

CURRICULUM VITAE

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Educational Background

- 2006 Ph.D. in Optics, University of Central Florida
Dissertation: *Predicting Surface Scatter Using a Linear Systems Formulation of Non-paraxial Scalar Diffraction Theory*, Advisor: James E. Harvey
- 2000 M.S. in Optics, University of Central Florida
- 1995 B.S. in Photonics, State University of New York Institute of Technology at Utica/Rome
- 1991 A.S. in Photonics, Mohawk Valley Community College

Areas of Technical Expertise and Research Interests: Optical system design, image analysis, surface scatter phenomena, performance modeling for optical systems, numerical modeling and simulation, remote sensing, space-based optical systems, thermosphere–ionosphere data analysis and modeling

Employment History:

- 2010- : Associate Scientist, Florida Space Institute, University of Central Florida
- 2006-2010: Postdoctoral Associate, Florida Space Institute, University of Central Florida
- 1997-2006: Graduate Research Assistant, CREOL, University of Central Florida

Professional Affiliations:

Member of AGU – American Geophysical Union
Member of SPIE – The International Society for Optics and Photonics

Refereed Journal Articles:

Krywonos, A., D. J. Murray, R. W. Eastes, A. Aksnes, S. A. Budzien, and R. E. Daniell (2011), Remote sensing of neutral temperatures in the Earth's thermosphere using the Lyman-Birge-Hopfield Bands of N₂: comparison with satellite drag data, under review at *J. Geophys. Res.*

Eastes, R., D. J. Murray, A. Aksnes, S. A. Budzien, R. E. Daniell, and **A. Krywonos** (2011), Modeled and Observed N₂ Lyman-Birge-Hopfield Band Emissions: A Comparison, *J. Geophys. Res.*, doi:10.1029/2010JA016417, in press.

Krywonos, A., J. E. Harvey and N. Choi (2011), Linear systems formulation of scattering theory for rough surfaces with arbitrary incident and scattering angles, *J. Opt. Soc. Am. A*, 28, 1121-1138

Harvey, J.E., N. Choi, **A. Krywonos**, G. Peterson, and M. Bruner (2010), Image degradation due to scattering effects in two-mirror telescopes, *Opt. Eng.*, **49**, 063202

R. W. Eastes, W. E. McClintock, M. V. Codrescu, A. Aksnes, D. N. Anderson, L. Andersson, D. N. Baker, A. G. Burns, S. A. Budzien, R. E. Daniell, K. F. Dymond, F. G. Eparvier, J. E. Harvey, T. J. Immel, **A. Krywonos**, M. R. Lankton, J. D. Lumpe, G. W. Prolss, A. D. Richmond, D. W. Rusch, O. H. Siegmund, S. C. Solomon, D. J. Strickland, and T. N. Woods (2008), Refereed Research Monograph entitled “Global-Scale Observations of the Limb and Disk (GOLD): New Observing Capabilities for the Ionosphere-Thermosphere”, in *Midlatitude Ionospheric Dynamics and Disturbances*; Editors: P. M. Kintner, A. J. Coster, T. Fuller-Rowell, A. J. Mannucci, M. Mendillo, and R. Heelis; Geophysical Monograph Series, Vol **181**, ISBN 978-0-87590-446-7

Harvey, J. E., **A. Krywonos**, C. L. Vernold (2007), Modified Beckmann-Kirchhoff scattering model for rough surfaces with large incident and scattering angles, *Opt. Eng.*, **46**, 078002

Krywonos, A., J.E. Harvey, R. E. Daniell, R. W. Eastes, and G. L. Peterson (2006), Scanless ultraviolet remote sensor for limb profile measurements from low earth orbit, *Opt. Eng.*, **45**, 106201, 1-9

Harvey, J. E., **A. Krywonos**, D. Bogunovic (2006), Non-paraxial scalar treatment of sinusoidal phase gratings, *J. Opt. Soc. Am. A*, **23**, 858-865

Harvey, J. E., M. Atanassova, **A. Krywonos** (2006), Balancing detector effects with wide-field aberrations in the design of grazing incidence x-ray telescopes, *Opt. Eng.*, **45**, 1-10

Harvey, J. E. and **A. Krywonos** (2003), Axial irradiance distribution throughout the whole space behind an annular aperture: reply to comments, *Appl. Opt.* **42**, 3792-3794

