Scanning Lens Phased Arrays

Collaborators in this topic:
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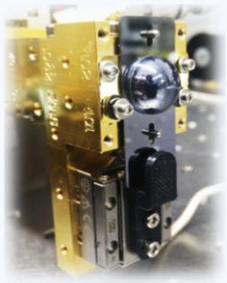
In this ERC it has been proposed, for the first time, to use of a small number of lens antennas as active elements in a sparse array with electrically large spacing. This architecture facilitates the integration of submillimeter-wave active technology into an array, aids thermal management and enhances the radiated power. At the same time, the lens' steering capabilities are exploited to achieve the desired beamforming while avoiding grating lobes and achieving wide bandwidths. A research frame-work collaboration was established with JPL/NASA to develop these kinds of arrays at 550GHz using micro-machining technology in silicon.

Dynamic beam steering at 550GHz

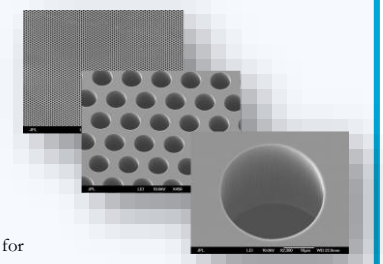
Key idea: dynamic steering of a high-gain beam at 550GHz via the integration of a leaky-wave lens antenna with an actuated lens using a low-power piezo-motor.



M. Alonso-delPino, C. Jung-Kubiak, T. Reck, N. Llombart and G. Chattopadhyay, "Beam Scanning of Silicon Lens Antennas Using Integrated Piezo motors at Submillimeter Wavelengths," in IEEE Transactions on Terahertz Science and Technology, vol. 9, no. 1, pp. 47-54, Jan. 2019

Wide-band top-hat feed antenna at 550GHz

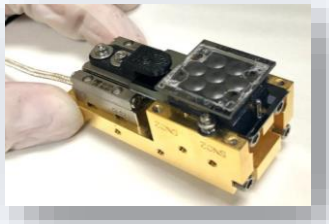
Key idea: By exploiting the use of silicon micro-machined artificial dielectrics, a technology developed at JPL, we can generate multiple leaky modes in the Fabry Perot cavity to generate a top-hat pattern that provides very high aperture efficiency in a shallow lens, a key parameter for lens phased arrays, over a wide bandwidth.



M. Alonso-delPino, S. Bosma, C. Jung-Kubiak, G. Chattopadhyay and N. Llombart, "Wideband Multi-Mode Leaky-Wave Feed for Scanning Lens Phased Array at Submillimeter Wavelengths," in IEEE Transactions on Terahertz Science and Technology, 2021

Lens phased array at 550GHz

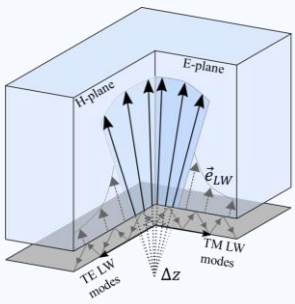
Key idea: Lens phased arrays can provide the dynamic steering of a high gain beam, using electrically large periodicities, over a limited field of view. The multiple grating lobes can be mitigated by the intrinsic true-time delay steering properties of the lenses. We have developed a first proof of concept lens prototype at 500GHz in collaboration with JPL/NASA.



M. Alonso-delPino, S. Bosma, C. Jung-Kubiak, G. Chattopadhyay and N. Llombart, "Wideband Multi-Mode Leaky-Wave Feed for Scanning Lens Phased Array at Submillimeter Wavelengths," in IEEE Transactions on Terahertz Science and Technology, 2021

Theoretical Framework

Key idea: The design of these antennas is done analytically by combining the CFO technique with the spectral field representation of the leaky-wave antenna, and the associated sparse array factor. We found that the field radiated by this leaky-wave antenna, even very closed to the source, can be modelled via a spherical wave. With this understanding, lenses are of moderate electrical dimensions for these array architectures, can be designed analytically.



Sjoerd Bosma, Andrea Neto, Nuria Llombart , "On the Near-Field Spherical Wave Formation in Resonant Leaky Wave Antennas: Application to Small Lens Design," in IEEE Transactions on Antennas and Propagation, accepted