Doppler Studies of Translational Objects inside a Compact Test Range
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The Doppler response of dynamic surfaces can be used in a variety of applications. Previous studies have focused on the rotational aspects of motion, including helicopter rotor blades (Balanis, IEEE Trans. Ant. Prop., 2001) and rotating wire scatterers (Kozlov, J. Quant. Spect. & Rad. Trans., 2017). The rotation of these targets gave rise to micro-Doppler peaks due to radar illumination of the individual elements. Additional studies have examined how the translational motion of an object can introduce constant Doppler shifts (Chen, V.C., IET Signal Processing, 2008). The present work extends this idea to a series of fins on a conveyor belt in an effort to better understand the generation of Doppler return from purely translational motion.

This effort explores the generation of Doppler shifts from the translational motion of objects within a compact test range. Such motion is implemented here using a conveyor belt system. Equally-spaced conducting fins are placed on the belt to completely cover the rotating surface. A motor is used to drive the conveyor belt at different forward or reverse speeds. Generated Doppler shifts are measured monostatically with a real-time spectrum analyzer with center frequencies between 2 and 18 GHz.

Results will be presented on Doppler shifts of the translational conducting fins for different conveyor velocities, including forward and reverse speeds. The velocities of the fins are extracted from the Doppler shifts and compared to actual surface velocities measured with a surface velocimetry device. Findings are also presented for Doppler shifts across the entire frequency range to better understand the relationship between frequency shifts and translational motion. Lastly, measurements of Doppler shifts are presented for various array spacing.

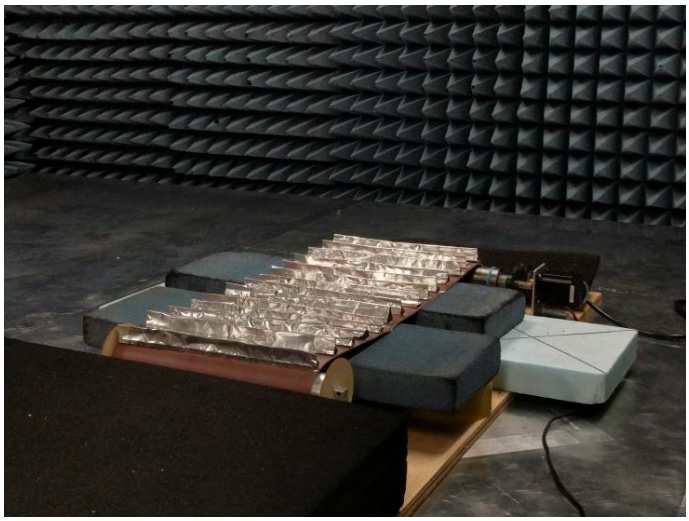

Figure 1. Array of equally-spaced conductive fins on conveyor belt within a compact test range