Harvey, J. E., D. Bogunovic, and **A. Krywonos** (2003), Aberrations of diffracted wave fields: distortion, *Applied Optics*, **42**, 1167-1174

Harvey, J. E., **A. Krywonos** (2002), Axial irradiance throughout the whole space behind an annular aperture, *Applied Optics*, **41**, 3790-3795

Harvey, J.E., **A. Krywonos**, and D. Bogunovic (2002), A tolerance on defocus precisely locates the far field (Exactly where is that far field anyway?)”, *Appl. Opt.* **41**, 2586-2588

Harvey, J.E., **A. Krywonos**, P. L. Thompson, and T. T. Saha (2001), Grazing incidence hyperboloid-hyperboloid designs for wide-field x-ray imaging applications, *Applied Optics*, **40**, 136-144

Harvey, J.E., C. L. Vernold, **A. Krywonos**, and P. L. Thompson (2000), Diffracted Radiance: A fundamental quantity in non-paraxial scalar diffraction theory: errata”, *Appl. Opt.* **39**, 6374-6375

Harvey, J.E., C. L. Vernold, **A. Krywonos**, and P. L. Thompson (1999), Diffracted Radiance: A fundamental quantity in non-paraxial scalar diffraction theory, *Appl. Opt.* **38**, 6469-6481

Conference Proceedings and Abstracts

R. Eastes, M. Codrescu, A. G. Burns, **A. Krywonos**, W. McClintock, A. Aksnes, D. Anderson, L. Andersson, S. Budzien, R. Daniell, K. Dymond, S. England, F. Eparvier, J. Harvey, T. Immel, M. Lankton, C. Martinis, J. Lumpe, A. Richmond, D. Rusch, O. Siegmund, S. Solomon, D. Strickland, and T. Woods, Poster Paper entitled “Observing geomagnetic storm effects in the Earth’s lower thermosphere from geostationary orbit: A new view of thermosphere-ionosphere variability”, Space Weather Workshop 2011, Boulder, CO (Apr 26 - 29, 2011).

J.E. Harvey, N. Choi, and A. Krywonos, "Scattering from moderately rough interfaces between two arbitrary media", Presented at SPIE's International Symposium on Optics and Photonics, San Diego, CA (Aug 2010), Published in Proc. SPIE **7794V** (September 2010)

Narak Choi, J. E. Harvey and **Andrey Krywonos**, "New Capabilities for Predicting Image Degradation from Optical Surface Metrology Data", Presented at SPIE's International Symposium on Optics and Photonics, San Diego, CA (Aug 2010) ; published in Proc. SPIE **7801E** (August 2010)

J. E. Harvey, Narak Choi and **Andrey Krywonos**, "Predicting Image Degradation from Optical Surface Metrology Data", Presented at OSA's Topical Meeting on Applied Industrial Optics, Jackson Hole, WY (Jun 2010); Summary to be published in Conference Proceedings.

Krywonos, A.; Murray, D. J.; Eastes, R.; Budzien, S. A.; Marcos, F. A. Remote Sensing of Neutral Temperatures in Earth's Thermosphere Using the Lyman-Birge-Hopfield Bands of N₂: Comparisons with Satellite Drag Data, Poster Paper presented at the American Geophysical Union Fall Meeting 2009, abstract #SA31B-1430

J. E. Harvey, Narak Choi, **Andrey Krywonos** and Jesus Marcen, "Calculating BRDFs from Surface PSDs for Moderately Rough Surfaces", Presented at SPIE's International Symposium on Optics and Photonics, San Diego, CA (Aug 2009) ; published in Proc. SPIE **7426-42** (August 2009).

R. Eastes, W. McClintock, A. Aksnes, D. Anderson, L. Andersson, A. Burns, S. Budzien, M. Codrescu, R. Daniell, K. Dymond, S. L. England, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, M. Lankton, J. Lumpe, A. Richmond, D. Rusch, O. Siegmund, S. Solomon, D. Strickland and T. Woods, "Global-scale Observations of the Limb and Disk (GOLD)", American Meteorological Society Annual Meeting, Phoenix, AZ (Jan 2009).

