Dasu Deva Karthik Lakshman

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Education

Indian Institute of Space Science and Technology (IIST), Thiruvananthapuram   *2018 - 2022*
Bachelor of Technology in Aerospace Engineering (AE)
CGPA : 8.75/10
Advisors : Dr. Pankaj Priyadarshi, Dr. Raveendranath P, and Dr. Aravind Vaidyanathan

Selected Research Projects

Vikram Sarabhai Space Centre, ISRO

1. Design of three-phalanxe three finger under-actuated multi-purpose compliant space gripper   **May 2024 – present**
   - Configured the gripper as a modular, single DoF compliant mechanism towards the goal of modular space robotics.
   - Synthesized the phalanxes of the fingers using freudenstein's equations by optimizing the transmission defect.
   - Developed a finite element model to compute the gripping forces for various irregular shaped objects.

2. Trajectory optimization of the series-parallel robotic manipulator for 3D printing in space   **Dec, 2023 – present**
   - Formulated the forward and inverse kinematics of the series-parallel hybrid robotic manipulator.
   - Formulated the trajectory optimization problem as a multi-objective optimization problem using cubic splines and adaptive time lengths, creating a benchmark. Presented at INSARM'23.
   - Introduced novel generalized hyperbolic radial basis functions for smooth trajectory planning, resulted nearly 50% reduction of jerk for the same time with benchmark case.

3. Feasibility study of the Venus Balloon and Impact probe for the Indian Veuns mission   **July, 2024 – Jan, 2025**
   - Modeled the preliminary configuration of the separation and deployment mechanisms of the aeroshell module
   - Developed the preliminary entry flight sequence of the aeroshell module.
   - One of the five selected projects for grant from VSSC, by **Secratary, Department of Space, India**, and currently is in project mode.

4. Study of reusable crew seat impact attenuation system for Indian manned space mission   **July, 2023 – Sep, 2023**
   - Studied and designed three semi-active configurations: Hydraulic, Hydro-pneumatic and Airbag to replace the passive honeycomb based impact attenuation system.
   - Optimized the attenuation systems with respect to the spatial constraints of the crew module and proposed a control law for each of the system.
   - With the existing spatial constraints, the semi-active hydraulic system is proven to be optimal, reducing the NASA's Brinkley DRI by 36% compared to conventional honeycomb system. Presented at **SAE AeroCON 2024**

Indian Institute of Space Science and Technology (IIST)

1. Reliability-based design optimization of novel Spear-In-Sand spent stage recovery approach   **June, 2022 – Nov, 2022**
     – Advisor: Dr. Pankaj Priyadarshi
   - Optimized the touchdown state vector of the spent stage satisfying the safety chance constraints for required reliable probabilities under uncertainties by formulating as a Reliability-based design optimization (RBDO)
   - Developed a *Modified Sequential Optimization and Reliability Assessment using Monte Carlo simulations (MSORAMCS)* algorithm, which reduced the computational cost by **49%** with less than **1%** error.

2. Multi-disciplinary design optimization of Spear-In-Sand spent stage recovery of launch vehicle   **Dec, 2021 – May, 2022**
     – Advisors: Dr. Pankaj Priyadarshi and Dr. Raveendranath P
   - Modeled the landing dynamics of penetration of landing legs into the sand using finite element analysis with the touchdown state vector as the input and the penetration, impact forces as the output.
   - Constructed a surrogate model for the finite element analysis using Radial Basis Function Neural Networks (RBFNN) and a second order gradient based adaptive sequential sampling method and extended it for vector-valued functions.
   - Formulated the re-entry trajectory of the spent stage and integrated with the surrogate model using MDF architecture, optimizing throttling the parameters and angle of attack with impact forces as the cost function.

3. Multi-disciplinary design optimization of a small size expendable launch vehicle   **July, 2021 – Oct, 2021**
     – Advisor: Dr. Aravind Vaidyanathan
   - Formulated the 3 DoF trajectory of launch vehicle with all the phases: gravity turn, stage separation, coasting, etc.
   - Formulated the solid rocket motor grain *burn back* analysis with geometric parameters as the design variables.
   - Integrated the sizing, aerodynamics, and propulsion modules to trajectory module using Multi-disciplinary Feasible (MDF) architecture and solved the design problem as an Multi-disciplinary Design Optimization (MDO) problem.

