G-band Micro-fabricated Frequency-Scanned Antenna Arrays with 60º beam steering over a 30 GHz bandwidth.

Leonardo Ranzani*(1), Daniel G. Kuester (1), Kenneth Vanhille(2), Zoya Popovic(1)
(1) University of Colorado, Boulder, CO
(2) Nuvotronics, LLC, Roanoke, VA

In frequency-scanned antenna arrays, the antenna beam is scanned by tuning the signal frequency. The antenna elements are fed serially, so that the relative phase-shift and therefore the scanning angle depends on frequency. Since no tunable phase shifters are needed, frequency steering is cheaper and particularly useful at millimeter-wave frequencies, such as G-band, where tunable phase shifters are not available. Wide scanning angles can be obtained by increasing the operating bandwidth as well as the dispersion of the array feedline. Since the antenna gain can vary considerably over a wide frequency range, a high scanning angle per unit frequency is needed in order to achieve wide scanning and uniform gain.

In this talk, planar frequency scanned slot arrays at G-band with increased scanning angle per unit frequency will be described. Up to 60º of scanning with 2º/GHz are obtained by using a highly dispersive corrugated waveguide feed line. The device has twice the scanning as previously reported micro-fabricated G-band arrays. A slow-wave corrugation in the bottom waveguide wall increases the phase shift between the radiating elements and the scanning angle of the array. By controlling the depth and period of the corrugation, beam steering per unit bandwidth and return loss can be optimized. The devices are micro-fabricated in a sequential metal deposition process called PolyStrata® to achieve lower losses and compact size (PolyStrata® waveguides can have losses as low as 0.1dB/cm at G-band). A micro-coaxial dividing network is used to feed multiple linear corrugated waveguide arrays in phase and thus obtain a narrow beam both in the scanning and non-scanning planes. Two prototypes will be presented: a 16x16 elements array operating from 130 to 150 GHz and a 32x32 element array operating from 150 to 180 GHz. Scaling to larger devices will be also discussed.