Deployable and Reconfigurable
Ultra-Wideband Apertures on Origami Lattices

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Reconfigurable and deployable antenna arrays are required for satellite/CubeSat communications and remote sensing applications. There is also a need for packaging before launch to address limited payload space for these exoatmospheric deployments. In this context, the proposed origami phased array antenna concept is relevant and attractive as it can provide repeatable folding while maintaining the array performance.

In this paper, we consider designs based on Miura-Ori folding for Tightly Coupled Dipole Arrays (TCDA). The latter has already been shown to achieve low cross-polarization across a contiguous bandwidth of greater than 20:1 with low angle scanning. But to achieve low-scanning using this origami-based TCDA configuration, we must incorporate new design features to optimize and retain the array's performance after repetitive folding and unfolding. This paper demonstrates an unprecedented 27.5:1 bandwidth TCDA with VSWR < 3 when scanning down to 60◦ in the E- and VSWR < 3.5 in both D- and H-planes. An Impressive radiation efficiency of 83% is achieved by incorporating multiple Frequency Selective Surface (FSS) substrates. These FSSs emulate a variable distance between the array aperture and the ground plane.

Additionally, we consider the effect of Miura-Ori and demonstrate that TCDAs can be folded and unfolded effectively without affecting their Radio-Frequency (RF) operation. Notably, we present a foldable TCDA that operates from 0.51 to 2.8 GHz with VSWR < 2.1 at broadside and VSWR < 3 when scanning down to 45◦ in the E- and H-planes. The latter employs a combination of rigid and flexible substrates allowing for foldability. Simulations and measurements are provided.