Niyati Desai

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Ph.D. in Space Engineering with 6+ years of experience in high-contrast imaging testbeds, coronagraph design, and wavefront control. Proven leadership in experimental optics and space instrumentation development for exoplanet direct imaging.

Education

2019 – 2024 **Ph.D. in Space Engineering**
California Institute of Technology, *GALCIT*
Advisor: Dimitri Mawet, Professor of Astronomy

2019 – 2020 **M.Sc. in Space Engineering**
California Institute of Technology, *GALCIT*

2015 – 2019 **B.Sc. in Physics**
Massachusetts Institute of Technology, *Physics Department*

B.Sc. in Aerospace Engineering
Massachusetts Institute of Technology, *Aero/Astro Department*

Skills

Optical design: FALCO, HCIPy
Simulation: MATLAB, Python
Experimental: mask metrology, EFC, in-air testbeds, self-coherent camera

Research, Teaching and Engineering Positions

Jul 2024 – Present **Jet Propulsion Laboratory,** *NASA Postdoctoral Fellow*
Astrophysics Division: Led the development and testing of vortex coronagraph masks on the IACT testbed, achieving the highest reported in-air contrast for the scalar vortex architecture to date.

Feb – May 2023 **Jet Propulsion Laboratory,** *Optics Intern*
High Contrast Imaging Testbed Facility: Implemented and performed the first experimental comparison of 3 different wavefront sensing and electric field conjugation algorithms on a single testbed.

2020 – 2024 **Caltech Exoplanet Technology Lab,** *Graduate Research Assistant (2020-2024), Postdoc (2024)*
Exoplanet Technology Lab: Developed FALCO models for the scalar vortex coronagraph concept. Designed and built the first prototype and demonstrated it on the HCST testbed.

Jun – Aug 2019 **Honeybee Robotics,** *Robotics Intern*
System Engineering: Designed modular systems architecture for robotic motion control tasks.

Jun – Aug 2018 **Jet Propulsion Laboratory,** *Flight Instruments Intern*
Nancy Grace Roman Space Telescope: Wrote EMCCD cosmic ray detection/removal algorithms.

Jun – Aug 2017 **Northrop Grumman,** *Integration and Testing Intern*
James Webb Space Telescope: Coded telemetry scripts for spacecraft command and data handling.

Jan – Jun 2016 **Computer Science and Artificial Intelligence Laboratory,** *Undergraduate Researcher*
Interactive Robotics Group: Tested human and autonomous agent communication models.

Awards and Fellowships

SPIE Overall Best Paper, Astronomical Telescopes + Instrumentation: Optical, Infrared, and Millimeter Wave *(2024)*

NASA Postdocotral Program Fellow, ORAU *(2024)*

Amelia Earhart Fellow, Zonta International *(2023)*

Three Minute Thesis: 1st Place Winner, Caltech Libraries *(2023)* https://www.youtube.com/watch?v=Gi0ZvqvVayE

AAS International Travel Grant, National Science Foundation *(2023)*

KISS Affiliate, Keck Institute for Space Studies *(2021)*

Admiral Luis de Florez Award for Original Thinking or Ingenuity, MIT Aero Astro *(2019)*

