Manan Arya

Curriculum Vitæ

Contact Information

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Pasadena, California 91109 USA

Education

06/2016 **PhD in Space Engineering**
Graduate Aerospace Laboratories
California Institute of Technology, Pasadena, California

06/2012 **Master of Science in Space Engineering**
Graduate Aerospace Laboratories
California Institute of Technology, Pasadena, California

06/2011 **Bachelor of Applied Science in Engineering Science**
Major in Aerospace Engineering
University of Toronto, Ontario, Canada

Experience

08/2016 - present **Technologist**
Jet Propulsion Laboratory
California Institute of Technology

I develop and mature technologies to enable the next generation of lightweight unfoldable spacecraft structures. I coordinate with JPL engineers and small business contractors to design, analyze, and test solutions for deployable starshades. I have designed and tested origami-inspired folding schemes for starshade structures. I lead a team that is advancing deployable antenna reflector technology for small satellites; these reflectors use ultrathin fiber-reinforced composite materials. I supervise postdoctoral fellows and students.

10/2011 - 06/2016 **Graduate Student**
Supervisor: Professor Sergio Pellegrino
Space Structures Laboratory
California Institute of Technology

I designed novel breakthrough schemes for the packaging and deployment of large thin space structures such as photovoltaic arrays, solar sails, reflectors, and sunshields. I performed experiments on scale test articles and developed analytical models to capture observed behavior. I applied these methods for the preliminary design of a large spacecraft for a space solar power station. As a side project, I developed and supervised the fabrication of an engineering model of an optical camera for a mission to demonstrate key technologies for a reconfigurable space telescope.

05/2011 - 08/2011 **Patent Agent's Assistant**
Hill & Schumacher
Toronto

I drafted and prosecuted patents for clients in academia and industry in the fields of space robotics, polymer chemistry, organometallic chemistry, and medical devices. I submitted and prosecuted applications in the United States Patent Office (USPTO), Canadian Intellectual Property Office (CIPO), and the European Patent Office (EPO).

09/2010 - 04/2011 **Undergraduate Thesis**
Supervisor: Professor Chris Damaren
University of Toronto Institute for Aerospace Studies

I modeled the dynamics of solar sailcraft, with emphasis on the coupling between the sail membrane dynamics and the attitude control system. I designed an attitude controller to reduce sail membrane deflections. Numerical simulations demonstrated a fivefold reduction in peak sail deflection during test slew manœuvres.

05/2010 - 09/2010 **Undergraduate Research Student**
Supervisor: Professor Craig A. Steeves
Multifunctional Structures Laboratory
University of Toronto Institute for Aerospace Studies

I analysed the propagation of acoustic waves in three-dimensional periodic lattice structures using finite element methods and Bloch-Floquet principles. I implemented a C++ computer program to perform such analyses for three-dimensional lattices with arbitrary topologies. I developed optimization schemes for the design of lattices with desired acoustic frequency bandgaps.

Publications

2020 — **M. Arya**, F.S. Mechentel, D.R. Webb, J. Steeves, P.D. Lisman, S.B. Shaklan, S.C. Bradford, E. Kelso, K. Neff, A. Swain, A. Iskra, N. Beidleman, J.D. Stienmier, G. Freebury, A. Tomchek, T. Thomas, C. Hazelton, K. Butler, K. Medina, M. Pulford, L. Adams, D. Hepper, and D. Turse, "Demonstration of deployment repeatability of key subsystems of a furled starshade architecture", (submitted for publication)

10/2020 — P. McGarey, S. Bandyopadhyay, R. Rafizadeh, A. Goel, **M. Arya**, I. Nesnas, J. Lazio, P. Goldsmith, A. Stoica, M. Quadrelli, G. Hallinan, "A Concept for the Deployment of a Large Lunar Crater Radio Telescope using Teams of Tethered Robots", *International Symposium on Artificial Intelligence, Robotics, and Automation*, October 2020

07/2020 — N.A. Pehrson, D.C. Ames, S.P. Smith, S.P. Magleby, and **M. Arya**, "Self-Deployable, Self-Stiffening, and Retractable Origami-Based Arrays for Spacecraft", *AIAA Journal*, vol 58, no 7, pp 3221-3228, July 2020

01/2020 — **M. Arya**, D. Webb, J. Steeves, P.D. Lisman, P.A. Willems, S.C. Bradford, E. Kelso, K. Neff, N. Beidleman, J.D. Stienmier, G. Freebury, A. Tomchek, T. Thomas, C. Hazelton, K. Butler, K. Medina, M. Pulford, L. Adams, D. Hepper, and D. Turse, "Demonstration of Deployment Accuracy of the Starshade Inner Disk Subsystem", *7^{th} Spacecraft Structures Conference*, AIAA 2020-1670, January 2020, Orlando FL

01/2019 — **M. Arya**, J.F. Sauder, R. Hodges, and S. Pellegrino, "Large-Area Deployable Reflectarray Antenna for CubeSats", *6^{th} Spacecraft Structures Conference*, AIAA 2019-2257, January 2019, San Diego CA

01/2019 — J.F. Sauder, **M. Arya**, N. Chahat, E. Thiel, S. Dunphy, M. Shi, G. Agnes, and T. Cwik, "Deployment Mechanisms for High Packing Efficiency One-Meter Reflectarray Antenna (OMERA)", *6^{th} Spacecraft Structures Conference*, AIAA 2019-0755, January 2019, San Diego CA

