, J., Thirupathi Raj, A., & Thangavelautham, J. (2023, May). Low Power LEDs for CubeSat Attitude estimation during proximity operations. Interplanetary Small Satellite Conference.
10. Cutler, R., Thirupathi Raj, A., & Thangavelautham, J. (2023, May). Flatworm-Inspired Robot for Extraterrestrial Exploration. Interplanetary Small Satellite Conference.
11. Thangavelautham, J., Thirupathi Raj, A., Muniyasamy, S., Kang, M., (2023, May). Evaluation of Artificial Neural Tissues for Small Multirobot Networks in Handling Emergencies Onboard Next-Generation Space Stations. Interplanetary Small Satellite Conference.
12. Thirupathi Raj, A., Sturgeon, C., Wildridge, M., Baniszewski, A., & Thangavelautham, J. (2023, May). Simulation of LEO Lighting Conditions for Small Satellite testing. Interplanetary Small Satellite Conference.
13. Thirupathi Raj, A., & Thangavelautham, J. (2022, May). Extensible, Transformative Spacecraft Using CubeSats and Modular Building Blocks. Interplanetary Small Satellite Conference.
14. Thirupathi Raj, A., & Thangavelautham, J. (2022, May). High-Speed Docking between Small Spacecraft. Interplanetary Small Satellite Conference.
15. Thirupathi Raj, A., Rickel, J., & Thangavelautham, J. (2022, May). Visible Light Communication Between CubeSats During Close Proximity Operations. Interplanetary Small Satellite Conference.
16. Thirupathi Raj, A., Sturgeon, C., & Thangavelautham, J. (2021, May). Two Stage CubeSat Docking with Visual Cues. Interplanetary Small Satellite Conference.

## **INVITED LECTURES**

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1. Guest Lecture for the Women in STEM Conference at the University of Arizona, October 2023.
2. Guest Lecture for the NASA STEM Conference (Online), November 2022.
3. Guest Lecture for the Women in STEM Conference at the University of Arizona, October 2022.

## HONORS & AWARDS

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|---|------|
| NASA Space Tech Catalyst Award (\$25000)            | 2024 |
| Tech Briefs Create the Future Contest Top 100 Entry | 2024 |
| Tech Briefs Create the Future Contest Top 100 Entry | 2023 |
| Tech Briefs Create the Future Contest Top 100 Entry | 2022 |
| Outstanding Service Award, Student Worker (UMich)   | 2017 |
| Outstanding Student, NIT Trichy                     | 2016 |

## GRANTS & FELLOWSHIPS

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| Graduate International Student Award (\$55,000)                          | 2024 |
| Graduate and Professional Student Council (GPSC) Research Grant (\$1500) | 2023 |
| Graduate International Student Award (\$55,000)                          | 2023 |
| Graduate International Student Award (\$55,000)                          | 2022 |
| Graduate International Student Award (\$55,000)                          | 2021 |

## LEADERSHIP & OUTREACH

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|---|-----------------------------|
| NASA MIRO Scholar and Mentor                  | February 2021 – August 2024 |
| NASA X-Hab Outreach Lead                      | March 2017– May 2017        |
| Team Captain and Manager, NIT Trichy Swimming | August 2014 – May 2016      |
| Outreach Program Coordinator, NIT Trichy      | March 2014 – May 2014       |

## PROFESSIONAL AFFILIATIONS

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|---|----------------|
| American Institute of Aeronautics and Astronautics (AIAA) | 2022 - Present |
| Acta Astronautica, Reviewer                               | 2022 - Present |
| American Society of Civil Engineers (ASCE), Student       | 2022 - 2023    |

## REFERENCES

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Dr. Jekan Thangavelautham  
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