

Athul P. Girija

PH.D., ASTRODYNAMICS AND SPACE APPLICATIONS

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Summary

Ph.D. in Astrodynamics and Space Applications with expertise in space mission design and formulation, aerocapture, orbital and atmospheric flight mechanics, Entry, Descent, and Landing (EDL) systems, and space systems analysis to support future planetary missions. Experience with astrodynamics software development (Python, C++), data science, machine learning, trajectory simulations, scientific programming, proposal writing, and presentations to the scientific community. Developer of the Aerocapture Mission Analysis Tool (AMAT).

Education

School of Aeronautics and Astronautics, Purdue University

West Lafayette, IN, USA

PH.D., ADVANCED ASTRODYNAMICS CONCEPTS (AAC) LAB

Aug. 2016 - Aug. 2021

- Dissertation: "A Systems Framework and Analysis Tool for Rapid Conceptual Design of Aerocapture Missions"
- Advisors: Dr. Sarag J. Saikia and Dr. James M. Longuski
- Major: Astrodynamics and Space Applications; Minor: Aerospace Systems; GPA: **3.9/4.0**

School of Aerospace Engineering, Indian Institute of Technology (IIT), Madras

Chennai, India

DUAL DEGREE (B.TECH.+M.TECH.) IN AEROSPACE ENGINEERING

Jul. 2011 - Jul. 2016

- Major: Aerospace Propulsion; Minor: Industrial Engineering
- GPA: **9.16/10.0**; Silver Medal, Class of Aerospace Engineering, 2016
- Graduated with Honors, awarded the Mayan Prize for best academic record and senior design project.

Industry Experience

Quality Assurance Engineer, LeoLabs

Menlo Park, CA

ENGINEERING R&D DIVISION

Feb. 2022 - present

- Responsible quality assurance engineer for several key sections of the LeoLabs data platform used for daily space operations by organizations such as SpaceX, OneWeb, and government agencies.
- Develop test system requirements, monitoring systems to ensure the reliable 24×7 operation of the LeoLabs global radar network, and accuracy of all downstream data products derived from radar tracking data.

Research Scientist, Pioneer Astronautics

Lakewood, CO

ADVANCED STIRLING ENGINE FOR ULTRA-HIGH EFFICIENCY SPACE POWER SYSTEMS

Aug. 2021 - Jan. 2022

- Lead systems engineer for the NASA SBIR Phase I contract on ultra-high efficiency space power systems.
- Developed thermodynamic and electromagnetic codes for analysis of the engine and the linear generator.
- Lead system design, fabrication, and testing of a demonstrator engine for deep space planetary missions.

Research Intern, Pioneer Astronautics

Lakewood, CO

MAGNETIC SAILS, PLASMA AEROBRAKING, LUNAR MATERIALS PROCESSING

Aug. 2020 - May 2021

- Led MHD, particle-in-cell (PIC) simulation effort for the NASA SBIR Phase I Magnetic Sails for Spacecraft Deorbit.
- Led computer modeling efforts and systems analysis to support the mineral processing effort to enrich lunar regolith ilmenite from 8% to 65% in support of the Artemis program to return US astronauts to the lunar surface.

Planetary Science Summer Seminar (PSSS), NASA Jet Propulsion Laboratory

Pasadena, CA

MISSION FORMULATION SECTION, TEAM X, JPL

May. 2018 - Aug. 2018

- Participant of the 30th NASA PSSS which formulated a New Frontiers mission concept to Uranus.
- Led the mission design and Uranus system tour design to achieve the science within the mission constraints.
- Co-led the magnetosphere science team, led the magnetometer instrument team for the mission study.

Summer Intern, Indian Space Research Organization (ISRO)

Trivandrum, Kerala, India

AEROHEATING DIVISION, VIKRAM SARABHAI SPACE CENTER, ISRO

May. 2013 - Jul. 2013

- Studied modeling and simulation techniques for entry vehicle thermal protection systems (TPS) materials.
- Implemented a 3-D thermal analysis code to predict the TPS material response during Earth re-entry.