08/2017 — **M. Arya**, D. Webb, J. McGown, P.D. Lisman, S. Shaklan, S.C. Bradford, J. Steeves, E. Hilgemann, B. Trease, M. Thomson, S. Warwick, G. Freebury, and J. Gull, "Starshade mechanical design for the Habitable Exoplanet Imaging Mission Concept (HabEx)", Proc. SPIE 10400, Techniques and Instrumentation for Detection of Exoplanets VIII, 104001C, 2017

2017 — C.A. Steeves, G.D. Hibbard, **M. Arya**, and A.T. Lausic, "Dynamics of Nanolattices: Polymer-Nanometal Lattices" in *Dynamics of Lattice Materials*, A.S. Phani and M.I. Hussein, eds, Chichester, United Kingdom: John Wiley & Sons, Inc., 2017

03/2017 **M. Arya**, N. Lee, and S. Pellegrino, "Crease-free biaxial packaging of thick membranes with slipping folds", *International Journal of Solids and Structures*, vol 108, pp 24-30, March 2017

06/2016 **M. Arya**, "Packaging and Deployment of Large Planar Spacecraft Structures", PhD Thesis, California Institute of Technology

01/2016 **M. Arya**, N. Lee, and S. Pellegrino "Ultralight Structures for Space Solar Power Spacecraft", *3rd AIAA Spacecraft Structures Conference*, January 2016, San Diego CA

01/2015 **M. Arya**, N. Lee, and S. Pellegrino "Wrapping thick membranes with slipping folds", *56th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, January 2015, Kissimmee FL

01/2014 **M. Arya** and S. Pellegrino "Unfolding mechanics of highly compacted thin membrane structures", *55th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, January 2014, National Harbor MD

06/2011 **M. Arya** and C.A. Steeves "Bandgaps in octet truss lattices", *23rd Canadian Congress of Applied Mechanics*, June 2011, Vancouver

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Patents

06/2020 S. Pellegrino, H.A. Atwater, S.A. Hajimiri, **M. Arya**, C. Leclerc, and N. Lee, "Large-area structures for compact packaging", US Patent No. 10,696,428 B2.

07/2019 S. Pellegrino, H.A. Atwater, S.A. Hajimiri, **M. Arya**, N. Lee, and M. Delapierre, "Large-scale space-based solar power station: packaging, deployment and stabilization of lightweight structures ", US Patent No. 10,340,698.

04/2019 T.A. Cwik, N.E. Chahat, J. Sauder, **M. Arya**, and E. Thiel, "Deployable reflectarray antenna", US Patent No. 10,276,926 B2.

12/2018 H.A. Atwater, S.A. Hajimiri, S. Pellegrino, B. Abiri, F. Bohn, J.P. Bosco, D. Callahan, E.C. Warmann, **M. Arya**, N. Lee, and M. Delapierre, "Large-scale space-based solar power station: multi-scale modular space power", US Patent No. 10,144,533 B2.

Scholarships and Awards

06/2015, 06/2014 Charles D. Babcock Award
from GALCIT for contributions in teaching

05/2011 Ontario Graduate Scholarship (declined)

09/2010	John M. Empey Scholarship from the University of Toronto for academic excellence
05/2010	Undergraduate Student Research Award from the National Science and Engineering Research Council
09/2009	Shaw Design Scholarship from the University of Toronto for academic excellence
05/2008 - 05/2011	Dean's Honour List Faculty of Applied Science and Engineering, University of Toronto
09/2007	University of Toronto Scholars Program
09/2007 - 09/2010	Queen Elizabeth II Aiming for the Top Scholarship
05/2007	Governor General's Academic Medal
05/2007	Summa cum laude, International Baccalaureate Program

Outreach and Teaching

05/2019 **Workshop Lead**
Atlas Obscura/The New York Times LA Science Weekend

I developed and ran an interactive workshop to demonstrate and explain the role of origami in the engineering of deployable structures. I led the participants in the folding and construction of origami models.

05/2018 **Invited Speaker**
The Knowledge Society Summit

I gave a talk to high school students explaining my work. I interacted with small groups to share my story.

03/2018 **Origami Artist and Exhibitor**
San Diego Festival of Science and Engineering

I created and exhibited interactive large-scale origami sculptures and explained the role of origami in the engineering of spacecraft structures.

02/2016 - 03/2016 **Instructor**
Space Origami Engineering
Esteban E Torres High School

I developed and taught a course for high school seniors on the mathematics of origami and the application thereof to the engineering

of spacecraft structures. Theoretical material was supplemented by hands-on construction of relevant origami and structural models. This activity was sponsored by the Huntington Library.

10/2013 - 06/2015 **Teaching Assistant**
Ae105abc - Aerospace Engineering
California Institute of Technology

I held weekly office hour sessions. I graded homeworks and midterms. I managed the class website. I rectified accidental misunderstandings about course material.

Community Involvement

09/2014 - 06/2016 **Vice President, Secretary**
EXPLiCIT (EXtracurricular PLayers at the California Institute of Technology)
EXPLiCIT is the student theater group at Caltech. As Vice President, I supported the President. As Secretary, I took notes at meetings and maintained the club Constitution.

07/2012 - 06/2013 **Vice President**
Students for the Exploration and Development of Space (SEDS)
Caltech Chapter

I organized various events relating to space, space exploration and astronomy. The mandate of SEDS is to share our enthusiasm for space with the broader community.

09/2008 - 05/2009 **Secretary, Executive Council**
Innis Residence Council
University of Toronto

I was a member of the executive of the student government of Innis Residence. I was responsible for calling, managing and presiding over council meetings, as well as managing the internal and external communications of the Council.

Los Angeles, October 18, 2020