MAcro Electro Mechanical Systems (MÆMS) Based Beam Steering in Reflectarray Antennas

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In recent years, there has been a growing interest in employing phased-array antennas in various applications ranging from satellite and airborne communications to radars and imaging systems. While a number of phased-array systems have been deployed, their extreme cost and complexity have limited their application only to the most expensive pieces of military hardware. Therefore, many military systems that can potentially benefit from the capabilities offered by phased arrays are left behind. Thus, new ideas for developing affordable phased arrays are needed to enable the widespread use of this technology in future tactical systems.

In this work, we present the concept of MAcro Electro Mechanical Systems (MÆMS) based phased arrays. The concepts introduced in this work are expected to enable the development of rapidly-reconfigurable, and affordable phased-array antennas capable of handling extremely high power levels without the need for using any phase shifters or solid-state devices. In this work, we discuss a specific design example where MÆMS tuning techniques are applied to a reflectarray antenna to achieve a beam-steerable structure. We demonstrated that beam steering in this reflectarray is accomplished through small, macro-scale physical movements of parts of the antenna aperture without the use of any solid-state devices or phase shifters. This concept makes the task of designing large scale tunable reflectarrays considerably simpler and more practical, since it eliminates the need for integrating individual electronic tuning elements (e.g. varactors, switches, etc.) within each unit cell of the structure. Additionally, because the mechanical movements involved are very small and the parts of the structure that need to be moved are light weight, mechanical movements can be performed very rapidly. Details of the proposed concept along with the simulation and measurement results of a prototype will be discussed and presented at the meeting.