

Pranav Nath

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EDUCATION

California Institute of Technology (Caltech)

September 2014-June 2015

MS, Space Engineering

GPA: 4.1 on scale of 4

Major courses on Fluid Mechanics, Solids and Structures, Space Propulsion, Mathematics and Aerospace Engineering.

Member of Thermal team for project on design of an autonomous assembly and reconfigurable space telescope (AAReST). Performed experiments on thermal deformation of mirrors due to space environment.

Indian Institute of Space Science and Technology

August 2010-June 2014

B. Tech., Aerospace Engineering

GPA: 9.4 on scale of 10

Courses on Thermodynamics, Heat transfer, Fluid Mechanics, Atmospheric Flight Mechanics, Space mission design and optimization, Aerospace Vehicle design, Solid mechanics and Structures, Manufacturing, Rocket Propulsion and basics in Mathematics, Astronomy, Electronics, Electrical engineering, Physics and Chemistry.

B. Tech. Project on design of space mission to Sun-Earth Lagrangian point L1.

Supervised by Dr. R.V. Ramanan, IIST. C++ code was developed. Stable and unstable manifolds based on Dynamical systems theory were derived and numerically integrated in restricted three-body problem. Fehlberg integrator was developed for precise design of halo orbits and transfer trajectories from Earth. Evolutionary algorithm was employed to find optimal solutions for transfer to halo orbit from low-Earth orbit.

WORK EXPERIENCE

LPSC, Indian Space Research Organization, Govt. of India

November 2015 – April 2021

Finite volume solver in C++ for plasma simulation

January 2019 – April 2021

Plasma simulation using two-fluid approach, dynamic grid generation and erosion modelling for Hall thruster design and simulation was carried out. Solution of Elliptic Partial differential equation in C++ for grid generation with changing simulation domain boundaries due to thruster erosion. 2-D Isothermal solver based on Roe's method was derived and implemented. Code was developed for isothermal single fluid simulation in 2-D. Two-fluid solver was developed with simultaneous solution of electron energy ODE's. Models were developed for SPT-100 and other Hall thrusters.

Design of Radio-frequency plasma thruster and test facility

March 2018 – April 2021

Supervised by Dr. Umesh R Kadhane, IIST. Principal scientist identified for design and development of Radio-frequency power driven plasma thruster at LPSC, on the lines of VASIMR engine. Experience was gained in high power water-cooled RF amplifiers, superconducting magnet system, vacuum chamber, RF antennas, RF transmission systems, system integration, data acquisition. Carried out Plasma mode analysis motivated by work of Prof. Francis F Chen at UCLA. Ideal Magneto-hydrodynamic simulations using a commercial code and particle trajectory simulation of magnetic nozzle in C++ were carried out.

Design of Doppler-LIF system for Hall thruster diagnostics

March 2016 – January 2020

Supervised by Dr. Umesh R Kadhane, IIST. System for laser locking and scanning, collection optics, signal detection system, and opto-mechanics for in-vacuum operation was configured. Collaborated with other

centres of expertise in India, viz. Physical Research Laboratory, Ahmedabad and Inter-University Accelerator Centre, New Delhi.

Development of 2-D DSMC solver for rarefied flows

March 2016 – January 2017

Supervised by Dr. Deepak Kumar Agarwal, LPSC. Two-dimensional Direct Simulation Monte Carlo solver was developed in C++. The code was validated with benchmark problems of Couette flow and Poiseuille flow. Another DSMC code was developed in collaboration with Indian Institute of Technology, Mumbai for simulating plume impingement on lunar surface and dust erosion using loosely coupled CFD-DSMC technique.

Lumped parameter model for Indian lunar lander propulsion system

January 2016 – March 2018

Supervised by Dr. Deepak Kumar Agarwal, LPSC. System level mathematical modelling for lunar lander propulsion system for Indian moon mission using Simulink platform. Component level mathematical models were incorporated using in-built libraries, and customized blocks for dynamic components like pressure regulators were developed using governing equations. Simultaneous solution of Differential-algebraic equation set was carried out to predict integrated system behaviour.

Graduate Student Internship on Acoustics at JPL, NASA

June 2015 – August 2015

Supervised by Dr. Ali R Kolaini, JPL. Simulation was carried out for predicting acoustic modes in the reverberation chamber at Jet Propulsion Laboratory used for acoustic testing on satellites. The simulation was carried out in a commercial code. The study predicted the acoustic modes with and without satellite in the chamber.

Teaching experience

2019

- Guest lecture on Electric propulsion for undergraduate students as a part of science week at Indian Institute of Space Science and Technology.
- Guest lecture on Magneto-plasma propulsion as a part of course on Rocket propulsion for undergraduate students at Indian Institute of Space Science and Technology.

PUBLICATIONS

Journal Publications

Pranav Nath, R. V. Ramanan. Precise halo orbit design and optimal transfer to halo orbits from earth using differential evolution. *Advances in Space Research* (a COSPAR publication), 2016, vol 57, 202-217.

Sanjeev Kumar Mishra, K Durga Prasad, **Pranav Nath**, Deepak Agarwal, S Sunil Kumar, Anil Bhardwaj. Effect of Lunar Landing on its surface, surrounding environment and hardware: A numerical perspective. Submitted to *Planetary and Space Science* (ELSEVIER Publication) in September 2020.

Conference Proceedings

- **Pranav Nath**, Nipin L, Deepak Kumar Agarwal, S Sunil Kumar. Mathematical modelling of throttleable propulsion system for lunar lander, International ISMHT-ASTFE Heat and Mass Transfer Conference, 2017, BITS Pilani, Hyderabad, India.
- Manish Kumar Mishra, Kartikey Sharma, **Pranav Nath**, Deepak Kumar Agarwal. Theoretical analysis of Helicon plasma discharge for RF driven plasma engine. International ISMHT-ASTFE Heat and Mass Transfer Conference, 2019, IIT Roorkee, Roorkee, India.
- Raviraj Awasthi, **Pranav Nath**, Deepak Kumar Agarwal, S Sunil Kumar. Two-dimensional direct simulation Monte Carlo solver for rarefied flows. International Conference on Thermal Engineering: Theory and Applications, PDPU Gandhinagar, India, 2019.
- Ramakrishna M. V. Malladi, **Pranav Nath**, Deepak Kumar Agarwal, S Sunil Kumar. Analytical simulation of Helicon discharge for RF power driven plasma engine. International Conference on Thermal Engineering: Theory and Applications, PDPU Gandhinagar, India, 2019.

- Rahul Ranjan, **Pranav Nath**, Rajesh Sadanandan, Umesh R Kadhane. Simulation of 3D Plasma flow and plasma detachment in Magnetic nozzle. International Conference on Thermal Engineering: Theory and Applications, PDPU Gandhinagar, India, 2019.
- Avinash Chandra, Prashumn PM, Annapurna B, Paghdar Dhaval, **Pranav Nath**, S Sunil Kumar. Magneto-hydrodynamic simulation of magnetic nozzle. International Astronautical Conference, 2020.

AWARDS

Dr. Satish Dhawan Endowed Fellowship for studies at Caltech

Department of Space, Government of India

Institute Gold Medal

Indian Institute of Space Science and Technology

MEMBER OF PROFESSIONAL BODIES

Indian Society of Heat and Mass Transfer

Lifetime Member

ONLINE CERTIFICATE COURSE

Humanitarian response to conflict and disaster, Harvard Humanitarian Initiative