Research Projects

JPL-Purdue Outer Planet Aerocapture Studies

West Lafayette, IN, USA

FUNDED BY NASA JET PROPULSION LABORATORY (JPL)

May. 2018 - Dec. 2019

- Led the joint JPL-Purdue end-to-end aerocapture mission study for a Flagship-class Neptune mission.
- Demonstrated for the first time that Neptune aerocapture could be viable using heritage blunt-body aeroshells.
- Coordinated project planning, execution, and delivery with Mission Design and Navigation Section at JPL.
- Presented results to senior JPL program managers and scientists. Link to [Final Report](#) and [Presentation](#)

Systems Framework for Rapid Conceptual Design of Aerocapture Missions

West Lafayette, IN, USA

IN COLLABORATION WITH NASA JET PROPULSION LABORATORY

Jan. 2017 - Aug. 2021

- Formulated an integrated systems framework for rapid conceptual design of aerocapture missions.
- Automated the creation of “aerocapture feasibility charts” unifying interplanetary trajectory and vehicle design.
- Implemented the framework in the open-source Aerocapture Mission Analysis Tool (AMAT), which provides rapid mission analysis capability for aerocapture mission concepts to the planetary science community.

Purdue Single Wheel Test Rig for Ocean World Rovers

West Lafayette, IN, USA

FUNDED BY NASA SCIENCE MISSION DIRECTORATE, NASA H.Q.

May. 2018 - Dec. 2019

- Led the mechanical design (SolidWorks), fabrication (machining, CNC), assembly, and testing of a state-of-the-art NASA funded planetary rover wheel-soil interaction test facility for Ocean Worlds at Purdue University.
- Led the testbed and simulant design effort to accommodate large tires (> 1 m dia.) and a range of surface conditions (such as snow, ice, cobblestones, boulders and sharp rock formations). Link to [Factsheet](#), [Video](#).
- Managed a team of five graduate students and coordinated project planning and execution with Robotics and Mobility group at JPL and industrial partners at Thin Red Line Aerospace. Link to [Test Rig Images](#).

Drag Modulation Enabled Small Satellite Constellations for Mars and Venus

West Lafayette, IN, USA

PURDUE UNIVERSITY

Jan. 2021 - Jun. 2021

- Led a research effort to assess the feasibility of establishing small satellite constellations at Mars and Venus.
- Studied potential mission architectures such as Synthetic Aperture Radar (SAR) constellations, communications relay, and magnetosphere observation clusters consisting of SmallSats at Mars and Venus.
- Presented results to the scientific community at IPPW 2021. Link to [Presentation](#)

Assessment of Aerocapture for Small Satellite Missions to Venus

West Lafayette, IN, USA

PURDUE UNIVERSITY

Jan. 2018 - Sep. 2018

- Led a comprehensive feasibility and mass-benefit assessment of aerocapture for future Venus missions.
- Demonstrated the viability of inserting small satellites into Venus orbit using drag modulation aerocapture as secondary payload from spacecraft flying to Venus or flying by Venus for gravity assist.
- Presented results to the scientific community at VEXAG meetings in 2017 and 2018. [Link](#) [Link](#)

