

J. Kent Wallace

Curriculum Vitae

Contact Jet Propulsion Laboratory *phone:* (818) 393-7066
MS 306-366 *cell:* (626) 319-1067
4800 Oak Grove Dr. *email:* james.k.wallace@jpl.nasa.gov
Pasadena, CA 91109 **Citizenship:** United States

Research Interests Optical instruments and methods for precision measurements including: digital holographic microscopy, adaptive optics, stellar interferometry, and wavefront sensing and control. Broadly speaking, this work is directed towards the detection of life in the universe.

Education **M.S. in Optics** **University of Rochester, Rochester NY**
Thesis Title: *A Theoretical Limit to a Reversible Lens Design* September 1992
Advisor: Prof. Gregory W. Forbes

B.A. in Physics **Rose-Hulman Institute of Technology**
Minors: Mathematics, Russian May 1988

Honors And Awards NASA Honors Award: WFIRST Coronagraph TechDev Team Aug 2018
JPL Team Bonus: CGI WFIRST Coronagraph Tech Milestone May 2018
NASA Honors Award: Exoplanet Laser Frequency Comb Team Sept 2017
JPL Team Bonus: OpTIIX Team Aug 2013

Professional Experience Optical Architect, Keck Fiber Injection Unit 2014 – Present
Optical Scientist, Digital Holographic Microscope 2014 – Present
Optical Scientist, Zernike Wavefront Sensing 2014 – Present
Telescope System Engineer, WFIRST-AFTA Project 2013 – Present
Wavefront Sensing and Control Lead – OpTIIX Project for ISS 2011 – 2013
Technical Program Manager/Co-I – Gemini Planet Imager Calibration 2005 – 2011

Students Advised **Matthew Noyes – University of Arizona** Summer 2019
JPL Summer Student
Project: "A Compact Adaptive Optics System for Single-mode fiber instruments"

Eden McEwen – University of California Berkeley Summer 2019
JPL Summer Student
Project: "A realtime control system for Compact Adaptive Optics"

Alex Rodriguez – University of San Diego Summer 2019
WAVE Student
Project: “Polarization Sensing in Digital Holography”

Judah van Zandt – University of Notre Dame Summer 2018
JPL Summer Student
Project: “Spectral Calibration of an Optical Spectrometer”

Luke Gelfius – Rose-Hulman Institute of Technology Summer 2018
JPL Summer Student
Project: “Sample Chamber Design for Digital Holograph”

Rebecca Jensen-Clem - MIT Summer 2012
NASA Space Grant Student
*Project: “The Zernike Wavefront Sensor:
Sensitivity Analysis to Fourier and Zernike Modes”*

Matthew William Smith - MIT Summer 2006, 2008
JPL Summer Student
*Project: “The Effects of Optically Induced
Polarization on Null Depth”*

Selected NASA Earth Science Technology Forum, Ames June 2019
Contributed SPIE, Digital Holography + 3D Imaging, Bordeaux May 2019
Talks SPIE, Remote Sensing, Berlin September 2018
IEEE Aerospace Conference, Big Sky, MT March 2018

Instrumentation Common-mode Digital Holographic Microscope
Experience *Lead: Chris Lindensmith*
Designed a compact, robust holographic microscope to detect bacteria in extreme environments in situ. This instrument has successfully detected bacteria in every field test in which it has been deployed.

Keck Fiber Injection Unit
Lead: Dimitri Mawet
Architect for the fiber injection unit the purpose of which is to couple light into a single-mode fiber. This instrument works after the Keck Adaptive Optics System, and includes a secondary deformable mirror, a fast-steering mirror and tracking camera with integral Zernike wavefront sensor.

CARBO – The Carbon Balance Observatory

Lead: Chip Miller

Designed a compact, robust holographic microscope to detect bacteria in extreme environments in situ. This instrument has successfully detected bacteria in every field test in which it has been deployed.

LAEDI: Lock-In Amplified, Externally Dispersed Interferometer

Lead: Phil Muirhead/Gautam Vasisht

Responsible for instrument optical design including: 1) external Mach-Zehnder interferometer 2) echelle spectrograph and 3) Th/Ar source + stabilized laser source bench. Supported optical assembly and alignment as well as inter-institution hardware transfers.

P3K: P1640 Calibration Wavefront Sensor

Lead: Gautam Vasisht

Led the calibration sub-system optical alignment activity at JPL. Supported the integration of the system with the P1640 on the telescope.

