An EHF radar for characterization of human micro-Doppler properties and backscatter from surfaces and rain

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Operation in the EHF portion of the spectrum—specifically, near the 220 GHz atmospheric window—introduces simultaneous advantages and challenges for radar systems. The advantages include (1) the high available bandwidth, resulting in improved range resolution, (2) the ability to generate video-rate synthetic aperture radar (SAR) imagery from an airborne platform, and (3) the ability to penetrate common atmospheric obscurants such as clouds and dust. The latter two advantages imply that next-generation SAR systems in the EHF band have the potential to supplant existing optical and infrared imaging systems, providing improved safety during landing, and situational awareness in general, for airborne systems operating in poor atmospheric conditions. On the other hand, the present challenges at these frequencies include (1) a lack of compact and reliable high-power transmitters, (2) a gap in knowledge of the scattering properties of natural and artificial surfaces, (3) incomplete understanding of the fully-polarimetric backscatter of rain, and (4) the unknowns of radar cross section (RCS) and micro-Doppler signatures of humans.

We are developing a fully-polarimetric frequency-modulated continuous-wave instrumentation radar to explore the latter three of the aforementioned topics, as part of DARPA's Video-rate SAR (ViSAR) program. The radar is comprised of commercial off-the-shelf components, with the exception of the high-performance orthomode transducers that are custom-built to provide the isolation necessary for measuring the weak cross-polarized return from rain. In this presentation we will describe the radar system and our progress so far, including RCS and micro-Doppler measurements of humans (and a phenomenological description of the results), and monostatic backscatter from surfaces such as asphalt and building materials. Additionally, we will present the experiment configuration we are developing to characterize *in situ* rain.