



Phase Retrieval for Chromatic Aberrations and Wide-Field Detectors

*Speaker: Dr. Matthew Bergkoetter, Code 551,
Optics Branch*

TUESDAY FEBRUARY 20TH 2018
6 PM

At the Goddard Visitor Center
6:00-6:30PM - Social gathering
6:30-7:30PM - Featured talk
7:45-? Speaker is our dinner guest
at a nearby restaurant

ABSTRAC

We present advancements in image-based wavefront sensing via phase retrieval which enable characterization of short-pulse lasers and wide-field telescopes. This includes use of a parameterized model for chromatic aberrations which can arise in dispersive optical systems such as chirped-pulse amplification lasers. Potential sign ambiguities are identified and strategies to avoid or remove them are prescribed. The algorithm is also tested in a real-world laboratory environment, with results in good agreement with expected values. As a prerequisite to this advance, we also evaluate a collection of less frequently utilized discrete Fourier transform (DFT) algorithms that have an advantage over the fast Fourier transform in that they allow for an

arbitrary scaling factor between the input and output domains. The trade-off in terms of computation speed is demonstrated using timing benchmarks for a variety of physical optics modeling scenarios, and multiple cases are found where the arbitrarily-scaled DFTs are preferable. In addition, we address issues with image-based wavefront sensing that arise from the unusually-large detector plane of a wide-field space telescope, where large chief ray angles at the edges of the field violate the small angle assumption of the usual Fresnel propagation integral. By starting from an exact expression and adapting an approximation approach previously derived for digital holography with non-parallel planes, we find an algorithm that is both sufficiently accurate and computationally efficient.

SPEAKER BIO

Matthew Bergkoetter received a Bachelor of Science degree in Optical Sciences and Engineering from the University of Arizona in 2009. As a SMART Scholarship recipient, he completed a Master of Science degree in Optics from the University of Rochester in 2010 and spent a year with the Air Force Research Laboratory's Propulsion Directorate, where he developed diagnostics for laboratory-scale rocket engine tests. In 2011, he began doctoral studies at the University of Rochester under the direction of Professor James

R. Fienup. His research related to high-intensity lasers was funded by a Horton Fellowship from the Laboratory for Laser Energetics in Rochester. As a Pathways Program participant at NASA Goddard Space Flight Center, he conducted research for the Wide-Field Infrared Survey Telescope project as part of the Wavefront Sensing and Control group. Following completion of his PhD in December 2018, he converted to a permanent full-time position at Goddard.



Winning photo from International Garden Photographer of the Year 2018, Cerrado Sunrise by Marcio Cabral of Brasilia, Brazil

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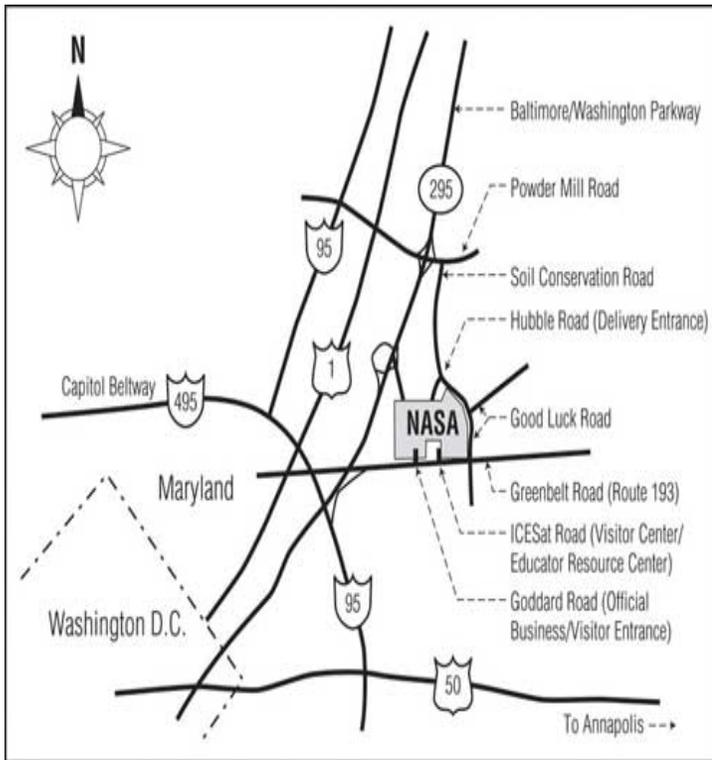
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Goddard Visitor Center



[Area map and direction](#)

The **main campus** of NASA's Goddard Space Flight Center is physically located at:
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