

Angadh Nanjangud

2022 HIGHLIGHTS Summary of achievements at QMUL in 2022.

Research

- Conference abstract accepted at top-tier aerospace conference in USA.
- Journal article submitted to Q1 aerospace engineering journal.
- Grant application (£250k) to EPSRC New Horizons call.
- Co-I on industry-led bid by Fraser Nash Consultancy to a European Space Agency tender for spacecraft autonomy software.

Teaching

- Faculty Education Excellence Award for Student Experience and Education.
- Individual nomination for QMSU Innovative Teaching & Technology Champion.

RESEARCH INTERESTS Spacecraft dynamics and control, computational multibody dynamics, autonomous space robotics, advanced mission concepts

EXECUTIVE SUMMARY I developed my aerospace engineering track record via appointments at the Surrey Space Center, NASA Jet Propulsion Laboratory, and UC Davis. During my PhD, I received multiple awards and in-kind support valuing to almost £100,000 and have been involved in the pedagogy of over **1000 students**.

GRANT WRITING EXPERIENCE As of 17th May 2019, my application to the Royal Academy of Engineering Research Fellowship (£500,000) is on the reserve list for the award. My proposal was on intelligent space robotics.

EDUCATION **University of California, Davis**
Ph.D., Mechanical and Aerospace Engineering, 2016

- Dissertation Title: On the Rotational Dynamics of Variable Mass Systems
- Advisor: (Emeritus) Prof. Fidelis O. Eke

Bangalore University
B.E., Mechanical Engineering, 2009 (**First Class with Distinction**)

RESEARCH EXPERIENCE **Queen Mary University of London**, London, UK

Lecturer in Spacecraft Engineering **2020-present**

- Director of research group developing robotic in-space assembly technologies.
- Teaching *Advanced Spacecraft Design* and *Computational and Math Modeling: Dynamics* supervised 3 postdoctoral researchers.

University of Surrey, Guildford, UK

Research Fellow **2017-2019**

- Lead researcher for Airbus/Surrey Satellite Technology Limited study on robotic in-space assembly of telescopes.
- Interim team lead for the EPSRC robotics hub; spearheaded robot test-bed development and supervised 3 postdoctoral researchers.

NASA/CalTech Jet Propulsion Laboratory, Pasadena, California USA

Visiting Student Researcher **2016-2017**

- Led internal study to develop deployment models of origami-folded spacecraft.
- Collaborated on and proposed projects in JPL's Mobility & Robotics Section in the areas of multibody spacecraft dynamics modelling, simulation, and control.

The University of California, Davis

Ph.D Student

2009-2016

- Sole-author paper presents the first closed-form solution to the second Euler angle characterizing nutation of variable mass systems (e.g., rigid rocket motors).
- Formulated analytical theory to geometrically analyze the rotational stability of various types of rigid rocket motors.

Google Summer of Code (GSoC)

Student Developer

2012

- Awarded \$5,000 to develop software for SymPy that automates generation of equations of motion of mechanical systems by Lagrange's method.
- Collaborated on 1 conference paper and mentored student developers in 2015 and 2016.

INVITED TALKS

- [1] "Robotics and AI technologies for on-orbit assembly of large space telescopes", *Light Conference*, Changchun, China, July 16-17, 2018.
- [2] "Robotics and autonomous systems for future SSTL on-orbit servicing missions", Surrey Satellite Technology Limited, Guildford UK, March 23, 2018.

HONOURS AND AWARDS

Award	Description
JPL Visiting Student Research Program, 2016-17	Invited research opportunity with NASA JPL researchers
UC Davis Drake Fellowship, 2016-17	~ \$10,000 award recognizing academic record and promise of productive scholarship
Post-Candidacy NRST Fellowship, UC Davis, 2015-17	> \$30,000 award towards tuition fees
Teaching Assistant Consultant Fellowship, UC Davis, 2014-15	~ \$6,000 award for engaging with instructors and improving pedagogy
Google Summer of Code, 2012	\$5,000 award for open-source software development
N & M Sarigul-Klijn Space Engineering/Flight Research Award, UC Davis, 2011	\$1,500 award recognizing best PhD research proposal
UC Davis GEMA Fellowship, 2010	\$1,400 award recognizing academic progress

First-author journal publications demonstrating research leadership are marked * and supervised students are underlined. I group the peer-reviewed papers in two categories: (i) landmark papers (either sole-author paper demonstrating independence or invited papers with exceptionally high visibility) and (ii) co-authored technical articles.