Zernike Wavefront Sensor

Lead: J. Kent Wallace

Originated concept for an all-reflective implementation of the Zernike phase-contrast for use as a wavefront sensor. Led the proposal effort for internal JPL R&TD funding. Technical lead for the development of this wavefront sensor for Palomar.

CSO Submillimeter Zernike Wavefront Sensor

Lead: Matt Bradford/Steve Padin

Led the engineering activity to design, build, assemble and test a Zernike wavefront sensor for the CSO using static phase plates. This was to demonstrate the principle of this concept for CCAT segment phasing. Supported observing run at CSO.

Fiber Scrambler for NIR/RV at IRTF

Lead: Peter Plavchan

Designed, specified, procured optics and hardware for a mode scrambling upgrade to the MidIR CSHELL spectrograph for IRTF.

High-Contrast Imaging Testbed (HCIT): Self-coherent Camera

Lead: Stuart Shaklan

Designed, specified and fabricated custom Lyot pupil for speckle sensing at the science detector image plane.

GPI: Calibration Wavefront Sensor Unit

Lead: Bruce Macintosh, LLNL

JPL technical lead for post-coronagraph wavefront sensor for the Gemini Planet Imager. Led the proposal activity, and technical management of the instrument team.

PICTURE: Coronagraph on a sounding rocket

Lead: Mike Shao – JPL/ Supriya Chakrabarti - BU

Responsible for optical design of: fast-steering mirror relay, beam compressor, acquisition camera, angle-tracking camera, nulling interferometer, science and wavefront sensing arms of the instrument.

Palomar Well-Corrected Sub-Aperture

Lead: Gene Serabyn

Optical lead for the design and implementation of a relay to produce a 1.5 meter, un-obscured portion of the Hale Telescope pupil for demonstrating extreme adaptive-optics coronagraphy.

Palomar Testbed Interferometer

Lead: Mark Colavita

Optical lead for: outrigger telescope, acquisition system, delay line, beam switchyard, recombination tables, IR detector dewars, laser metrology.

Refereed Publications

Cohoe, D., Hanczarek, I., **Wallace, J. Kent**, and Nadeau, J., “[Multiwavelength digital holographic imaging and phase unwrapping of protozoa using custom Fiji plug-ins](#)”, *Frontiers in Physics*, Vol. 7, p. 94 (2019).

Ruane, G., Wang, J., Mawet, D., Jovanovic, N., Delorme, J.-R., Mennesson, B., and **Wallace, J. Kent**, “[Efficient spectroscopy of exoplanets at small angular separations with vortex fiber nulling](#)”, *The Astrophysics Journal*, Vol. 867, Issue 2, p. 143 (2018).

Marin, Z., **Wallace, J. Kent**, Nadeau, J., and Khalil, A., “[Wavelet-based tracking of bacteria in unreconstructed off-axis holograms](#)”, *Methods*, Vol. 136, Issue 2, pp. 60-65 (2018).

Serabyn, E., Liewer, K. and **Wallace, J. Kent**, “[Resolution optimization of an off-axis lensless digital holographic microscope](#)”, *Applied Optics*, Vol. 57, Issue 1, pp. A172-A180 (2018).

Bottom, M., **Wallace, J. Kent**, Bartos, R.D., Shelton, J.C., and Serabyn, E. “[Speckle suppression and companion detection using coherent differential imaging](#)”, *Monthly Notices of the Royal Astronomical Society*, Vol. 464, Issue 3, pp. 2937-2951 (2016).

Bottom, M., Shelton, J.C., **Wallace, J. Kent**, Bartos, R.D., Kuhn, J., Mawet, D., Mennesson, B., Burruss, R., and Serabyn, E. “[Stellar double coronagraph](#)”, *Publications of the Astronomical Society of the Pacific*, Vol. 128, Issue 965, pp. 1-13 (2016).

Lindensmith, C.A., Rider, S., Bedrossian, M., **Wallace, J. Kent**, Serabyn, E. “[A submersible, off-axis holographic microscope for detection of microbial motility and morphology in aqueous and icy environments](#)”, *PloS one*, Vol. 11, Issue 1, pp. 1-13 (2016).

Serabyn, E., **Wallace, J. Kent**, and Mawet, D., “[Speckle-phase measurement in a tandem-vortex coronagraph](#)”, *Applied Optics*, Vol. 50, Issue 28, pp. 5453-5456 (2011).

Mawet, D., Serabyn, E., **Wallace, J. Kent**, and Pueyo, L., “[Improved high-contrast imaging with on-axis telescopes using a multistage vortex coronagraph](#)”, *Optics Letters*, 36, pp. 1506-1508 (2011).