Professional Experience

Vikram Sarabhai Space Centre, ISRO
System design engineer, Aerospace Mechanisms Group (ASMG)

1. System design engineer for GAGANYAAN Crew Module Up-righting System (CMUS) **Dec 2023 – present**
   – *Makes the Crew Module mono-stable in the water for safe recovery using inflatable floats.*
   - Developed origami-inspired optimal deployment scheme for the CMUS inflatable floats and validated the same for the worst case scenario flight loads.
   - Developed the space qualification plan and instrumentation plan for the system.
   - Designed the joint scheme between the crew module and the inflatable floats to withstand the buoyancy loads.
   - Carried out the structural analysis of all components of the system and verified the robustness of the system.

2. System engineer for LVM3 payload fairing for **Chandrayaan-3** and **OneWeb-2** missions **Nov 2022 – Nov 2023**
   – *Asia's third largest payload fairing.*
   - Carried out space qualification and acceptance testing of payload fairing separation system, shock-reduction system, acoustic protection system, debris-free system, and rain-proofing system.
   - Led a team of five and carried out integration of payload fairing auxiliary systems.
   - Carried out encapsulated assembly with spacecraft and final assembly to the launch vehicle.
   - Carried out post-flight performance analysis of all the payload fairing auxiliary systems.

Publications & Manuscripts

Journal articles

1. Study of crew seat impact attenuation system for Indian manned space mission. Nohin K Avirah, **Dasu Deva Karthik Lakshman**, Sai Santhosh Potnuru, Athul P Pramod, and Sabin Kurian. *SAE Int. J. Adv. & Curr. Prac. in Mobility*, 7(2):919-933, 2025.

2. On novel generalized hyperbolic radial basis functions for scattered data approximation. **Dasu Deva Karthik Lakshman**. In: *Under review in Applied Mathematics and Computation Journal*

3. Surrogate assisted reliability-based design optimization of novel Spear-In-Sand launch vehicle spent stage recovery approach using Monte Carlo simulations. **Dasu Deva Karthik Lakshman** and Pankaj Priyadarshi. In: *Manuscript in progress*

4. Optimal time-jerk trajectory planning of a series-parallel robotic manipulator using novel generalized hyperbolic RBFs. **Dasu Deva Karthik Lakshman**, Anirudh R, and Manu V Unnithan. In: *Manuscript in progress*

Conference Proceedings

1. Optimal smooth trajectory planning of robotic manipulator for additive manufacturing in space. **Dasu Deva Karthik Lakshman**, Anirudh R, and Manu V Unnithan. In: *Proceedings of INSARM International Conference ARMS'23.*

Theses

1. Multi Disciplinary Design Optimization of Vertically Landing Stage Recovery of Launch Vehicle. **Dasu Deva Karthik Lakshman**. In: Bachelor's thesis, AE'22, IIST.

2. Multi-Disciplinary Design Optimization of Small Size Expendable Launch Vehicle. **Dasu Deva Karthik Lakshman** and Shashwat Gupta. In: Internship thesis, AE'21, IIST.

Skills

Programming Languages: Python, C++
Tools and sofwares: MATLAB, Simulink, Simscape, Octave, LaTeX, SolidWorks, ABAQUS, AnSys
Frameworks: NumPy, Pandas, SciPy, SymPy, Matplotlib, Seaborn, Plotly, scikit-learn, Keras, TensorFlow
Relevant Courses: Space Flight Mechanics, Atmospheric Flight Mechanics, Multi-Rigid Body Dynamics, Applied Dynamics and Vibrations, Optimization Techniques in Engineering, Aerospace Vehicle Design, Machine Learning for Signal Processing
Mentorship & service: Mentored the junior year students in launch vehicle design and trajectory optimization at IIST. Currently supervising a senior year student on robot motion planning and control for in-space activities.

Awards & Achievements

- Best paper award in both **Aerospace** and **Overall Industry** tracks at **SAE AeroCON 2024**.
- Consistent **Outstanding performance** achievement at VSSC, ISRO for 2023-24, 2024-25.
- **Department of Space** merit-based student scholarship for four consecutive years, 2018-2022.
- **Top 0.88%** in **JEE Main (2018)** examination among 1.05 million students.
- **Top 2.8%** in **JEE Advanced (2018)** examination among 224,000 students.