

BIOGRAPHICAL SKETCH

PAUL G. STEFFES
PROFESSOR
SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GEORGIA 30332-0250

EDUCATION

S.B. Electrical Engineering 1977
S.M. Electrical Engineering 1977
Massachusetts Institute of Technology

Ph.D. Electrical Engineering 1982
Stanford University

EMPLOYMENT HISTORY

Massachusetts Institute of Technology, Research Laboratory
of Electronics, Radio Astronomy and Remote Sensing Group
Graduate Research Assistant 1976-1977

Watkins-Johnson Company, Sensor Development, San Jose,
California
Member of the Technical Staff 1977-1982

Stanford University, Electronics Laboratory,
Center for Radar Astronomy, Stanford, California
Graduate Research Assistant 1979-1982

Georgia Institute of Technology, School of Electrical and Computer Engineering,
Atlanta, Georgia

Assistant Professor	1982-1988
Associate Professor	1988-1994
Professor	1994-Present
Associate Chair for Graduate Affairs	2004-2006
Associate Chair for Research	2006-2013

EXPERIENCE SUMMARY

At Massachusetts Institute of Technology

Responsible for development, operation, and data analysis for an 8-channel, 118 GHz radiometer system flown aboard the NASA Flying Laboratory (CV-990) as an engineering model for a meteorological sensing satellite. Duties included hardware development of millimeter-wave, microwave, analog, and A to D segments of the system, in addition to airborne operation and reduction of data. The research resulted in a Master's thesis entitled "Atmospheric Absorption at 118 GHz," detailing the first airborne

measurement of high altitude atmospheric absorption in the 2.5 millimeter wavelength range, due to atmospheric oxygen.

At Watkins-Johnson Company

Responsibilities included proposals and system design and development, particularly in the area of millimeter-wave systems. Responsibility for millimeter-wave systems development included government sponsored study and development of ELINT (Electronic Intelligence) and radar warning receiving systems to frequencies as high as 110 GHz, as well as internal company sponsored development projects including a 60 GHz communications system and millimeter-wave downconverters.

At Stanford University

Research was concentrated in the area of microwave radio occultation experiments from Voyager and Mariner spacecraft, with specific interest in microwave absorption in planetary atmospheres. Work included computer-based theoretical development of microwave absorption coefficients for planetary atmospheres, to facilitate the use of radio occultation-derived microwave absorption profiles in determining constituent densities. Additional work included the development of a fully instrumented experimental facility for use in measuring the microwave properties of planetary atmospheres under simulated planetary conditions. The research resulted in a Ph.D. dissertation entitled "Abundances of Cloud-Related Gases in the Venus Atmosphere as Inferred from Observed Radio Opacity."

At Georgia Tech

Research Activities: Principal Investigator of the National Science Foundation (NSF) grant, "Remote Sensing of Clouds Bearing Acid Rain." This research studied and designed a microwave/millimeter-wave system for remotely sensing the pH of acidic clouds (1982-1983). Principal Investigator for the NASA Planetary Atmospheres Program grant, "Laboratory Evaluation and Application of Microwave Absorption Properties under Simulated Conditions for Planetary Atmospheres." This research involves laboratory study of the interaction between atmospheric constituents and electromagnetic waves, with application to microwave remote sensing of the atmospheres of Venus and the outer planets using both spacecraft and radio telescopes (1984-2015). This project (31 years continuous support, \$2.533M) was acknowledged by Georgia Tech President Peterson as the longest single-topic research activity supported by any NASA science program. Principal Investigator of the GTE Spacenet Program, "Satellite Interference Location System (SILS)." The program involved location of uplink signals on the surface of the earth without disrupting regular satellite operations (1986-1990). Principal Investigator of the Emory University/Georgia Tech Biomedical Technology Research Center project, "Research in Development of a Non-Invasive Blood Glucose Monitoring Technique." This research involved the use of active infrared systems to determine glucose levels in the human eye and bloodstream (1988-1989), with subsequent support (1990-1991) from Lifescan, Inc. Principal Investigator of the NASA Pioneer Venus Guest Investigator Program, "Pioneer Venus Radio Occultation (ORO) Data Reduction: Profiles of 13 cm Absorptivity." This research inferred 13 cm wavelength absorptivity profiles using the Pioneer Venus Orbiter, and then used such profiles to characterize abundance profiles for gaseous H₂SO₄ in the Venus atmosphere (1988-1990). Principal Investigator/Team Member of NASA High Resolution Microwave Survey (HRMS). This research involved development and operation of the world's most sensitive receiving system used for a 1-10 GHz Sky Survey (1991-1994). Subsequent support was provided by the SETI Institute (1994-2000) and involved development of a 30-meter radio telescope system at Woodbury, Georgia and a database containing all earth orbiting transmitters. Developer of atmospheric radio occultation experiments conducted with the Magellan (Venus) Spacecraft (1991-1994). Director of the Georgia Tech Satellite Earth Station System. Responsible for development of a Ku-band uplink/downlink system for use in inter-university networks (1985-1995). Principal investigator in the NASA/ACTS Propagation Experiments Program (1994-1999). This research involved study of Ka-Band propagation effects on CDMA satellite communications systems. Developed prototype Ka-Band CDMA satellite

