ROMA TRE UNIVERSITÀ DEGLI STUDI
Dipartimento di Ingegneria Industriale, Elettronica e Meccanica

SEMINARIO

Multistatic 3D Whole Body Millimeter-Wave Imaging for Explosives Detection

Prof. Carey Rappaport

Department of Electrical and Computer Engineering, Northeastern University, Boston, MA, USA
rappaport@neu.edu

Mercoledì 18 maggio 2022, ore 16.00 – 17.00
Aula Conferenze - via Vito Volterra 62, edificio Vasca Navale corpo B P1

Organizzatrice: Dott.ssa Cristina Ponti

Abstract

Most of the airport passenger security systems use millimeter-wave radar portals to detect threats concealed under clothing. These sophisticated sensors employ advanced RF radar modules and GPU-based accelerated processing. While they are very sensitive, alerting on even small anomalies, they are prone to false alarms, which lead to invasive pat-downs.

New research in multistatic focusing radar systems has the potential to improve detection and lower false alarms. Improvements in the antenna system and in the inversion algorithms help rule out innocent objects while making the detection of non-shape-specific anomalies more likely, without increasing the processing time.

A proposed toroidal reflector antenna, consisting of a tilted ellipse rotated about the vertical axis, provides for multiple, overlapping high-resolution nearfield beams that form multi-view, true multistatic mm-wave imaging for security applications. The elliptical curvature in the vertical plane focuses beams to narrow horizontal slices on the object to be imaged. With only this slice illuminated, the scattered field will be due to just this narrow portion of the subject, allowing for computationally simple inversion of a one-dimensional contour rather than an entire two-dimensional surface. Modeled results indicate that the illumination is wide and short, allowing for quickly computed images. Stacking the reconstructed contours for various horizontal positions provides the full object image.

Assuming typical smooth variations of the human body surfaces, the object detection is performed by comparing the retrieved surface with a smoothed one. In addition, weak dielectric explosive threats can be detected as foreign objects, and distinguished from innocuous concealed items. The improved advanced imaging technology system has the promise of reducing false alarms and minimizing pat-downs at airport security lines.

Biography

Carey M. Rappaport received five degrees from the Massachusetts Institute of Technology: the SB in Mathematics, the SB, SM, and EE in Electrical Engineering in June 1982, and the PhD in Electrical Engineering in June 1987. He is married to Ann W. Morgenthaler, and has two children, Sarah and Brian.

Prof. Rappaport has worked as a teaching and research assistant at MIT from 1981 until 1987, and during the summers at COMSAT Labs in Clarksburg, MD, and The Aerospace Corp. in El Segundo, CA. He joined the faculty as an Assistant Professor at Northeastern University in Boston, MA in 1987. He has been Professor of Electrical and Computer Engineering since July 2000. In 2011, he was appointed College of Engineering Distinguished Professor. During fall 1995, he was Visiting Professor of Electrical Engineering at the Electromagnetics Institute of the Technical University of Denmark, Lyngby, as part of the W. Fulbright International Scholar Program. During the second half of 2005, he was a visiting research scientist at the Commonwealth Scientific Industrial and Research Organisation (CSIRO) in Epping Australia. He has consulted for CACI, Alion Science and Technology, Inc., Geo-Centers, Inc., PPG, Inc., and several municipalities on wave propagation and modeling, and microwave heating and safety. He was Principal Investigator of an ARO-sponsored Multidisciplinary University Research Initiative on Humanitarian Demining, Co-Principal Investigator of the NSF-sponsored Engineering Research Center for Subsurface Sensing and Imaging Systems (CenSSIS), and Co-Principal Investigator and Director of the DHS-sponsored Awareness and Localization of Explosive Related Threats (ALERT) Center of Excellence.

Prof. Rappaport has authored over 450 technical journal and conference papers in the areas of microwave antenna design, electromagnetic wave propagation and scattering computation, and bioelectromagnetics, and has received two reflector antenna patents, two biomedical device patents and four subsurface sensing device patents. He was awarded the IEEE Antenna and Propagation Society's H.A. Wheeler Award for best applications paper, as a student in 1986. He is a member of Sigma Xi and Eta Kappa Nu professional honorary societies.