2nd Place in Physics, Intel International Science Engineering Fair *(2015)*

Regional Finalist, Siemens Competition in Math, Science and Technology *(2015)*

Simons Research Fellow, Stony Brook University *(2014)*

Research Talks

Technical Presentations

Aug 2025	SPIE Optics and Photonics: Contributed Talk
Jul 2025	Towards the Habitable Worlds Observatory: Contributed Talk
Dec 2024	JPL Poster Research Day: Contributed Poster
	Fraunhofer Institute for Applied Optics and Precision Engineering: Technical Seminar
	Carl Zeiss Jena Microoptics and Fabrication Group Technical Seminar
Oct 2024	NASA APRA PI Review Workshop: APRA Review talk
Sep 2024	Keck Institute for Space Studies Workshop: Metasurface Optics for High Contrast Imaging *(Invited Workshop)*
Jun 2024	SPIE Astronomical Telescopes + Instrumentation: Contributed Talk
Jan 2024	Goddard Spaceflight Center Exoplanet Series Seminar
	Space Telescope Science Institute Seminar at Johns Hopkins University
Oct 2023	2nd International Vortex Workshop: Two Contributed Talks *(Invited Workshop)*
Aug 2023	SPIE Optics and Photonics: Contributed Talk
	SPIE Optics and Photonics: Two Poster Presentations
Jun 2023	Adaptive Optics for Extremely Large Telescopes: Contributed Poster
	Seminar at Institut de Planétologie et d'Astrophysique de Grenoble
Feb 2023	Lorentz Center Workshop: Optimal Exoplanet Imagers *(Invited Workshop)*
Nov 2022	Network of Young Researchers in Instrumentation for Astronomy (NYRIA) Workshop
	Planetary & Stellar systems Imaging Lab Group Seminar at Université de Liège
Sept 2022	Exoplanet Group Seminar at University of California Santa Barbara
Jul 2022	SPIE Astronomical Telescopes + Instrumentation: Poster Presentation
Jun 2022	Spirit of Lyot: Poster Presentation
	High Angular Resolution for Astrophysics Seminar at the Paris Observatory
Aug 2021	SPIE Optics and Photonics: Contributed Talk

Public Talks

Jul 2025	JPL Summer Intern Science 101 Series Seminar
Mar 2024	Zonta LA Chapter: Aerospace Career Talk
Jan 2024	LA Astronomy on Tap Public Outreach Lecture
Feb 2023	GALCIT Graduate Student Lunch Lecture Series
Apr 2023	Three Minute Thesis: Caltech Libraries
Oct 2022	Yucca Valley Hi-Desert Museum Outreach Talk
Sept 2022	Caltech Associates Keynote Speaker

Scientific Publications

Peer-Reviewed Journal Articles (first author)

1. **N. Desai**, D. Mawet, G. Ruane, D. Shanks, L. König, S. Redmond, E. Serabyn, and B. Mennesson, "Dual layer achromatic scalar vortex concept and design," In prep., 2025.
2. **N. Desai**, S. Redmond, G. Ruane, A. J. Riggs, and B. Mennesson, "High contrast demonstration of broadband scalar vortex with radial phase dimple," In prep., 2025.
3. **N. Desai**, D. Mawet, E. Serabyn, G. Ruane, A. Bertrou-Cantou, J. Llop-Sayson, and A. J. E. Riggs, "Benefits of adding radial phase dimples on scalar coronagraph phase masks," *Journal of Astronomical Telescopes, Instruments, and Systems*, vol. 10, no. 1, p. 015 001, 2024. DOI: 10.1117/1.JATIS.10.1.015001.
4. **N. Desai**, A. Potier, S. F. Redmond, G. Ruane, P. K. Poon, A. J. E. Riggs, M. Noyes, and C. M. Prada, "Comparative laboratory study of electric field conjugation algorithms," *Journal of Astronomical Telescopes, Instruments, and Systems*, vol. 10, no. 3, p. 035 001, 2024. DOI: 10.1117/1.JATIS.10.3.035001.

5. **N. Desai**, G. J. Ruane, J. D. Llop-Sayson, A. Betrou-Cantou, A. Potier, A. E. Riggs, E. Serabyn, and D. Mawet, "Laboratory demonstration of the wrapped staircase scalar vortex coronagraph," *Journal of Astronomical Telescopes, Instruments, and Systems*, vol. 9, no. 2, p. 025 001, 2023. DOI: 10.1117/1.JATIS.9.2.025001.

Conference Proceedings (first author)