R. W. Eastes, D. N. Anderson, W. E. McClintock, A. Aksnes, L. Andersson, A. G. Burns, S. A. Budzien, M. V. Codrescu, R. E. Daniell, K. F. Dymond, S. L. England, F. J. Eparvier, J. E. Harvey, T. J. Immel, **A. Krywonos**, M. R. Lankton, J. D. Lumpe, A. D. Richmond, D. W. Rusch, O. H. Siegmund, S. C. Solomon, D. J. Strickland, T. N. Woods, "Low Latitude Ionosphere Measurements by the Global-scale Observations of the Limb and Disk (GOLD) Mission", Poster Paper presented in the Section entitled *Solar Wind Control of Planetary Ionospheres During the Declining Phase of the Solar Cycle*, AGU Fall Meeting, San Francisco, CA (15-19 December 2008).

R. Eastes, A. G. Burns (Presenter), W. McClintock, A. Aksnes, D. Anderson, L. Andersson, S. Budzien, M. Codrescu, R. Daniell, S. England, K. Dymond, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, M. Lankton, J. Lumpe, A. D. Richmond, D. Rusch, O. Siegmund, S. C. Solomon, D. Strickland, and T. Woods, "Global-Scale Observations of the Limb and Disk: A Key Mission for Understanding Thermosphere-Ionosphere Forcing", oral presentation in the 7th Thermospheric-Ionospheric-Geospheric (TIGER) Symposium (C12), Section entitled *Space Studies of the Upper Atmospheres of the Earth and Planets including Reference Atmospheres* (C), 37th COSPAR Scientific Assembly, Montreal Canada (13-20 July 2008).

R. Eastes, A. G. Burns, W. McClintock, A. Aksnes, D. Anderson, L. Andersson, S. Budzien, M. Codrescu, R. Daniell, S. England, K. Dymond, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, M. Lankton, J. Lumpe, A. Richmond, D. Rusch, O. Siegmund, S. C. Solomon, D. Strickland, T. Woods, "Global-scale Observations of the Limb and Disk: a Key Mission for Understanding

Thermosphere-Ionosphere Forcing”, Poster Paper presented in the Section entitled *Auroral Science With Heliophysics Great Observatory Imagers: Successes, Challenges, and Opportunities*, AGU Joint Assembly 2008, Ft. Lauderdale, FL (May 2008).

M. Codrescu, R. Eastes, W. McClintock, A. Aksnes, D. Anderson, L. Andersson, A. Burns, S. Budzien, R. Daniell, K. Dymond, S. England, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, M. Lankton, J. Lumpe, A. Richmond, D. Rusch, O. Siegmund, S. Solomon, D. Strickland, and T. Woods, Poster Paper entitled “Global-scale Observations of the Limb and Disk (GOLD) - New Observing Capabilities for Space Weather Specification and Forecasting”, Space Weather Workshop 2008, Boulder, CO (Apr 28 - May 1, 2008).

R. Eastes, M. Codrescu, W. McClintock, A. Aksnes, D. Anderson, L. Andersson, A. Burns, S. Budzien, R. Daniell, K. Dymond, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, M. Lankton, J. Lumpe, G. Prölss, A. Richmond, D. Rusch, O. Siegmund, S. Solomon, D. Strickland and T. Woods, “Global-scale Observations of the Limb and Disk (GOLD)”, AGU Fall Meeting, San Francisco, CA (Dec 2007).

J. E. Harvey, **A. Krywonos**, and J. C. Stover “Unified Scatter Model for Rough Surfaces at Large Incident and Scattered Angles”, **Invited Paper** presented at SPIE’s International Symposium on Optics and Photonics, San Diego, CA, August 2007; published in Proc. SPIE **6672-12** (August 2007).

J. E. Harvey, **A. Krywonos**, M. Atanassova, and P.L. Thompson, “The Solar X-ray Imager (SXI) on GOES-13: Design, Analysis, and On-orbit Performance”, presented at SPIE’s International Symposium on Optics and Photonics, San Diego, CA, August 2007; published in Proc. SPIE **6689-11** (August 2007).

J. E. Harvey and **A. Krywonos**, “Improved Characterization of Optical Surfaces from Scattered Light Measurements”, presented at OSA Topical Meeting on Optical Interference Coatings, Tucson, AZ, June 4-7, 2007; Summary published in Conference Proceedings.

