# Rashika Sugganahalli Natesh Babu



Research Interests: Space Mission Design, Attitude Dynamics and Control, Systems Engineering

Education

- 2018 2021 MS Space Engineering, Politecnico di Milano, Italy, GPA 3.3/4. Courses: Orbital Mechanics, Attitude Dynamics and Control, Space Mission Design and Analysis, Space Physics
- 2013 2017 B.Tech Aerospace Engineering, Alliance University, India, GPA 3.6/4. Courses: Space Flight stability and control, Spacecraft Navigation, Spacecraft design, Control Engineering

### Research Publications

- 2023 Maria Crespo, Rashika Sugganahalli Natesh Babu, et al. "The Achieved Academy, Accessible Space Education Initiative Launched by the Space Generation Advisory Council" at International Astronautical Congress (IAC), October, 2023. Link
- 2023 Alessio Bocci, Rashika Sugganahalli Natesh Babu, et al. "IRIS mission: tackling the problem of climate change by monitoring water areas' pollution" at Global Space Conference on Climate Change (GLOC), Norway, May 2023. Link
- 2021 Alessio Bocci, Rashika Sugganahalli Natesh Babu, et al. "ARGO: a planetary defense mission to test gravity traction techniques" at International Astronautical Congress (IAC), Dubai, 2022. Link
- 2021 Francesco Ventre, Rashika Sugganahalli Natesh Babu, et al. "PoliSpace: a student approach for enabling the growth of the Italian Space workforce" at International Astronautical Congress (IAC), Dubai, 2022. Link

# Work Experience

2023 - Present Software Developer, Space Systems.

- Company: Research & Innovation, Enginium, Rome, Italy
  - Verification and Validation activities for the On-board computers and AOCS sensors of Sicral-3 satellites constellation in accordance with ECSS and CCDSS standards.
  - Creation of sub-system models in UML MagicDraw and code for the On-board computer of the INNOSAT.
  - Implementation and execution of the Subsystems, Spacecraft environment, and Perturbation models on SIMSAT - SIMULUS and verification on Automated testbed (ATB) in the clean room facility.

### 2021 - 2023 Systems Engineer, Consultant.

#### Company: Capgemini, Milan, Italy

- Developed and Managed system requirements leveraging Model-Based System Engineering practices for On-Board Charger dedicated to electric vehicles and Infotainment - HMI system for Light Vehicles.
- Defined and analyzed the Architecture and algorithm for Electronic Control Units(ECU) and Adaptive cruise control system. Wrote lean verification and validation test criteria along with risk analysis of system requirements.
- Assessed for any non-conformances by processing S-FMEA for the 1000+ requirements in 2.5 months.
- Automated the task of attribute creation and KPI calculation on IBM DOORS by developing a script on **DXL**, saving man-hours by 30%.

#### 2017 - 2018 Graduate Engineer, Launch Vehicle - GSLV MK III.

Company: Hindustan Aeronautics Limited, Bangalore, India

- Spearheaded the design of crucial subsystems for the Indian Launch Vehicle GSLV MK III in AutoCAD, ensuring seamless integration and functionality from Phase 0 through launch.
- Ensured Thermal Protection system reliability, participated in Preliminary Design review (PDR) and Critical design reviews (CDR), and maintained stringent quality and safety standards at the production site.
- Verified and validated outsourced products to integrate with the launch vehicle's subsystems.

# Research Experience

### 2020 - 2021 Graduate Researcher, Master Thesis, DAER, Laboratory, Milan, Italy.

- Advisors: Prof. Mauro Massari & Prof. Francesco Topputo, Politecnico di Milano
  - Title: Automatic Mass Balancing of 3-DOF Attitude Simulator using System Identification. Link
    - Built parameter estimation based on the gray-box model and efficiently performed sensor fusion using the Least-Square approach and **Kalman Filters**, further designed estimation algorithm based on the EKF
    - Developed and applied an **adaptive control** algorithm, utilizing a Lyapunov function, for real-time automatic mass balancing of the simulator testbed, eliminating the center of mass offset from the center of rotation.
    - Achieved higher control authority with multiple masses, reducing system response time by 4 seconds in transverse axes and justifying the selection of 8 Non-captive motors.
  - 2017 Undergraduate Researcher, Bachelor Thesis, Indian Space Research Organization (ISRO), Bengaluru, India.

Advisors: Dr. Feroz Ahmed, Alliance University & Dr. Padmdeo Mishra, ISRO

- Title: Modeling of Media Correction and Atmospheric Drag for Orbit Determination. Link
- Performed statistical method of data analysis to interpret the efficiency of existing GPS media correction algorithms - Klobuchar model and NeQuick model
- Developed an algorithm based on Least-square estimation to compensate for GPS communication delay caused by lonosphere and atmospheric drag, which is 30% more efficient than available Klobuchar coefficients.
- Created a C++ framework on Linux for the Jacchia 1971 density model, enabling real-time estimation of atmospheric density and drag acceleration, and significantly improving the precision of satellite position prediction.