1. **N. Desai**, G. Ruane, D. Shanks, L. König, S. Redmond, E. Serabyn, J. Llop-Sayson, and B. Mennesson, "Model validation and tolerancing of scalar vortex masks in the high contrast imaging testbed facility," In preparation for SPIE Optics and Photonics 2025, Conference 13627: Techniques and Instrumentation for Detection of Exoplanets XII, Aug. 2025.
2. **N. Desai**, D. Mawet, A. Bertrou-Cantou, M. Kraus, A. Deparnay, E. Serabyn, G. Ruane, and S. Redmond, "Prototype development of broadband scalar vortex coronagraphs with phase dimples for exoplanet imaging," in *Space Telescopes and Instrumentation 2024: Optical, Infrared, and Millimeter Wave*, vol. 13092, SPIE, 2024, p. 1 309 221. DOI: 10.1117/12.3020702.
3. **N. Desai**, A. Bertrou-Cantou, G. Ruane, J. Llop-Sayson, A. E. Riggs, E. Serabyn, and D. Mawet, "Achromatizing scalar vortex coronagraphs with radial phase mask dimples," in *Techniques and Instrumentation for Detection of Exoplanets XI*, vol. 12680, SPIE, 2023. DOI: 10.1117/12.2677224.
4. **N. Desai**, L. König, E. Por, R. Juanola-Parramond, R. Belikov, *et al.*, "Integrated photonic-based coronagraphic systems for future space telescopes," in *Techniques and Instrumentation for Detection of Exoplanets XI*, vol. 12680, SPIE, 2023. DOI: 10.1117/12.2677210.
5. **N. Desai**, A. Potier, G. Ruane, A. E. Riggs, P. K. Poon, M. Noyes, and C. Mejia Prada, "Experimental comparison of model-free and model-based dark hole algorithms for future space telescopes," in *Techniques and Instrumentation for Detection of Exoplanets XI*, vol. 12680, SPIE, 2023. DOI: 10.1117/12.2677040.
6. **N. Desai**, J. Llop-Sayson, A. Bertrou-Cantou, G. Ruane, A. E. Riggs, E. Serabyn, and D. Mawet, "Topological designs for scalar vortex coronagraphs," in *Space Telescopes and Instrumentation 2022: Optical, Infrared, and Millimeter Wave*, vol. 12180, SPIE, 2022, 121805H. DOI: 10.1117/12.2630950.
7. **N. Desai**, J. Llop-Sayson, N. Jovanovic, G. Ruane, E. Serabyn, S. Martin, and D. Mawet, "High contrast demonstrations of novel scalar vortex coronagraph designs at the high contrast spectroscopy testbed," in *Techniques and Instrumentation for Detection of Exoplanets X*, SPIE, 2021. DOI: 10.1117/12.2603953.

Co-authored Publications

1. L. König, **N. Desai**, S. Palatnick, O. Absil, D. Mawet, M. Millar-Blanchaer, and E. Serabyn, "Microstructured vortex and azimuthal cosine phase mask design for high-contrast imaging," *Journal of Astronomical Telescopes, Instruments, and Systems*, vol. 11, no. 02, Apr. 2025, ISSN: 2329-4124. DOI: 10.1117/1.jatis.11.2.025002.
2. L. Leboulleux, **N. Desai**, D. Echeverri, *et al.*, "A socio-demographic study of the exoplanet direct imaging community," Under review, Submitted to the Bulletin of the AAS, Mar. 2025.
3. A. Bertrou-Cantou, S. Redmond, D. Mawet, G. Sercel, D. Echeverri, **N. Desai**, J. Llop-Sayson, G. Ruane, E. Serabyn, and J. K. Wallace, "High-contrast spectroscopy testbed (HCST): tip/tilt sensing in reflection of the vector vortex coronagraph (VVC)," in *Space Telescopes and Instrumentation 2024: Optical, Infrared, and Millimeter Wave*, vol. 13092, SPIE, 2024, 130926B. DOI: 10.1117/12.3019237.
4. L. König, S. Palatnick, **N. Desai**, O. Absil, D. Mawet, M. Millar-Blanchaer, T. Wenger, and E. Serabyn, "Design and prototyping of broadband metasurface scalar phase masks for high-contrast imaging," in *Advances in Optical and Mechanical Technologies for Telescopes and Instrumentation VI*, vol. 13100, SPIE, 2024, p. 1 310 024. DOI: 10.1117/12.3020488.
5. J. Liberman, J. Llop-Sayson, A. Bertrou-Cantou, D. Mawet, **N. Desai**, S. Y. Haffert, and A. J. E. Riggs, "Implicit electric field conjugation through a single-mode fiber," 2, vol. 10, SPIE, 2024, p. 029 002. DOI: 10.1117/1.JATIS.10.2.029002.
6. S. Palatnick, L. König, M. Millar-Blanchaer, J. K. Wallace, E. Serabyn, D. Mawet, **N. Desai**, D. John, and J. A. Schuller, "Optimizing metasurfaces to achieve deeper direct imaging contrasts: analyses of current performance and lessons learned from fabrication," in *Advances in Optical and Mechanical Technologies for Telescopes and Instrumentation VI*, vol. 13100, SPIE, 2024, p. 1 310 063. DOI: 10.1117/12.3018594.
7. J. Fowler, S. Y. Haffert, M. A. M. van Kooten, *et al.*, "Visible extreme adaptive optics on extremely large telescopes: towards detecting oxygen in Proxima Centauri b and analogs," in *Techniques and Instrumentation for Detection of Exoplanets XI*, International Society for Optics and Photonics, vol. 12680, SPIE, 2023. DOI: 10.1117/12.2677503.
8. L. König, S. Palatnick, **N. Desai**, O. Absil, M. Millar-Blanchaer, and D. Mawet, "Metasurface-based scalar vortex phase mask design in pursuit of 1e-10 contrast," in *Techniques and Instrumentation for Detection of Exoplanets XI*, vol. 12680, SPIE, 2023. DOI: 10.1117/12.2676174.
9. J. Liberman, J. Llop-Sayson, A. Bertrou-Cantou, D. Mawet, A. J. E. Riggs, and **N. Desai**, "Implicit electric field conjugation for improved starlight rejection through a single-mode fiber," in *Techniques and Instrumentation for Detection of Exoplanets XI*, vol. 12680, SPIE, 2023. DOI: 10.1117/12.2677532.

