Machined Conformal Dual-Polarized Vivaldi Feed Array for Multi-Beam 3-D Luneburg Lens Antenna

Gitansh Gulati(1), Min Liang(1), and Hao Xin*(1)
(1) Electrical and Computer Engineering Department, University of Arizona, Tucson, AZ, 85721, USA

Advancement in wireless communication systems has facilitated requirements for antennas with wide-angle beam scanning, high gain, broadband behavior and capability to form multiple beams. To obtain these characteristics, broadband Luneburg lens has been proposed (Min Liang, Wei-Ren Ng, Kihun Chang, Kokou Gbele, Michael E. Gehm and Hao Xin, "A 3-D Luneburg lens antenna fabricated by polymer jetting rapid prototyping," IEEE Trans. Antenna Propag., vol. 62, no. 4, pp. 1799-1807, Feb. 2014).

To demonstrate multi-beam property of the proposed Luneburg lens with high gain, a dual-polarized broadband (3 - 6 GHz) compact Vivaldi feed array has been engineered, taking to account base design proposed by Kindt *et al* (Rick W. Kindt and William R. Pickles, "Ultrawideband all-metal flared notch array radiator," IEEE Trans. Antennas Propag., vol. 58, no. 11, pp. 3568-3575, Nov. 2010), to facilitate minimal pattern distortion, high-efficiency and low-side lobe level. Vivaldi array design including slot line region parameters has been optimized to meet two primary requirements: (1) coincident phase center location with lens focal point, and (2) reduced backward radiation. The adjacent horizontally polarized and vertically polarized feeding elements are placed 10 degrees apart in both planes, thus covering 90 degrees in azimuth plane and 30 degrees in elevation plane as shown in Fig. 1(a). Each element of the array is designed to be cut using a standard waterjet cutting process to realize relatively accurate thin slots and complex features, reducing manufacturing costs considerably. Further, holes for inserting extended Teflon SMA connectors at the backplane are drilled using standard milling machine. The elements are then assembled and welded at the intersecting points with a Gas Tungsten Arc Welding process to secure the completed array. The proposed conformal dual-polarized Vivaldi array made of aluminum is designed to operate over the frequency range from 3 – 6 GHz corresponding to an impedance bandwidth of 66.66 % for VSWR < 3 as shown in Fig. 1(b). Pattern gain measurements with 3-D printed Luneburg lens are currently under progress.

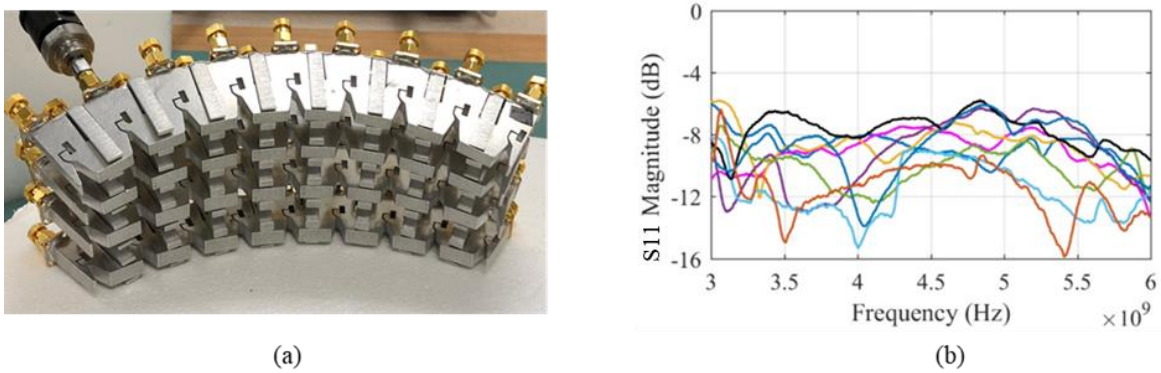

Figure 1. (a) Conformal dual-polarized 60-element (9 x 4 H-pol. and 8 x 3 V-pol. elements) Vivaldi feed array fabricated prototype (b) Return loss measurements for 9 H-pol. elements in azimuth plane (elevation = 0 deg.).