# **Research Projects**

- 2020 Asteroid Redirection with Gravity Tractoring and Observation  $\underline{\mathsf{Link}}$ 
  - Phase A study of a Gravity Tractoring assessment on Binary Asteroid system- following requirement-based systems engineering approach and ESA ECSS and CCDSS standards.
  - Served as the Lead Engineer for the complete Telecommunication system, conducted budget, risk and RF analysis, and performed Ground link assessments using FreeFlyer software.
  - Utilized Matlab to design satellite-to-ground and inter-satellite links across X, S, and Ka bands, considering occultation and redundancies, optimizing communication window loss.
- 2020 Attitude Determination and Control of 12U CubeSat using reaction wheel and cold-gas thrusters Link
  - Implemented Singular value decomposition method for Attitude determination and Designed control logic for Detumbling, Slew, and tracking phases.
  - $\circ\,$  Implemented disturbance rejection control system in the tracking phase where the pointing error remained below  $1^{\circ}.$
- 2019 Conceptual Design and Performance Estimation of Sounding Rocket
  - Designed a sounding rocket with a launch from the Mediterranean area carrying a payload of 150 kg. Performance, Budget, and landing uncertainty analysis was performed considering Microgravity conditions.
- 2018 Design of Interplanetary transfer using Gravity assist Inner Planets  $\underline{Link}$ 
  - Optimized interplanetary trajectory by performing fly-by over Venus, plotted pork-chop to study precise launch and arrival windows. Designed environmental and J2 perturbation models in MATLAB.
  - Employed both heuristic (Genetic Algorithm) and nested looping function approaches to identify the optimal solution in terms of  $\Delta V$ , enhancing mission efficiency.

# Mentor/Teaching Experience (Volunteer)

2016 - present Achieved Academy Lead & Instructor, Space Mission Design & Systems Engineering.

Organization: Space Generation Advisory Council, Ongoing

- Creating an internationally aligned curriculum for motivated students in Space Systems Engineering (ECSS, INCOSE).
- Leading the world's first free well-structured Space system engineering course (SMAD, ADCS, Payload, Systems engineering), breaking down barriers to space education.
- Coordinating master classes with top scientists and professors, fostering a passionate space industry community.
- Mentoring students in Model-Based System Engineering and Requirements Development, emphasizing Valispace for practical experience.

### 2019 - 2021 Mentor & Instructor, Space Mission Design & ADCS.

Organization: Society of Space Education Research and Development, India

- Guided and mentored students to develop Phase 0/A Space Mission studies, Attitude and controls, and Rocket propulsion projects.
- Devised resources and problem sets for students to provide additional practice and improve knowledge on complex subjects
- Successfully developed 7+ projects by guiding 70+ students strictly following ECSS & CCDSS standards.

#### 2020 - 2021 Systems Engineer, Analog Astronaut Mission.

- Organization: Mission Asclepios, Space@yourService, Switzerland
  - Spearheaded the development of precise and effective experiment protocols, ensuring mission success by meticulously crafting procedures for the Scientific experiments.
  - Designed a robust communication system facilitating seamless astronaut-ground control interaction, enhancing mission efficiency and safety.
  - Played a pivotal role and collaborated with Labeleldby (*link*) in the design and development of spacesuits, integrating temperature sensors, tool holders, and communication-activated helmets for astronaut's comfort and safety.

# Mentored Research Projects (selected)

- 2021 Conceptual Design of an Autonomous Asteroid Mining Robot
  - Led and provided guidance to the team in designing an autonomous Asteroid Mining Robot for extracting water from C-type asteroid (341843) 2008 EV5, incorporating advanced mining methods and essential subsystems for mission success.
- 2019 Top-Level Mission Analysis and Feasibility Study of a Near-Earth Asteroid Mining Mission and Resource Return o Mentored a team of 12 in designing an asteroid mining and resource return mission to 1989 ML. Performed trade studies, budget analysis and checked for mission feasibility.

### 2019 STARS-Simplified Tool for Analysis of Rocket Systems Mentored students in developing an interactive application on GlideApps, resulting in a Knowledge Management System that streamlined mission design and enhanced payload feature information retrieval.

2019 Interactive Payload database application and literature survey on debris mitigation - Team ICARUS VI Co-mentored a team in developing an interactive tool enabling users to select payloads based on destination and specifications while identifying and recommending effective space debris removal techniques for LEO and GEO orbits.

### Achievements

- 2021 Awarded University Financial AID DIRITTO ALLO STUDIO UNIVERSITARIO (DSU) for enitre MS program, Italy - 2018 to 2021.
- 2017 Ranked amongst the top 5 in the B.Tech (Aerospace Engineering) Batch of 2017. Secured first rank in 8<sup>th</sup> semester with highest marks for Bachelor thesis.
- 2014 Awarded Central Sector Scheme of Scholarships for College and University Students by the Department of Higher Education, Government of India – 2013, 2014.

### Skills

Programming C, C++, Python, SysML, UML Software MATLAB & Simulink, Eclipse, MagicDraw, GMAT, STK, IBM DOORS, MagicDraw, Polarion Design AutoCAD, CATIA Documentation LATEX, Confluence, SVN, Jira Communication English, Italian(B2), German (A2), Kannada