DUAL-BAND, HIGHLY-STEERABLE MICROSTRIP PATCH PHASED-ARRAYS

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Reported are the results of an investigation to design, build and test low-profile antennas suitable for airborne datalinks. Airborne datalink antennas ideally have high-gain pencil beams steerable to optimize the SNR of the channel. In the past, these requirements have been met by dual-axis, mechanically steered antennas. Although this renders the high-gain requirement more practicable, these designs generally result in large protrusions from the conducting surface of an airborne platform. In addition to possible RCS concerns, such obtrusions generally result in a significant increase in the aerodynamic drag of the platform. Minimizing this effect while maintaining coverage throughout a specified cone has traditionally lead to the use of mechanically steered antennas with almost hemispherical coverage, in an effort to minimize the number of antennas used. Nonetheless, the impact on fuel efficiency and range on airborne platforms from the addition of datalink antennas is far from satisfactory.

In this work, the use of phased-array microstrip antennas to meet the aforementioned performance requirements is explored. In particular, a challenging dual-band datalink is pursued, with center frequencies of the two bands having a ratio of approximately 1.5:1. This bandwidth requirement is not easily met by microstrip elements, so a variety of broadbanding and dual-banding element design techniques have been investigated, including various combinations of multilayer stacking, aperture coupling, slotting patches and shorting patches. Even with an element that provides satisfactory bandwidth, it is far from trivial to implement an array that maintains this bandwidth while permitting steering from on-boresight to near-horizon. Some of the array design considerations investigated include architectures for time-delay beamforming networks, sub-arraying beamforming techniques, element active (mutual) impedance, impact of scan blindness, and surface-wave phenomena.

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2. B - Fields and Waves

3. (a)

4. C - Contributed Paper

5. No special instructions