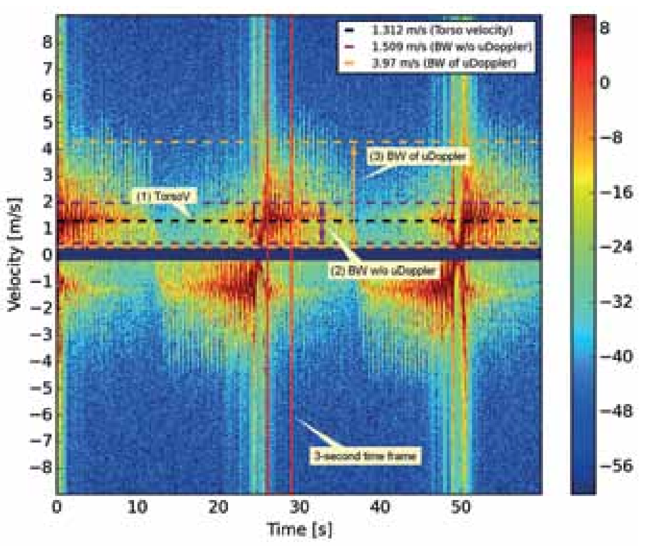
SENTIRE RADAR

RADAR APPLICATION NOTE

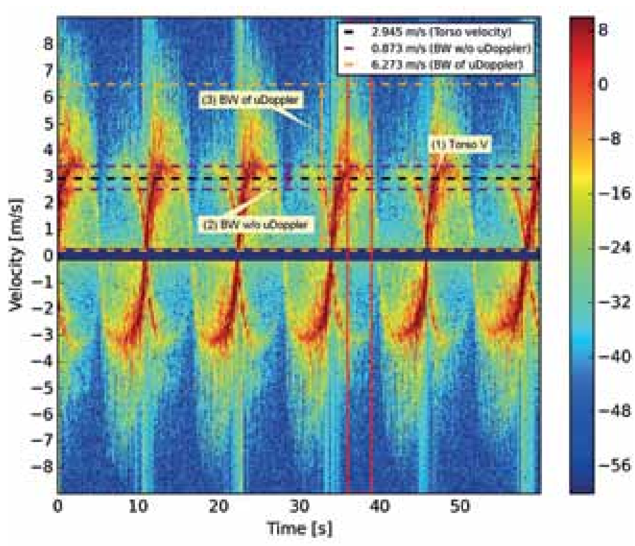
MICRO-DOPPLER MEASUREMENTS FOR TARGET CLASSIFICATION

Motivation: Due to advanced developments of sensor technology and autonomous systems in recent years, security applications used in critical infrastructures such as airports and power plants received much attention in the world. However, current systems which usually involve visual cameras and human operators are inadequate for early warning tasks, highly restricted by environmental factors, and are in conflict with the right to privacy and data protection. Recent researches indicate that radar can be used in classification of moving targets through observing the μ-Doppler signatures of the reflected signal. Therefore, using radar as a security application can provide ground surveillance under a wide range of weather and lighting conditions, high privacy standards and low false alarm rate.

TV diagram of walking person

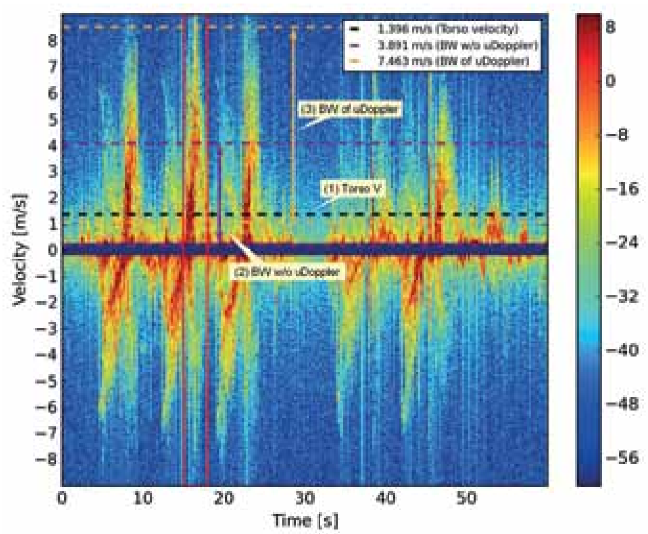


TV diagram of running person

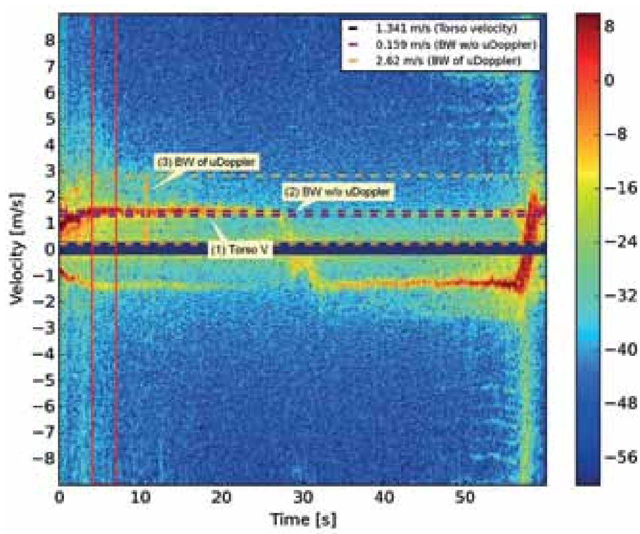


The 24 GHz FMCW radar sR-1200 was modified to enable μ-Doppler measurements in CW mode. The RF frontend has one transmit and two receive antennas and channels. Both allow I/Q modulation so that complex radar signals are available. A positive velocity represents targets, which move away from the radar, while targets with negative travelling speed are approaching the radar. Furthermore, the micro-Doppler signature includes characteristic movements from the target like the oscillating arms, legs and torso of a walking person. In case of vehicles it would be the rotating wheels of a car or the revolving blades of a multicopter. The different signatures become obvious from time-velocity diagrams (TV). IMST carried out a number of μ-Doppler measurements with the modified radar. The objective of this campaign was to analyze the micro-Doppler signatures in order to classify different moving targets: human, vehicle, UAV and animal. By analyzing the μ-Doppler signatures within a short time frame, the potential of using radar as a remote sensor for security and perimeter protection applications could be demonstrated. It is also shown that I/Q sampling during the signal processing preserves the direction of the targets' motions, which provides additional information on top of the micro-Doppler signatures. This information can then be used as a parameter during the danger assessment of ground surveillance.

TV diagram of running dog



TV diagram of small 4-wheels vehicle



μ-Doppler features provide information for target classification, recognition and identification. Here, three features were extracted to distinguish persons from 4-legs animals and other vehicles: (1) mean torso velocity, (2) bandwidth without micro-Doppler and (3) bandwidth of micro-Doppler.

Related Publications:

17th International Radar Symposium 2016, Krakow, Poland, 10-12 May 2016:
O. Lam, R. Kulke, M. Hägelen, G. Möllenbeck "Classification of Moving Targets Using Mirco-Doppler Radar",
Svante Björklund, "Target Classification in Perimeter Protection with a Micro-Doppler Radar".

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