Development of the Impulse Slot Antenna (ISA)

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Here, we describe the development of the Impulse Slot Antenna (ISA), which is a conformal ultra-wideband (UWB) antenna suitable for printing onto a non-conducting aircraft wing. This antenna, designed to look out over the wingtip, will likely be useful in UWB radar applications having only limited space available for an antenna. We describe the design, fabrication, and testing of the ISA and a number of earlier designs; and we demonstrate the improved performance of the ISA over its predecessors.

The frequency range of interest for the ISA is from 250 MHz to 2 GHz, and we built a series of 1/8th-scale models operating in the 2–16 GHz range. In all cases, we constrained our designs to make maximum use of an aircraft wing with an aspect ratio of 2:5. We first investigated several tapered slot antennas with 50-ohm input impedance. However, none of these exhibited satisfactory performance. This led to the development of the ISA, which is a hybrid antenna consisting of 200-ohm flattened biconical coplanar plates near the feed and a spline-tapered slot of gradually increasing impedance farther out. The antenna is fed by a 50-to-200-ohm splitter balun through a 200-ohm twin-line.

The ISA out-performed all its predecessor designs and performed nearly as well as the Farr Research Model TEM-1-50 sensor, which has a radiating element with nearly five times the area of the radiating elements of the scale model ISA. Moreover, the conformal ISA completely avoids the aerodynamic drag of a TEM horn. We describe the 1/8th-scale ISA, and we compare its performance in terms of return loss, boresight gain, and antenna pattern to both its immediate predecessor, the linear tapered slot antenna (LTSA), and to the Farr Research TEM sensor. Finally, we note some design improvements that should lead to improved performance in the next generation ISA.