10 P. Morrissey, L. Harding, N. Bush, *et al.*, "Flight photon counting electron multiplying charge coupled device development for the Roman Space Telescope coronagraph instrument," *Journal of Astronomical Telescopes, Instruments, and Systems*, vol. 9, no. 1, p. 016 003, Jan. 2023. DOI: 10.1117/1.JATIS.9.1.016003.

11 S. Palatnick, L. König, M. Millar-Blanchaer, J. K. Wallace, O. Absil, D. Mawet, **N. Desai**, D. Echeverri, D. John, and J. Schuller, "Prospects for metasurfaces in exoplanet direct imaging systems: From principles to design," in *Techniques and Instrumentation for Detection of Exoplanets XI*, vol. 12680, SPIE, 2023. DOI: 10.1117/12.2677834.

12 S. R. Vaughan, T. D. Gebhard, K. Bott, *et al.*, "Chasing rainbows and ocean glints: Inner working angle constraints for the Habitable Worlds Observatory," *Monthly Notices of the Royal Astronomical Society*, vol. 524, no. 4, pp. 5477–5485, Aug. 2023, ISSN: 0035-8711. DOI: 10.1093/mnras/stad2127.

Outreach & Leadership

Conference Organizing

- 6th Spirit of Lyot Local Organizing Committee *(Feb 2026)*
- KISS Institute for Space Studies Public Lecture Host *(2022 - 2024)*
- Caltech Undergraduate Summer Research Seminar Day Session Chair *(August 2024)*
- 2nd International Vortex Workshop: Scientific Organizing Committee *(Oct 2023)*
- SPIE Optics and Photonics: Session Chair: Coronagraph Testbeds and Results I *(August 2023)*
- Caltech Space Challenge Organizer *(2021-2022)*

Community Volunteering

- Caltech Astronomy Public Lectures, Panels, and Telescope Operation Volunteer *(2019-present)*
- Pasadena Unified School District Innovation Expo Judge *(2022-present)*
- Girl Scouts Spring into STEM Booth Organizer and Volunteer *(May 2024)*
- Caltech Admitted Graduate Student Panelist *Sep 2020 - Sep 2023*
- Women in Aerospace Engineering Student Mentor *2021-2023*
- JPL Explore Day Exoplanet Guide *(April 2023)*
- STEM Summer Camp Mentor *(Summer 2023)*

Hobbies

Sunday League Soccer · Baking sweet treats · Doodling and creating digital art · Caring for plants · Reading biographies and mysteries · Pickup Volleyball