R. Eastes, W. McClintock, A. Aksnes, D. Anderson, L. Andersson, A. Burns, S. Budzien, M. Codrescu, R. Daniell, K. Dymond, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, M. Lankton, J. Lumpe, G. Prölss, A. Richmond, D. Rusch, S. Solomon, D. Strickland and T. Woods, “Global-scale Observations of the Limb and Disk (GOLD)”, AGU Joint Assembly, SA33A12, Acapulco, Mexico (May 2007).

D. Rusch, A. Aksnes, S. Budzien, R. Eastes, D. Anderson, L. Andersson, A. Burns, M. Codrescu, R. Daniell, K. Dymond, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, W. McClintock, M. Lankton, J. Lumpe, G. Prölss, A. Richmond, S. Solomon, D. Strickland and T. Woods, “Global-scale Observations of the Limb and Disk (GOLD): Temperature Measurements”, AGU Joint Assembly, SA33A08, Acapulco, Mexico (May 2007).

J. E. Harvey and **A. Krywonos**, “Closing the Loop between Optical Fabrication and Performance: Recent Advances in Modeling Surface Scatter Effects”, presented at SPIE’s Optifab 2007, Rochester, NY, May 14-17, 2007; Summary published in Conference Proceedings.

R. Eastes, M. Codrescu, W. McClintock, A. Aksnes, D. Anderson, L. Andersson, A. Burns, S. Budzien, R. Daniell, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, M. Lankton, J. Lumpe, G. Prölss, A. Richmond, D. Rusch, S. Solomon, D. Strickland and T. Woods, “Global-scale Observations of the Limb and Disk (GOLD)—New Observing Capabilities for Space Weather Specification and Forecasting”, Space Weather Workshop, Boulder, CO (April 2007).

R. Eastes, W. McClintock, A. Aksnes, D. Anderson, L. Andersson, S. Budzien, A. Burns, M. Codrescu, R. Daniell, K. Dymond, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, M. Lankton, J. Lumpe, G. Prölss, A. Richmond, D. Rusch, S. Solomon, D. Strickland and T. Woods, “Global-scale Observations of the Limb and Disk (GOLD)”, Paper presented at the Chapman Conference on Mid-latitude Ionospheric Dynamics and Disturbances, Yosemite National Park, CA (Jan 3, 2007).

W. McClintock, M. Lankton, R. Eastes, A. Aksnes, D. Anderson, L. Andersson, A. Burns, M. Codrescu, R. Daniell, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, J. Lumpe, G. Prölss, A. Richmond, D. Rusch, S. Solomon, D. Strickland and T. Woods, “Global-scale Observations of the Limb and Disk (GOLD): Mission Implementation”, Poster Paper presented 2006 Fall AGU Meeting, San Francisco, CA (Dec 2006).

R. Eastes, W. McClintock, A. Aksnes, D. Anderson, L. Andersson, D. Baker, A. Burns, M. Codrescu, R. Daniell, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, J. Lumpe, G. Prölss, A. Richmond, D. Rusch, S. Solomon, D. Strickland and T. Woods, “Global-scale Observations of the Limb and Disk (GOLD): Continuous, Global-scale Ultraviolet Observations of Earth”, Poster Paper presented 2006 Fall AGU Meeting, San Francisco, CA (Dec 2006).

R. Eastes, W. McClintock, A. Aksnes, D. Anderson, L. Andersson, A. Burns, M. Codrescu, R. Daniell, F. Eparvier, J. Harvey, T. Immel, **A. Krywonos**, M. Lankton, J. Lumpe, G. Prölss, A. Richmond, D. Rusch, S. Solomon, D. Strickland and T. Woods, “Global-scale Observations of the Limb and Disk (GOLD): Science Objectives”, Poster Paper presented 2006 Fall AGU Meeting, San Francisco, CA (Dec 2006).

A. Krywonos and J. E. Harvey, “Recent Developments in the Analysis of Surface Scatter Phenomena”, presented at SPIE’s International Symposium on Optics and Photonics, San Diego, CA, August 2006; published in Proc. SPIE **6291B-27**, (August 2006).

J. E. Harvey and **A. Krywonos**, “Understanding Diffraction Effects in Novel Systems Containing Nanostructures”, **Invited paper** presented at SPIE’s International Symposium on Optics and Photonics, San Diego, CA, August 2006; published in Proc. SPIE **6286-23**, (August 2006).