terminal for Raytheon/TI systems, and assisted in evaluation and testing (1997-99). Principal Investigator of the NSF Division of Astronomical Sciences Grant, "A Spectrum Study and Demonstration of the Role of "Smart Radios" in the Protection of Passive Scientific Radio Services." This research involved development of a Radio Spectrum Evaluation System (RSES) and studies of spectrum usage and compatibility (2003-05). Science Team Member and Mission Co-Investigator for the NASA Juno (Jovian Polar Orbiter) Mission (2006-2019): NASA selected the Juno Mission as the second "New Frontiers" mission in 2005. The Georgia Tech activity has involved development of a new microwave laboratory measurement system and application of the new measurements to radiative transfer modeling in support of detection and measurement of water vapor in the deep Jovian atmosphere using passive microwave radiometry. Juno was successfully launched in August 2011, and will enter Jovian orbit in July 2016. Before orbital entry, we will complete the laboratory measurement component of our activity, and focus on development of microwave radiative transfer retrieval algorithms, which will allow near real-time interpretation of data returned from the Juno microwave radiometer (MWR). (Support level over mission, \$1.6M). Co- investigator on project with NASA Jet Propulsion Laboratory (JPL) entitled "Improved Radio Occultation Retrievals" supporting characterization of atmospheric effects on propagation of GPS signals (2015-2016). Principal Investigator for the NASA Solar System Workings Program grant, "Laboratory Evaluation and Application of the Millimeter-Wavelength Absorption Properties of Gaseous Sulfuric Acid under Simulated Venus Conditions." This research involves laboratory study of the interaction between sulfuric acid vapor and millimeter-waves, with application to remote sensing of the atmosphere of Venus using both spacecraft and radio telescopes (2016-2019, \$473K).

Teaching Activities: Was Principal Professor for "Satellite Communications and Navigation Systems" (graduate course) and for "Electromagnetics Design" (undergraduate design experience). Also serve as developer and coordinating Professor for "Professional Communications Seminar" (for Ph.D. students). Currently coordinate the School's student seminar, providing guidance to both undergrads and first year grad students on career paths and on a wide range of professional and research topics. Have also taught "Electromagnetics" (Junior level course required of all EE students). Have taught "Antennas," "Introduction to Radar," "Electromagnetics I and II," "Electromagnetics Applications," "Signals and Systems," and "Survey of Remote Sensing."

Administrative Activities: Chairman, School of ECE Electromagnetics Technical Group, 1990-1996. Associate Chair for Graduate Affairs, 2004-2006, was responsible for graduate admissions and all aspects of the graduate program operation including admissions, GTA assignments, advising, fellowship awards, and chairing the Graduate Recruitment committee. This involved a program of over 1000 graduate students. Associate Chair for Research, 2006-2013, responsible for administration of the \$60M+/yr research operation for the School of ECE including proposal support, deliverable monitoring, intellectual property and faculty new-start innovation, and research program development. Was also responsible for resolution of issues with industrial research contracts, including conflict-of-interest resolution and non-disclosure agreements.

HONORS AND AWARDS

- Fellow, IEEE (Member of 6 IEEE Societies).
- Fellow, American Association for the Advancement of Science (AAAS)
- Recipient of the Stewart Award (MIT for exceptional contribution to student extra-curricular life, 1977).
- Recipient of the Metro Atlanta Young Engineer of the Year Award, presented by the Society of Professional Engineers, 1985.
- Recipient of the Sigma Xi Young Faculty Research Award, 1988.
- Associate Editor, Journal for Geophysical Research (JGR-Atmospheres), 1984-1989.
- Appointed Member of the NASA Management and Operations Working Group for the Planetary Atmospheres Program (1986-1990).
- Recipient of the Sigma Xi Best Faculty Paper Award, 1991.

- Recipient of the NASA Group Achievement Award, "For outstanding contribution to the design, development, and operation of the High Resolution Microwave Survey Project, and its successful inauguration," March 1993.
- Recipient of the 1996 IEEE Judith A. Resnik Award, "For contributions to an understanding of the Venus atmosphere through innovative microwave measurements," January 1996.
- Named to the Editor's list of distinguished reviewers for the journal ICARUS (International Journal of Solar System Exploration), ICARUS, v. 134, p185 (August 1998).
- National Research Council / Space Studies Board Certificate of Appreciation for outstanding service as a member of the Task Group on NASA Research and Analysis Programs (1998).
- Recipient of the "2000-2001 Professor of the Year Award" by the Georgia Tech Graduate Student Senate.
- Named a lifetime National Associate of the National Academy of Sciences, in recognition of service to the National Academies, December 2001.
- Recipient of the Georgia Tech School of ECE Distinguished Faculty Achievement Award, April 2010.
- Georgia Tech Research Corporation 75th Anniversary Award for Excellence, December 2011.
- Member, Eta Kappa Nu.
- Member, Sigma Xi.
- Recipient of the NASA Group Achievement Award, "For exceptional contributions to the Juno Step 1 and Step 2 exemplary winning proposal efforts leading to the start of mission development," August 2012.
- Recipient of the NASA Group Achievement Award, "For outstanding contributions to the Juno mission leading to successful development, launch, and early operations," August 2012.
- Recipient of the Georgia Tech D. Scott Wills ECE Distinguished Mentor Award, April 2015.

