

# Manan Arya

## Curriculum Vitæ

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### Contact Information

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### Experience

02/2022 - present **Assistant Professor**, Department of Aeronautics and Astronautics  
Stanford University

I founded and lead the Morphing Space Structures Laboratory at Stanford University. Our research focuses on novel shape-changing structures, including deployable structures for spacecraft. Attaining high performance parameters, e.g. stiffness, thermal stability, deployment accuracy, is a key design driver. A particular focus is enabling higher-performance small spacecraft through the use of breakthrough designs for large deployable structures on such craft. Other research interests include novel lightweight composite materials to enable innovative structural design, and the spaceflight testing of such structures.

08/2016 - 01/2022 **Technologist**, Advanced Deployable Structures Group  
[Jet Propulsion Laboratory](#), California Institute of Technology

I developed and matured technologies to enable the next generation of lightweight unfoldable spacecraft structures. I coordinated with JPL engineers and small business contractors to design, analyze, and test solutions for deployable [starshades](#). I designed and tested origami-inspired folding schemes for starshade structures. I led a multi-organization team to advance deployable antenna reflector technology for small satellites; these reflectors use ultrathin fiber-reinforced composite materials. I supervised 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 manoeuvres.

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.

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## Publications

- 01/2022 **M. Arya**, R. Hodges, J.F. Sauder, S. Horst, M. Mobrem, A. Pedivelano, A. Wen, A. Truong, S. Pellegrino, “Lightweight composite reflectarray that can be flattened, folded, and coiled for compact stowage”, *9<sup>th</sup> Spacecraft Structures Conference*, AIAA 2022-1886, January 2022, San Diego CA
- 01/2022 B.Y. Dharmadasa, J.M. Mejia-Ariza, **M. Arya**, J.F. Sauder, P. Focardi, S.C. Bradford, F. Lopez Jimenez, “Design of Flexures for Deployable Reflectarrays using High Strain Composites”, *9<sup>th</sup> Spacecraft Structures Conference*, AIAA 2022-0651, January 2022, San Diego CA
- 03/2021 S. Bandyopadhyay, P. McGarey, A. Goel, R. Rafizadeh, M. Delapierre, **M. Arya**, J. Lazio, P. Goldsmith, N. Chahat, A. Stoica, M. Quadrelli, I. Nesnas, K. Jenks, G. Hallinan, “Conceptual Design of the Lunar Crater Radio Telescope (LCRT) on the Far Side of the Moon”, *IEEE Aerospace Conference*, March 2021
- 04/2021 **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”, *Journal of Astronomical Telescopes, Instruments, and Systems*, vol 7, no 2, 021202, 2021
- 01/2021 **M. Arya**, D.R. Webb, S.C. Bradford, L. Adams, V. Cormarkovic, G. Wang, M. Mobrem, K. Neff, N. Beidleman, J.D. Stienmier, G. Freebury, K.A. Medina, D. Hepper, D.E. Turse, G. Antoun, C. Rupp, and L. Hoffman, “Origami-Inspired Optical Shield for a Starshade Inner Disk Testbed: Design, Fabrication, and Analysis”, *8<sup>th</sup> Spacecraft Structures Conference*, AIAA-2021-0904, January 2021
- 01/2021 J.F. Sauder, C.A. Gebara, and **M. Arya**, “A Survey of CubeSat Deployable Structures: The First Decade”, *8<sup>th</sup> Spacecraft Structures Conference*, AIAA 2021-1704, January 2021
- 2020 N. Chahat, **M. Arya**, J.F. Sauder, E. Thiel, M. Zhou, and T. Cwik, “One Meter Reflectarray Antenna: OMERA”, in *CubeSat Antenna Design*, N. Chahat ed., Piscataway, NJ: IEEE Press, 2020
- 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<sup>th</sup> 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<sup>th</sup> 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<sup>th</sup> 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”, *3<sup>rd</sup> AIAA Spacecraft Structures Conference*, January 2016, San Diego CA
- 01/2015 **M. Arya**, N. Lee, and S. Pellegrino “Wrapping thick membranes with slipping folds”, *56<sup>th</sup> 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”, 55<sup>th</sup> 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”, 23<sup>rd</sup> Canadian Congress of Applied Mechanics, June 2011, Vancouver

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## Patents

07/2021 **M. Arya**, J.F. Sauder, R.E. Hodges, S. Pellegrino, “Large aperture deployable reflectarray antenna”, US Patent No. 11,063,356 B2.

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.

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## 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

## 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](#)
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## 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.

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## Community Involvement

01/2021 - present **Vice-Chair, Secretary**  
AIAA Spacecraft Structures Technical Committee (SSTC)  
The AIAA SSTC organizes the community of spacecraft structures researchers, developers, and builders across academia, industry, and government, and organizes the annual Spacecraft Structures conference at the AIAA SciTech forum.

09/2014 - 06/2016 **Vice President, Secretary**  
[EXPLiCIT \(EXtracurricular PLayerS at the California Institute of Technology\)](#)  
EXPLiCIT is the student theater group at Caltech that organizes the community of theater lovers and performers at Caltech, including producing at least one summer play.

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.

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Palo Alto, February 6, 2022