1. **A. P. Girija**, “ADEPT Drag Modulation Aerocapture: Applications for Future Titan Exploration”, *Journal of Aeronautics, Astronautics and Aviation*, Vol. 55, No. 4. DOI: [https://doi.org/10.6125/JoAAA.202312_55\(4\).06](https://doi.org/10.6125/JoAAA.202312_55(4).06)
2. **A. P. Girija**, R. Agrawal, Y. Lu, A. Arora, M. de Jong, S. J. Saikia, and J. M. Longuski, “A single wheel test rig for Ocean World rovers”, *Journal of Terramechanics*, Vol. 109, 2023, pp. 101-119. DOI: [10.1016/j.jterra.2023.07.001](https://doi.org/10.1016/j.jterra.2023.07.001).
3. L. Iorio, **A. P. Girija**, and Daniele Durante, ‘One EURO for Uranus: the Elliptical Uranian Relativity Orbiter mission.’, *Monthly Notices of the Royal Astronomical Society*, Volume 523, Issue 3, August 2023, Pages 3595–3614 DOI: <https://doi.org/10.1093/mnras/stad1446>
4. **A. P. Girija**, S. J. Saikia, and J. M. Longuski “Aerocapture: Enabling Small Spacecraft Direct Access to Low-Circular Orbits for Planetary Constellations”, *Aerospace*, Vol. 10, No. 3. DOI: [10.3390/aerospace10030271](https://doi.org/10.3390/aerospace10030271)
5. **A. P. Girija**, “A Flagship-class Uranus Orbiter and Probe mission concept using aerocapture”, *Acta Astronautica*, Vol. 202, pp 104–118, January 2023. DOI: [10.1016/j.actaastro.2022.10.005](https://doi.org/10.1016/j.actaastro.2022.10.005)
6. R. Agrawal, W. P. Buchanan; A. Arora, **A. P. Girija**, M. De Jong, S. Seager, J. J. Petkowski, S. J. Saikia, C. E. Carr, D. H. Grinspoon, J. M. Longuski, “Mission Architecture to Characterize Habitability of Venus Cloud Layers via an Aerial Platform”, *Aerospace*, Vol. 9, Number 359, July 2022. DOI: [10.3390/aerospace9070359](https://doi.org/10.3390/aerospace9070359)
7. **A. P. Girija**, S. J. Saikia, J. M. Longuski, Y. Lu, and J. A. Cutts, “Quantitative Assessment of the Aerocapture and Applications to Future Solar System Exploration”, *AIAA Journal of Spacecraft and Rockets*, Vol. 59, Number 4, July 2022. DOI: [10.2514/1.A35214](https://doi.org/10.2514/1.A35214)
8. **A. P. Girija**, S. J. Saikia, J. M. Longuski, and J. A. Cutts, “AMAT: A Python package for rapid conceptual design of aerocapture and atmospheric Entry, Descent, and Landing (EDL) missions in a Jupyter environment”, *Journal of Open Source Software*. Vol. 6, Number 67. November 2021. DOI: [10.21105/joss.03710](https://doi.org/10.21105/joss.03710)
9. **A. P. Girija**, S. J. Saikia, J. M. Longuski, S. Bhaskaran, M. Smith, and J. A. Cutts, “Feasibility and Performance Analysis of Neptune Aerocapture Using Heritage Blunt-Body Aeroshells”, *AIAA Journal of Spacecraft and Rockets*. Vol. 57, Number 6. November 2020. DOI: [10.2514/1.A34719](https://doi.org/10.2514/1.A34719)
10. A. Austin, G. Afonso, S. Albert, H. Ali, A. Alunni ..., **A. P. Girija**, ..., + 57 co-authors, Enabling and Enhancing Science Exploration Across the Solar System: Aerocapture Technology for SmallSat to Flagship Missions, *Bulletin of the AAS*, Vol. 53, Issue 4, March 2021. DOI: [10.3847/25c2cfcb.4b23741d](https://doi.org/10.3847/25c2cfcb.4b23741d)
11. **A. P. Girija**, Y. Lu, and S. J. Saikia, “Feasibility and Mass-Benefit Analysis of Aerocapture for Missions to Venus”, *AIAA Journal of Spacecraft and Rockets*. Vol. 57, Number 1. January 2020. DOI: [10.2514/1.A34529](https://doi.org/10.2514/1.A34529)
12. S. Dutta, M. Perez-Ayucar, A. Fedele, ..., **A. P. Girija**, ..., + 59 co-authors, Aerocapture as an Enhancing Option for Ice Giants Missions, *Bulletin of the AAS*, Vol. 53, Issue 4, March 2021. DOI: [10.3847/25c2cfcb.e8e49d0e](https://doi.org/10.3847/25c2cfcb.e8e49d0e).
13. S. Limaye, N. Abedin, C. Ao, T. Bocanegra, M. A. Bullock, ..., **A. P. Girija**, ..., + 30 co-authors, Venus Observing System, *Bulletin of the AAS*, Vol. 53, Issue 4, March 2021. DOI: [10.3847/25c2cfcb.7e1b0bf9](https://doi.org/10.3847/25c2cfcb.7e1b0bf9).
14. I. Cohen, C. Beddingfield, R. Chancia, G. DiBraccio, ..., **A. P. Girija**, ..., + 84 co-authors, New Frontiers-class Uranus Orbiter: Exploring the feasibility of achieving multidisciplinary science with a mid-scale mission, *Bulletin of the AAS*, Vol. 53, Issue 4, March 2021. DOI: <https://doi.org/10.3847/25c2cfcb.262fe20d>.
15. S. Jarmak, E. Leonard, A. Akins, E. Dahl, D. R. Cremons, S. Cofield, A. Curtis, C. Dong, E. T. Dunham, B. Journaux, D. Murakami, W. Ng, M. Piquette, **A. P. Girija**, K. Rink, L. Schurmeier, N. Stein, N. Tallarida, M. Telus, L. Lowes, C. Budney, K. L. Mitchell, “QUEST: A New Frontiers Uranus Orbiter Mission Concept Study”, *Acta Astronautica*. January 2020. DOI: [10.1016/j.actaastro.2020.01.030](https://doi.org/10.1016/j.actaastro.2020.01.030)

Open-Source Software

1. **A. P. Girija**, “Aerocapture Mission Analysis Tool (AMAT)”. [Project Website](#). AMAT provides rapid mission design capability for aerocapture and EDL mission concepts to all atmosphere-bearing Solar System destinations. AMAT is open-source and is made available under the GNU GPLv3 license.

