Classification of moving target by radar using spectrum based features

Pavlo Molchanov from Tampere University of Technology, Finland

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Abstract

Doppler radar is a powerful tool for numerous military, security and civil applications. The microwave radar can efficiently operate at long distance, in the darkness and almost all weather conditions. The applications of Doppler radar include moving target detection, identification and classification. In the presentation I will focus on solutions for radar target classification by features extracted from the spectrum. Currently, the analysis of micro-Doppler radar signatures is usually performed by second-order statistics, i.e. by using common energy-based power spectra and spectrograms. However, the information about phase coupling content in backscattering is totally lost in these energy-based statistics. This useful information can be extracted by using higher-order statistics. In the beginning of the presentation, principle behind radar sensing will be introduced. Then, higher-order statistics (HOS) will be discussed and their properties will be analyzed. Then, I will investigate the presence of frequency and phase coupling (one of the HOS properties) phenomenon in the micro-Doppler signatures of a walking human and flying aircrafts. Next, we will exploit this phenomenon for classification of ground moving targets. Then I will consider problem of small unmanned aerial vehicles classification by Doppler radar. The final topic will be about challenges in automotive radars: pedestrian classification and ongoing vehicle detection.

Bio

Pavlo Molchanov received the B.Sc. and M.Sc. degrees, with distinction, in radio technical systems, devices, and complexes from National Aerospace University, Kharkov, Ukraine, in 2008 and 2010, respectively. Since 2010, he is working toward the Ph.D. degree with Tampere University of Technology, Tampere, Finland. The topic is analysis of radar returns from moving objects, including detection, filtering, and classification. The thesis will contribute to the area of classification of ground moving targets, aerial targets (airplanes and UAV's), and pedestrians by automotive radar. Special attention is paid to the Higher Order Spectrum Analysis techniques, which emphasize non-linear structures in the signal, preserving phase information. He received best paper award at EuRAD2011 conference for paper: “Moving Target Classification in Ground Surveillance Radar ATR System by Using Novel Bicepstral-based Information Features”.