2022

- * [1] Asci, S. and **Nanjangud, A.** “Towards A Generalizable Simulation Framework To Study Collisions Between Spacecraft And Debris”, *2022 AAS/AIAA Astrodynamics Specialist Conference*, , Charlotte, N.C., USA, Paper Number AAS-22-705 (Aug 7-11, 2022).
- * [2] **Nanjangud, A.**, Underwood, C., Bridges, C. P., Saa, C. M., Eckersley, S., Sweeting, M., and Bianco. P. “Towards Robotic On-Orbit Assembly of Large Space Telescopes: Mission Architectures, Concepts, and Analyses”, *Acta Astronautica* (Submitted)
- * [3] Asci, S. and **Nanjangud, A.** “Towards A Generalizable Simulation Framework To Study Collisions Between Spacecraft And Debris”, (In Preparation, estimated submission: September 2022).
- * [4] **Nanjangud, A.**, Asif, M., and Asci, S. “An Interactive Textbook for Introductory Computational Multibody Dynamics”, *Journal of Open Source Education* (In Preparation, estimated submission: July 2022).

Landmark Papers

- * [5] **Nanjangud, A.** “Geometry of motion and nutation stability of free axisymmetric variable mass systems”, *Nonlinear Dynamics*, **94**(3), pp. 2205-2218, (2018). (**IF 4.339, top-ranked Q1 journal in ‘AEROSPACE ENGINEERING’ on Scopus and ‘NONLINEAR SCIENCE’ in Google Scholar.**)
- * [6] **Invited Paper in Special Issue on ‘Small Satellites’**
Nanjangud, A., Blacker, P. C., Bandyopadhyay, S., and Gao, Y. “Robotics and AI-enabled on-orbit operations with future generation of small satellites”, *Proceedings of the IEEE*, **106**(3), pp. 429-439, (2018). (**IF 9.107, Q1 journal with fourth highest h-index in ‘ELECTRICAL AND ELECTRONIC ENGINEERING’.**)

Technical Papers

- * [7] **Nanjangud, A.** and Eke, F. O. “Angular momentum of free variable mass systems is partially conserved”, *Aerospace Science and Technology*, **79**, pp. 1-4, (2018). (**Top eight Q1 journal in ‘AEROSPACE ENGINEERING’ with IF 2.228.**)
- * [8] **Nanjangud, A.** and Eke, F. O. “Approximate solution to the angular speeds of a nearly-symmetric mass-varying cylindrical body”, *The Journal of the Astronautical Sciences*, **64**(2), pp. 99-117, (2017). (**Among the oldest and most respected journals in ‘AEROSPACE ENGINEERING’ with IF 1.406.**)
- * [9] **Nanjangud, A.** and Eke, F. O. “Attitude dynamics of a near-symmetric variable mass cylinder”, *Advances in Astronautical Sciences*, **156**, pp. 2105-2121, (2016). (**Reputed conference proceedings ranked on Scopus under ‘AEROSPACE ENGINEERING’.**)

- [10] Gede, G., Peterson D. L., **Nanjangud, A.**, Moore, J. K. and Hubbard, G. “Constrained multibody dynamics with python: from symbolic equation generation to publication” *ASME 2013 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference*. American Society of Mechanical Engineers, (2013).
- * [11] **Nanjangud, A.** and Eke, F. O. “Lagrange’s equations for rocket-type variable mass systems”, *International Review of Aerospace Engineering*, 5(5), pp. 256-260, (2012). (**Top ten Q1 journal in ‘AEROSPACE ENGINEERING’ WITH IF 1.411.**)

