

A Frequency Selective Surface Used as a Broadband Filter to Pass Low-Frequency UWB While Reflecting X-band Radar

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Although airborne ultra wideband (UWB) systems typically operate at or below a few gigahertz, they employ impulse-radiating antennas (IRAs) characterized by especially large X-band radar cross-sections. Thus, an aircraft with a UWB antenna may be highly visible to X-band radars. In response to this, we sought to identify a window or radome material to reflect X-band while transmitting lower frequency UWB signals with no loss or dispersion. The goal is to allow the UWB mission while perturbing the natural X-band cross-section of the aircraft as little as possible.

To design our window, we investigated the use of a frequency selective surface (FSS) as a passive broadband filter, reflecting X-band (8–12.4 GHz) radar, while propagating UWB signals below about 5 GHz without dispersion. Although a fully optimized window would typically consist of multiple FSS layers interleaved with dielectric materials, we limited our study to structures having a single FSS layer or dual FSS layers separated by a material with dielectric constant approximating that of air. Each FSS layer consisted of a planar periodic array of conducting hexagons embedded between a pair of 0.0508-cm RT/duroid 5880 sheets. We present the results of numerical simulations and experimental measurements demonstrating that the dual-layer FSS reflects essentially all of X-band and is transparent to UWB frequencies below 2.5 GHz.

Although FSS structures related to those considered here have been used extensively in radomes and other protective structures for narrowband applications, this UWB application is new, requiring both a broad, low-frequency, dispersion-less pass band and a similar high-frequency stop band.