Ka-Band Phased Array Antenna with Integrated MEMS Phase Shifters

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We present a wideband Ka-band phased array antenna with micro electro-mechanical systems (MEMS) phase shifters integrated directly into the feeding structure of each element. Traditionally, phased arrays use GaAs monolithic microwave integrated circuits (MMIC) phase shifters for beam-steering. However, as the number of array elements grow, MEMS-based phase-shifter technologies become more attractive due to lower insertion loss and very low power consumption. In particular, for a new class of phased arrays developed recently, the large number of elements necessitates use of MEMS-based phase-shifter to minimize total power.

Traditional phased-array designs are based on an isolated element to avoid dramatic changes in element performance due to mutual coupling. Nonetheless, the close proximity of the radiating elements to the array housing (such as the metallic body of the vehicle) introduces large inductance and limits the operation bandwidth significantly. However, it was demonstrated that this ground plane shorting can be mitigated by introducing controlled mutual capacitive coupling between array elements (B. Munk, *Finite Antenna Arrays and FSS*, 2005) to offset the inductance. As such, tightly-coupled phased arrays can be realized with wideband operation, exceeding 4:1 bandwidth.

In this work, we present a Ka-band (25~28 GHz) tightly coupled dipole array with MEMS phase shifters directly integrated with the element feed structure. The dipole elements are fabricated on Al_2O_3 substrate (ε_r=9.8) with a twin coplanar waveguide (CPW) feed to ensure balanced feeding. Unfortunately, this feeding structure requires two phase-shifters per element. Thus, a new balanced feed structure with a single CPW line is needed. For this purpose, a Γ-match structure is considered. At the conference, we will present the optimized antenna structure with Γ-feed line for wideband coverage. We will also demonstrate overall performances based on the simulation results, including VSWR, pattern and radiation efficiency.