Conference Publications

1. **A. P. Girija**, S. J. Saikia, J. A. Cutts, and J. M. Longuski, “A Unified Framework for Aerocapture Systems Analysis”, AAS 19-811, *AAS/AIAA Astrodynamics Specialist Conference*, Portland, ME, August 2019. [enrXiv](#)
2. **A. P. Girija**, S. J. Saikia, J. M. Longuski, S. Bhaskaran, M. Smith, and J. A. Cutts, “Aerocapture Performance Analysis for a Neptune Mission using Blunt-Body Aeroshell”, AAS 19-815, *AAS/AIAA Astrodynamics Specialist Conference*, Portland, ME, August 11–15, 2019. [enrXiv](#)
3. **A. P. Girija**, S. J. Saikia, and M. de Jong, “Candidate Mechanisms and Fabric Layup Materials for the Mars Surface Tunnel Concept”, *IEEE Aerospace Conf.*, Big Sky, MT, March, 2018. [DOI:10.1109/AERO.2018.8396720](#)

Oral Presentations

1. **A. P. Girija**, S. J. Saikia, J. M. Longuski “Drag Modulation Aerocapture Enabled Small Satellite Constellation Concepts for Mars and Venus”, *18th International Planetary Probe Workshop*, Virtual Event. [Link](#)
2. **A. P. Girija**, S. J. Saikia, J. M. Longuski, and J. A. Cutts, “AMAT: A Rapid Design Tool for Aerocapture Missions”, *17th International Planetary Probe Workshop*, Invited student speaker for online webinar series. (Originally scheduled to be held in Monterey, CA.) [Link](#)
3. **A. P. Girija**, S. J. Saikia, J. M. Longuski, S. Bhaskaran, M. Smith, and J. A. Cutts, “Ice Giant Aerocapture Using Low-L/D Aeroshells: Uncertainty Quantification and Risk Assessment”, *16th International Planetary Probe Workshop*, Oxford University, Oxford, United Kingdom, July 8–12, 2019. [Link](#)
4. **A. P. Girija**, Y. Lu, S. J. Saikia, J. M. Longuski, and J. A. Cutts, “Feasibility and Mass-Benefit Analysis of Aerocapture for SmallSat Missions to Venus”, *16th NASA Venus Exploration Group (VEXAG) Meeting*, Johns Hopkins University Applied Physics Lab (APL), Laurel, MD, November 5–8, 2018. [Link](#)
5. **A. P. Girija**, A. Arora, S. J. Saikia and J. A. Cutts, “Hybrid Aerocapture using Low L/D Aeroshells for Ice Giant Missions”, *15th International Planetary Probe Workshop*, Boulder, CO, June 11–15, 2018. [Link](#)
6. Y. Lu, **A. P. Girija**, S. J. Saikia, and J. A. Cutts, “Venus Aerocapture Assessment”, *15th NASA Venus Exploration Group Meeting*, Johns Hopkins University APL, Laurel, MD, November 14–16, 2017. [Link](#)
7. **A. P. Girija**, E. Shibata, Y. Lu, S. J. Saikia and J. A. Cutts, “Considerations for Atmospheric Sample Return from Venus”, *14th International Planetary Probe Workshop*, The Hague, Netherlands June 12–17, 2017. [Link](#)

Poster Presentations

1. T. E. Hook, **A. P. Girija**, S. J. Saikia, J. M. Longuski, S. E. Matousek, and J. A. Cutts, “JPL-Purdue Rapid Mission Design Pilot Study”, *54th Lunar and Planetary Science Meeting*, The Woodlands, TX, Mar. 13–17, 2023. [Link](#)
2. S. Jarmak, E. Leonard, A. Akins, E. Dahl, D. R. Cremons, S. Cofield, A. Curtis, C. Dong, E. T. Dunham, B. Journaux, D. Murakami, W. Ng, M. Piquette, **A. P. Girija**, K. Rink, L. Schurmeier, N. Stein, N. Tallarida, M.

