

# Manan Arya

## Curriculum Vitæ

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### Contact Information

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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
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### Experience

- 08/2016 - present **Technologist**  
[Jet Propulsion Laboratory](#)  
California Institute of Technology

I develop technologies to enable the next generation of deployable spacecraft structures. Currently, I work on both large structures such as [starshade](#) and small structures such as antennas for CubeSats.

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 a variety of clients, both industrial and academic, in the fields of space robotics, polymer chemistry, organometallic chemistry, medical devices, and others. 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 examined the dynamics of solar sails, in particular the coupling between the sail membrane dynamics and the attitude control system. I modelled the dynamics of the solar sail, and 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 used this analysis to create schemes for the design of lattices with desired acoustic frequency bandgaps. Fur-

ther, I implemented a C++ computer program to perform such analyses for three-dimensional lattices with arbitrary topologies.

05/2009 - 09/2009

**Lab Assistant**

Supervisor: Dr. Reza Emami

University of Toronto Institute for Aerospace Studies

I designed the mechanical system for a mechatronic device intended for patenting and commercialisation. I integrated the mechanical design with the electrical and computer systems of the device. I used CAD tools to model the mechanical system. I also created several working prototypes of the device as proof-of-concepts.

05/2008 - 09/2008

**Research Assistant**

Supervisor: [Mr. Steve Engels](#)

[Department of Computer Science](#), University of Toronto

I assisted with the development of a video game design course. I tested software tools for video game design, and evaluated them on the basis of accessibility and usability.

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## Publications

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

01/2019

N.A. Pehrson, S.P. Smith, D.C. Ames, S.P. Magleby, and **M. Arya**, Self-Deployable, Self-Stiffening, and Retractable Origami-Based Arrays for Spacecraft, *6<sup>th</sup> Spacecraft Structures Conference*, AIAA 2019-0484, January 2019, San Diego CA

08/2017

**M. Arya**, et al., "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

- 06/2020 S. Pellegrino, H.A. Atwater, S.A. Hajimir, **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. De-

lapierre, “Large-scale space-based solar power station: multi-scale modular space power”, US Patent No. 10,144,533 B2.

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## Scholarships and Awards

06/2015, 06/2014	Charles D. Babcock Award from GALCIT for contributions in teaching
05/2011	<a href="#">Ontario Graduate Scholarship</a> (declined)
09/2010	John M. Empey Scholarship from the University of Toronto for academic excellence
05/2010	<a href="#">Undergraduate Student Research Award</a> from the <a href="#">National Science and Engineering Research Council</a>
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	<a href="#">Governor General’s Academic Medal</a>
05/2007	Summa cum laude, <a href="#">International Baccalaureate Program</a>

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## Outreach and Teaching

05/2019	<b>Workshop Lead</b> 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	<b>Invited Speaker</b> The Knowledge Society Summit  I gave a talk to high school students explaining my work. I interacted with small groups to share my story and to inspire the students.

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 five-session 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

09/2014 - 06/2016

**Vice President, Secretary**  
[EXPLiCIT \(EXtracurricular PLayers at the California Institute of Technology\)](#)

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.

09/2007 - 05/2008

**Yearbook Editor**

Innis Residence  
University of Toronto

I organised and lead a team of 25 individuals to produce a digital yearbook. I was responsible for the overall design, production, marketing and sales of the yearbook.

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**References**

Available upon request

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Los Angeles, July 8, 2020