OTHER PROFESSIONAL AFFILIATIONS

- Member, American Astronomical Society, Division for Planetary Sciences.
- Member, American Geophysical Union.
- Member, American Institute of Physics.
- Member, American Society for Engineering Education.
- Member (Elected), International Union of Radio Scientists (URSI), Commission J (Radio Astronomy).
- Chairman, Atlanta Chapter, IEEE Antennas and Propagation Society and Microwave Theory and Techniques Society, 1986-1988. Director, IEEE Atlanta Section, 1988-1989.
- Georgia Tech Chapter, Sigma Xi, Vice President, 1990-1991; President 1991-1992; Past-President, 1992-1993.
- Chairman, Publicity Committee, 1993 IEEE International Microwave Symposium.
- Local Arrangements Committee, 2001 American Astronomical Society/ Division for Planetary Sciences Meeting.

OTHER PROFESSIONAL ACTIVITIES

- Member of Executive Committee, NASA Venus Exploration Analysis Group (VEXAG), 2015-2018.
- Member of the Planetary Science Subcommittee (PSS) of the NASA Advisory Council (NAC), 2010-2014.
- Chairman, National Research Council (NAS/NAE) Committee on Radio Frequencies, 1998-2001. (Member, 1995-98; Past-Chair, 2001-02).
- Member, National Research Council (NAS/NAE) Task Group reviewing the NASA Research and Analysis Programs. 1996-1998.
- Member of the selection committee for the IEEE Judith E. Resnik Award, 2007-present.
- Proposal Reviewer and Panelist for the NASA Solar Systems Observation Program, the NASA Planetary Astronomy Program, the NASA Planetary Atmospheres Program, the NASA Planetary Instrument Definition and Development Program, the NASA Planetary Data Analysis Programs, the NASA Exobiology Program, the NASA Discovery Program, the NASA Pluto-Kuiper Express Mission, the

NASA Pluto-Kuiper Belt Mission, the NASA/ESA Rosetta Mission, the NASA Microgravity Biotechnology Program, the NSF Communications Research Program, the NIH SBIR Program, the CDC Technology Development Grants Program, and the Juvenile Diabetes Foundation International Grants Program..

-Reviewer/Referee for *Icarus* (International Journal of Solar System Studies), *Journal of Geophysical Research*, *RadioScience*, *IEEE Microwave and Guided Wave Letters*, *Science*, *Diabetes Technology and Therapeutics*, *IEEE Transactions on Geoscience and Remote Sensing*, *IEEE Transactions on Microwave Theory and Techniques*, *Earth and Planetary Science Letters*, and for several textbooks in the area of electromagnetics.

-Consultant to industry in the areas of microwave, millimeter-wave, and RF systems for communications, detection, and monitoring. This includes satellite communications, antenna systems, and propagation. Also consult in the area of non-invasive glucose detection systems. Expert witness in cases involving antenna/communications system performance, and the effects of environmental factors on such systems. Has been a principal expert witness in the area of cellular telephone position estimation. Testimony was heavily cited in the September 2000 Georgia Supreme Court decision which allowed use of reception records from cell towers to be used in determination of handset location (*Pullin v. the State of Georgia*, S00A1063, Supreme Court of Georgia).

PATENTS

E. H. Orr and P. G. Steffes, "Method and System for Detecting Water Depth and Piloting Vessels," Patent # 4,757,481, issued July 12, 1988.

R. V. Tarr and P. G. Steffes, "Non-Invasive Blood Glucose Measurement System," Patent #5,243,983, issued September 14, 1993.

P.G. Steffes, "Non-Invasive Blood Glucose Measurement System and Method Using Optical Refractometry," Patent #6,442,410, issued August 27, 2002.

PUBLICATIONS

Theses

P. G. Steffes, "A Microwave (UHF) Television Repeater System," S.B. Thesis, Massachusetts Institute of Technology, 1976.

P. G. Steffes, "Atmospheric Absorption at 118 GHz," S.M. Thesis, Massachusetts Institute of Technology, 1977.

P. G. Steffes, "Abundances of Cloud-Related Gases in the Venus Atmosphere as Inferred from Observed Radio Opacity," Ph.D. Dissertation, Stanford University, 1982.

Books

A.W. England, P. G. Steffes *et al.*, Supporting Research and Data Analysis in NASA's Science Programs: Engines for Innovation and Synthesis. National Academy Press, Washington, D. C. ISBN 0-309-06275-6, 1998.

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