Sivaramakrishnan, A., Soummer, R., Pueyo, L., **Wallace, J. K.**, Shao, M., “[Sensing Phase Aberrations behind Lyot Coronagraphs](#)”, *ApJ*, Vol. 688 (2008).

Serabyn, E., **Wallace, J. Kent**, Troy, M., Mennesson, B., Haguenaer, P., Gappinger, R., “[Extreme adaptive optics imaging with a clear and well-corrected off-axis telescope sub-aperture](#)”, *Astrophys. J.*, 658, pp. 1386-1391 (2007).

Wallace, K., Hardy, G., Serabyn, E., “[Deep and Stable Interferometric Nulling of Broadband Light with Implications for Observing Planets around Nearby Stars](#)”, *Nature* 406, 700 (2000).

Colavita, M. M., **Wallace, J. K.**, Hines, B. E., Gursel, Y., Malbet, F., Palmer, D. L., Pan, X. P., Shao, M., Yu, J. W., Boden, A. F., van Belle, G. T., (The PTI Collaboration), “[The Palomar Testbed Interferometer](#)”, *The Astrophysical Journal*, 510, 505 (1999).

Forbes, G. W. and **Wallace, J. K.**, “[Can the bounds to system performance in geometrical optics be obtained?](#)”, *Opt. Soc. Am.*, A 12, 2064-2071 (1995).

**Selected
Proceedings
And Other
Publications**

Wallace, J. K., “[Common-path interferometric wavefront sensing for space telescopes](#)”, IEEE Aerospace Conference, (March 2012)

Wallace, J. Kent, Rao, S., Jensen-Clem, R., Serabyn, E., “[Phase-shifting Zernike interferometer wavefront sensor](#)”, *Proc. SPIE*, Vol. 8126 (Sept. 2011).

Wallace, J. K., Burruss, R. S., Bartos, R. D., T. Q. Trinh, L. A. Pueyo, S. F. Fregoso, Angione, J. R. and Shelton, J. C., “[The Gemini Planet Imager calibration wavefront sensor instrument](#)”, *Proc. SPIE*, Vol. 7736, 77365D (2010)

Shao, M., Levine, B. M., **Wallace, J. K.**, Orton, G. S., Schmidtlin, E., Lane, B. F., Seager, S., Tolls, V., Lyon, R. G., Samuele, R., Tenerelli, D. J., Woodruff, R., Ge, J. “[A nulling coronagraph for TPF-C](#)”, *Space Telescopes and Instrumentation I: Optical, Infrared, and Millimeter*. Edited by J.C. Mather, H. A. M. MacEwen, W. M. de Graauw., *Proc. SPIE*, Vol. 6265, pp. 626517 (2006).

Bloemhof, Eric E., **Wallace, J. Kent**, “[Phase Contrast wavefront sensing for adaptive optics](#)”, *Proc. SPIE*, Vol. 5553 (2004).

Wallace, J. K., Green, J. J., Shao, M., Troy, M., Lloyd, J. P., Macintosh, B., “[Science camera calibration for extreme adaptive optics](#)”, *Advancements in Adaptive Optics*. Edited by D. B. Calia, B. L. Ellerbroek, and R. Ragazzoni., *Proc. SPIE*, Vol. 5490, pp. 370-378 (2004).

Shao, M., **Wallace, J. K.**, Levine, B. M., Liu, D., “[Visible Nulling Interferometer](#)”, *Optical, Infrared, and Millimeter Space Telescopes*, Edited by J. C. Mather, *Proc. SPIE*, Vol. 5487, pp. 1296-1393 (2004).

Patents

Compact Digital Holographic Microscope for Planetary Imaging or Endoscopy, Serial Number: US15/422,241, Patent Number: 10,345,572
Inventors: Eugene Serabyn; Christian A. Lindensmith; **James K. Wallace**; Kurt M. Liewer; Jay L. Nadeau

A Common-Mode Digital Holographic Microscope
Serial Number: US14/939,389, Patent Number: 10,045,777
Inventors: **James K. Wallace**, Kurt Liewer; Christian A. Lindensmith; Eugene Serabyn; Stephanie Rider; Emilio Castano Graff

Broadband, Common-Path, Interferometric Wavefront Sensor, US13/747,235,
Inventor: **James Kent Wallace**

Free space communication system with common optics and fast, adaptive tracking, US20040208595 A1, Inventors: Fai Mok, **James Kent Wallace**