CONFERENCE
PUBLICATIONS
AND ORAL
PRESENTATIONS

- [12] Nair, M. H., Saaaj, C. M., Esfahani, A. G., **Nanjangud, A.**, Eckersley, S., and Bianco. P. “In-Space Robotic Assembly and Servicing of High-Value Infrastructure”, *Proceedings of the 71st International Astronautical Congress*, Bremen, Germany, Paper Number IAC-20-B4.27x59387 (2020).
- * [13] **Nanjangud, A.**, Underwood, C., Bridges, C. P., Saaaj, C. M., Eckersley, S., Sweeting, M., and Bianco. P. “Towards Robotic On-Orbit Assembly of Large Space Telescopes: Mission Architectures, Concepts, and Analyses”, *Proceedings of the 70th International Astronautical Congress*, Washington, D.C., USA, Paper Number IAC-19-D1.6.6x54139 (2019).
- * [14] **Nanjangud, A.**, Young, A., Blacker, P. C., Underwood, C., Saaaj, C. M., Eckersley, S., Sweeting, M., and Bianco. P. “Robotic Architectures for the On-Orbit Assembly of Large Space Telescopes”, *15th Symposium Advanced Space Technologies in Robotics and Automation conference* at ESA-ESTEC, Noordwijk, the Netherlands.
- [15] Blacker, P. C., Ors, T., and **Nanjangud, A.**, “Planetary rovers - paving the way for human exploration”, *Reinventing Space*, British Interplanetary Society, 2018. (Abstract and oral presentation).
- [16] Eckersley, S., Saunders, C., Gooding, D., Sweeting, M., Whiting, C., Ferris, M., Friend, J., Forward, L., Aglietti, G., **Nanjangud, A.**, Blacker, P. C., Underwood, C., Bridges, C., and Bianco. P. “In-orbit assembly of large spacecraft using small spacecraft and innovative technologies”, *Proceedings of the 69th International Astronautical Congress, Bremen, Germany, 1st-5th*, Paper Number IAC-18,B4,6A,1,x43225 (2018).

TECHNICAL
REPORTS

The following reports are part of an ongoing study that I am leading at the Surrey Space Centre for SSTL as the end-user. As this is industry-funded research by Airbus, these documents are not available in the public domain.

- [17] “Mission concepts review and architecture definition for on-orbit assembly”.
- [18] “Requirements, Mission Architectures, and Concepts towards On-orbit Assembly of Large Space Telescopes”.

PUBLIC AND
COMMUNITY
ENGAGEMENT

The University of California, Davis

Outreach-related Teaching Assistantships (TAship)

2010-2016

- Taught engineering fundamentals to 25 high school students from California.
- Led ‘Space Sciences’ tours for Japanese exchange middle-school students to NASA Ames Research Center and robotics companies in California.

Center for Excellence in Teaching & Learning, UC Davis

Teaching Consultant Fellow

2014-2015

- Led UC Davis Teaching Assistant orientation with a team of consultants.
- Conducted professional development workshops for instructors.
- Consultations with instructors to improve student learning experience.

SELECTED
TEACHING
EXPERIENCE

University of Surrey

Lecturer and Laboratory Teaching Assistant

2018

- Spacecraft Guidance, Navigation, and Control (2019): Delivered guest lecture on spacecraft attitude dynamics and control.
- Control Theory (2019): Delivered two lectures (5 hours total) on introduction to classical control theory.
- Spacecraft Engineering Laboratory (2018): Assisted with lab course introducing students to spacecraft subsystems.

The University of California, Davis

Lecturer (for 2 semesters)

2015-2016

- Dynamics: As a PhD student, I had the **unique opportunity** to serve as the instructor for this core undergraduate mechanical and aerospace engineering course. Outstanding student evaluations in my first appointment led to a second term. My responsibilities included course design, delivering lectures, writing exams, and managing teaching assistants; active learning strategies were incorporated in the classroom.

Teaching Assistant

2010-2016

- Automatic Control Theory : This is the upper division undergraduate course on topics in the realm of classical feedback control design such as root-locus and bode plots. My responsibilities included weekly recitations, 2 guest lectures, preparing solutions to homeworks, holding office hours, and grading responsibilities.
- Vehicle Stability and Control : This is an upper division undergraduate course on dynamics of transportation vehicles with examples drawn from aircraft, high-performance automobiles, rail cars, and boats. Laboratory experiments illustrate the dynamic behavior of automobiles, race cars, bicycle. Apart from regular TA responsibilities, I also coordinated demonstrations of experiments at the California Highway Patrol and a flying school, the Cal Aggie Flying Farmers Association.
- Experimental Methods: This is an upper division laboratory course to study mechanical systems using data acquisition systems and basic sensors such as load cells, accelerometers, strain gauges, and microphones. As lead TA for several quarters, I served as the unofficial lab instructor, and also trained other TAs. Additional responsibilities included delivering stand-in lectures.
- Introduction to Numerical Analysis and Methods : This is an upper division undergraduate course on numerical analysis of nonlinear equations and sets of linear equations, numerical integration, and ordinary differential equations.

STUDENTS
MENTORED

@PhD

Simone Asci (at Queen Mary University of London)

Peter Blacker (at University of Surrey)

@MSc/MEng

Mughees Asif (at Queen Mary University of London)

Priyanka Prabhath (at Queen Mary University of London)

Marco Anselmi (at Queen Mary University of London)

James O'Farrell (at University of Surrey)

Alex Young (at University of Surrey)