- Telus, L. Lowes, C. Budney, K. L. Mitchell, “QUEST: A New Frontiers Uranus Orbiter Mission Concept Study”, *50th Lunar and Planetary Science Conference*, The Woodlands, TX, March 18–22, 2019. [Link](#)
3. Y. Lu, **A. P. Girija**, M. Rajapakshe, J. M. Longuski, and S. J. Saikia, “A Single-Wheel Test Rig for Ocean Worlds”, *NASA Outer Planets Assessment Group Meeting*, Pasadena, CA, Sept. 11–12, 2018. [Link](#)
 4. R. Agrawal, B. Aiken, M. de Jong, **A. P. Girija**, J. M. Longuski and S. J. Saikia, “A Surface Mobility System with Large Deployable and Conformal Tires for Ocean Worlds Exploration”, *15th International Planetary Probe Workshop*, Boulder, CO, June 11–15, 2018. [Link](#)
 5. **A. P. Girija**, R. Agrawal, Y. Lu, B. Aiken, M. de Jong, and S. J. Saikia, “A Novel Surface Mobility System for Ocean Worlds”, *NASA Outer Planets Assessment Group Meeting*, Hampton, VA, February 21–22, 2018. [Link](#)
 6. Y. Lu, M. Rajapakshe, R. Agrawal, **A. P. Girija**, and S. J. Saikia, “A Single Wheel Test Rig for Ocean World Rover”, *NASA Outer Planets Assessment Group Meeting*, Hampton, VA, Feb. 21–22, 2018. [Link](#)
 7. E. Shibata, Y. Lu, **A. P. Girija**, J. A. Cutts, and S. J. Saikia, “A Venus Atmospheric Sample Return Mission Concept: Feasibility and Technology Requirements”, *Planetary Science Vision 2050 Workshop*, NASA Headquarters, Washington D.C., February 27–28, 2017. [Link](#)

Research Grants

Co-Investigator, Rapid Mission Design Pilot Study

West Lafayette, IN, USA

SPONSOR: NASA JET PROPULSION LABORATORY, AMOUNT: \$40,000

Jul. 2021 – Dec. 2021

- PI: Prof. James Longuski, Purdue University
- Leading the development of an interactive web-based mission design suite to enable rapid, end-to-end early-stage mission formulation for future NASA planetary science missions.
- Provide planetary mission design and astrodynamics software expertise to the team at Purdue University.

Citation Record

Google Scholar: <https://scholar.google.com/citations?user=XxLVDPEAAAAJhl=en>

Peer Reviews

Peer-review activity for the following journals.

- *AIAA Journal of Spacecraft and Rockets*
- *Life Sciences in Space Research*
- *Journal of Astronautical Sciences*
- *AIAA Journal of Aerospace Information Sciences*
- *CEAS Space Journal*
- *Aerospace Systems*
- *Advances in Space Research*
- *The Aeronautical Journal*
- *Journal of Aerospace Engineering*

- *SAE International Journal of Aerospace*
- *ASCE Journal of Aerospace Engineering*
- *Aerodynamics*
- *Space: Science and Technology*
- *IEEE Transactions on Aerospace and Electronic Systems*

Scholastic Achievements

- **Mayan Prize** for best academic record in Aerospace Engineering, Class of 2016, IIT Madras.
- **Silver Medal** for academic excellence, Class of Aerospace Engineering (B.Tech + M.Tech), 2016, IIT Madras.

Scholarships and Awards

- **IPPW Student Scholarship** to attend the International Planetary Probe Workshop (IPPW)
 - Awarded in 2017, 2018, and 2019
- **College of Engineering/Graduate School Scholarship**
 - Awarded in Fall 2018 and Spring 2019
- **IPPW Student Poster Award** - 3rd place on co-authored poster, 15th IPPW, Boulder, CO.
- **NASA Planetary Science Summer Seminar Stipend**
 - attend the 30th annual NASA Planetary Science Summer Seminar (PSSS) at NASA Jet Propulsion Lab, Pasadena, California, August 6-10, 2018.
- **VEXAG Student Travel Grant** to attend NASA Venus Exploration Group (VEXAG) Meetings (2017, 2018)

Extras

- **Languages:**
 - English
 - Hindi
 - Malayalam (native proficiency)
 - Chinese (basic proficiency), Russian (elementary proficiency)