PENNSTATE

1855

EE 500 GRADUATE COLLOQUIUM

Spring 2014

You are cordially invited to

"DEVELOPMENT OF THE TALL VESSEL DETECTION SYSTEM (TVDS) AT BOSTON'S LOGAN INTERNATIONAL AIRPORT AND THE OPPORTUNISTIC DEMONSTRATION OF HIGH-RESOLUTION DETECTION AND CHARACTERIZATION OF AIRCRAFT-GENERATED WAKE VORTICES USING THE TVDS W-BAND RADAR"

By

Dr. Thomas A. Seliga

Consulting Electrical/ Electronics Engineer

Atmospheric Scientist

Date: April 17, 2014

Time: 4:00 pm

Location: 160 Willard

Abstract

Aircraft landing at and departing from the primary runway at Boston's Logan International Airport must pass through airspace that may be occupied with ocean-going and other tall vessels residing in the Boston Harbor Channel south of the Airport. This intersection requires continuous coordination of air traffic operations between flight arrivals and departures and tall vessels navigating the Channel. Dealing with these conditions had been a continuing challenge to FAA air traffic controllers and the Massachusetts Port Authority (Massport), which is responsible for ensuring the integrity of airspace in the airport environment. The FAA installation of the ASDE-X surface surveillance system in 2009 further complicated the impact of tall vessels, since it removed controller access to radar coverage of the Harbor in the Control Tower. Concerned about possible interferences with air traffic, MASSPORT sought to upgrade the technology air traffic controllers use to monitor local ship movements. To this end, they enlisted the technical expertise of the Volpe Center and asked me to provide recommendations and technical assistance that might lead to a system to address the problem. Subsequently, MASSPORT formed a project team that included the Volpe Center, the FAA and Pro-Sensing, Inc. of Amherst, MA to develop a solution. The effort resulted in the successful installation of the Tall Vessel Detection System (TVDS), a high-resolution dual radar system, the first in the U.S. to present air traffic controllers with ship location and height information on a visual display. Logan's Air Traffic Controllers now possess a greatly improved level of ship-traffic situational awareness in any level of daylight or poor visibility due to weather. The system is highly regarded by controllers and has been operational with little down time for over four years. This presentation will review the development of the TVDS and the process leading up to its successful implementation at Logan International Airport.

A second topic for discussion relates to an opportunity that afforded itself during the testing phase of the TVDS. Based on discussions with ProSensing engineers, it appeared to me that the W-band radar component of the system might also be useful for detecting aircraft-generated wake vortices. That is, the radar specifications (high spatial resolution and Doppler velocity capabilities) and location relative to two runways seemed well-suited for this purpose under rainfall conditions. Accordingly, proof-of-concept experiments were conducted to test the hypothesis. The results were highly successful, having produced velocity measurements of aircraft-based wake vortices at spatial resolutions never before achieved. This effort will be reviewed and include examples of wakes observed with the radar. The technology remains dormant for such applications, but can be implemented readily for related research applications.

Biography

Dr. Thomas A. Seliga is a Consulting Electrical/Electronics Engineer and Atmospheric Scientist, specializing in related areas of remote sensing and systems, aviation systems, surface transportation systems and ionospheric wave propagation. He received his B.S. degree in Electrical Engineering from Case Institute of Technology and his M.S. and Ph.D. degrees in the same field from The Pennsylvania State University. His research studies were conducted at the Ionosphere Research Laboratory that was founded and directed by Dr. Arthur H. Waynick.

Prior to retiring in 2010, he served as an Electronics Engineer with the Communications, Navigation and Surveillance Division of the USDOT Volpe National Transportation Systems Center, Cambridge, Massachusetts. His primary responsibilities involved studies and support of operational weather sensors and systems for the Federal Aviation Administration (FAA) as well as contributions to airport surveillance systems.

Most of his career was spent in academe as a faculty member that included service in a variety of administrative positions at Penn State University (Associate Dean for Research and Graduate Studies in the College of Engineering), Ohio State University (Director of the Atmospheric Sciences Program), the University of Washington (Chairman of Electrical Engineering) and the University of Toledo (Chairman of the Department of Electrical Engineering and Computer Science). He also served as the Program Director for Aeronomy at the National Science Foundation (1967-68) and held short-term, visiting scientist positions at the National Center for Atmospheric Research (1976), the National Weather Service (1996) and the Italian National Research Council's Institute of Atmospheric Sciences and Climate (2010).

Dr. Seliga is a Life Fellow of the IEEE in recognition of his innovative contributions to radar meteorology and higher education. His awards include the Ohio State University College of Engineering Research Award in 1985 and the Volpe Center Special Achievement Award for Innovative Technical Contributions to a Broad Range of Aviation Weather and Radar Programs in 2005. He also received special recognition via a Named Special Session during the 2006 IEEE International Geosciences and Remote Sensing Society Symposium as a Tribute to Contributions to Weather Radar Polarimetry.

His research and teaching interests have covered a wide range of topics, incorporating subjects related to electromagnetic wave propagation and scattering in ionized and non-ionized media, atmospheric studies on air pollution, surface surveillance radar techniques for aviation, and airport weather sensors and systems. His contributions to ionospheric wave propagation included a focus on the effects of high intensity, high frequency electromagnetic waves. He was the first to recognize the importance of critical wave coupling and effects of high intensity standing waves. The Russian Radiophysical Research Institute (NIRFI) has credited him with recognizing the possibility of creating artificial periodic inhomogeneities (APIs) of the ionospheric plasma that helped lead them to a new method of experimentation that is now performed at ionospheric heating facilities throughout the world.

He was the main force in developing the dual polarization concepts that have revolutionized the field of radar meteorology worldwide. Of particular importance are the concepts and technical implementations of differential reflectivity and specific differential phase shift measurements that have led to significant improvements in weather radar applications such as reliable rainfall rate estimation, hail detection and other hydrometeor characterization. Such dual polarization measurements have also gained major international prominence for their value in improving understanding of cloud physics and dynamic meteorology. His original work indicated two effective ways of making dual polarization measurements, one involving pulse-to-pulse switching between successive linear polarization states and the second involving simultaneous transmission and reception of the two linear polarization states. The latter method has been selected for the recent implementation of dual polarization capabilities to the U.S. NEXRAD operational weather radar system. He also helped further research into acid precipitation and sun-weather relationships by providing leadership on the organization and successful conduct of international symposia on these topics at Ohio State University.

His recent studies included investigations on transportation weather-related issues (in which he conceptualized and pioneered the use of NEXRAD weather radar data for evaluating and monitoring precipitation effects on surface transportation), evaluating the efficacy of using lightning data as a means of automating thunderstorm reports in automated weather stations, demonstrating the high degree of comparability between lightning and weather radar data, testing and analyzing forward scatter visibility measurements and systems, and evaluating and formulating wind and runway visual range algorithms. In the area of airport surface surveillance, he contributed to the development of the FAA's ASDE-X airport surface surveillance system that is currently deployed in many airports throughout the United States and developed and demonstrated an innovative multistatic means for reducing multipath false target reports of airport surface surveillance radars. In collaboration with ProSensing, Inc., Amherst, MA, he conceptualized a dual radar system for detecting and reporting on tall ships that intrude on landing and takeoff corridors at Boston's Logan Airport. The latter system has been successfully developed and deployed for use by FAA air traffic controllers at Logan for the Massachusetts Port Authority. The testing phase of this system was also used to demonstrate the efficacy of using one of its radar systems (W-band) for high-resolution detection and characterization of aircraft-generated wake vortices during rainfall conditions.