J. E. Harvey and **A. Krywonos**, “Radiance: The Natural Quantity for Describing Diffraction and Propagation”, presented at SPIE’s International Symposium on Optics and Photonics, San Diego, CA, August 2006; published in Proc. SPIE **6285-4**, 12 pages (August 2006).

R. Eastes, W. McClintock, D. Anderson, L. Andersson, D. Baker, A. Burns, M. Codrescu, R. Daniell, F. Eparvier, J. Harvey, **A. Krywonos**, J. Lumpe, G. Prölss, A. Richmond, D. Rusch, S. Solomon and T. Woods, “Continuous, Global-scale Ultraviolet Observations of Earth: The Future for Space Weather Observations”, Poster Paper presented at Eos Trans. AGU, 86(52), 2005 Fall Meet. Suppl., Abstract SA51B-1143, non-refereed, international.

J. E. Harvey, **A. Krywonos**, and J. B. Houston, Jr., “Performance Modeling of Launch Vehicle Imaging Telescopes”, Proc. SPIE **5867-16**, 12 pages (August 2005).

J. E. Harvey, M. Atanassova, and **A. Krywonos**, “Systems Engineering Analysis of Five “As-manufactured” SXI Telescopes”, Proc. SPIE **5867-15**, 11 pages (August 2005).

J. E. Harvey, **A. Krywonos**, and J. B. Houston, Jr., “Performance Modeling of Launch Vehicle Imaging Telescopes”, 114th Meeting of the Optical Systems Group of the Range Commander’s Council, Yuma, AZ (April 2005).

Andrey Krywonos, James E. Harvey, Robert E. Daniell, Nicolas Parent, and Richard Eastes, “Scannless Ultraviolet Remote Sensor for Limb Profile Measurements from Low Earth Orbit”, Proc. SPIE **5660**, 56-65 (Nov 2004).

J. E. Harvey, Martina Atanassova, and **A. Krywonos**, “Including Detector Effects in the Design of Wide-field Imaging Systems”, **Invited paper** presented at SPIE’s International Symposium on Optical Science and Technology, Denver, CO, August 2004; published in Proc. SPIE **5523**, 90-99 (August 2004).

J. E. Harvey and **A. Krywonos**, “A Global View of Diffraction - Revisited”, **Invited paper** presented at SPIE’s International Symposium on Optical Science and Technology, Denver, CO, August 2004; published in Proc. SPIE **AM100-26**, 191-210 (August 2004).

J. E. Harvey, Martina Atanassova, and **A. Krywonos**, “Including Detector Effects in the Design of Grazing Incidence X-ray Telescopes”, presented at SPIE’s International Symposium on Astronomical Telescopes and Instrumentation, Glasgow, Scotland, June 2004; published in Proc. SPIE **5497**, 636-645 (June 2004).

J. E. Harvey and **A. Krywonos**, “Axial Irradiance Distribution Throughout the Whole Space Behind an Annular Aperture”, **(Reviewed)** poster paper **PDP9**, presented at the OSA Annual Meeting, Long Beach, CA (Oct. 2001).

J. E. Harvey and **A. Krywonos**, “A Systems Engineering Analysis of Image Quality”, presented at SPIE’s International Symposium on Optical Science and Technology, San Diego, CA, August 2000; published in Proc. SPIE **4093**, 379-388 (August 2000).

J. E. Harvey, P. L. Thompson and **A. Krywonos**, “Hyperboloid-Hyperboloid Grazing Incidence X-ray Telescope Designs for Wide-field Imaging Applications”, presented at SPIE’s Astronomical Telescope and Instrumentation Symposium, Munich, Germany. Proc. SPIE **4012**, 328-341 (March 2000).

J. E. Harvey and **A. Krywonos**, “Common Misconceptions of Diffraction Grating Behavior”, **(Reviewed)** poster paper presented at the OSA Annual Meeting, Santa Clara, CA (Sept. 1999). C93.

J. E. Harvey, C. L. Vernold, and **A. Krywonos**, “A Fourier Treatment of Non-paraxial Scalar Diffraction Theory”, **(Reviewed)** poster paper presented at the OSA Annual Meeting, Santa Clara, CA (Sept. 1999).