Small Conformal Ultra-Wideband Omnidirectional Traveling-Wave Antenna on Platform Circumventing Chu Limitation

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For decades antenna engineers have been trying to achieve one or more of the following difficult antenna design goals: broad bandwidth, small size, and conformable mounting on platform. For the omnidirectional antenna, one faces the fundamental gain bandwidth limitation constrained by the antenna's electrical size, generally referred to as the Chu limitation (L. J. Chu, *J. Appl. Phys*., Vol. 19, 1948). However, there are major shortcomings and ambiguities in the Chu theory when applied to real-world problems, as pointed out recently by the senior author (J. J. H. Wang, *PIERS 2005*, Hangzhou, China, August 2005; J. J. H. Wang, *IWAT 2006*, White Plains, New York, March 2006). One problem is that, when an antenna is mounted on a platform, its size becomes ambiguous. The other problem is the unrealistic assumption of a lossless antenna in the theory. This observation has led to a technique to extend the bandwidth of antennas beyond the Chu limitation, by circumventing the size and loss/gain criteria, and simultaneously resolve the practical problem of conformal mounting of antenna on platform, such as cell phone.

Fig. 1 shows a scale model of a traveling-wave antenna (without radome) mounted on, and strongly coupled to, a horizontal instrument pod (21.6" long × 5.1" dia) under a small airborne platform. The radiating aperture consists of an array of rectangular slots excited by a traveling wave.

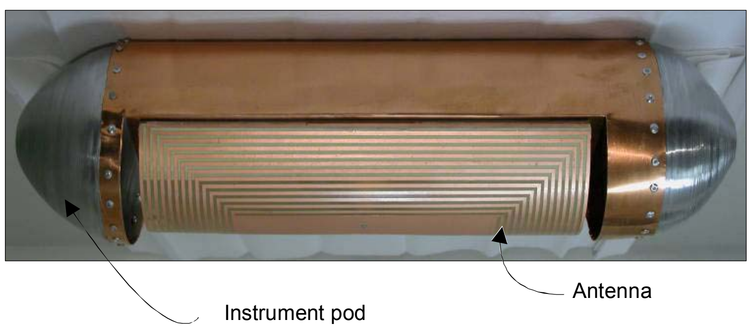

Fig. 1. Antenna on pod.

Fig. 2 shows measured SWR over 0.44 to 4.4 GHz, a 10:1 octaval bandwidth. Measured gain patterns exhibit omnidirectional coverage with vertical polarization. Ripples in azimuth patterns arise with increasing frequency, due to the elongated shape of the antenna. Research continues to enhance antenna gain at low end of the frequency, below 0.64 GHz, by improving impedance matching between the antenna and the strongly coupled pod, further circumventing the Chu limitation.

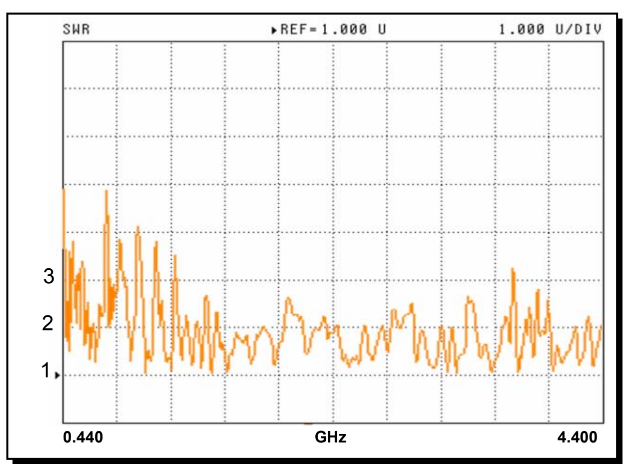

Fig. 2. Measured SWR over 0.44-4.40 GHz.