

A PHASED ARRAY USING OSCILLATORS COUPLED ON A TRIANGULAR GRID

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During the past few years it has been demonstrated by several authors that an array of mutually injection locked oscillators coupled to nearest neighbors on a Cartesian grid can be used to control the aperture phase of a phased array antenna. [R. A. York, *IEEE Trans.*, MTT-41, pp.1799-1809] [P. Liao and R. A. York, *IEEE Trans.*, MTT-41, pp. 1810-1815] [R. Ispir, S. Nogi, M. Sanagi, and K. Fukui, *IECE Trans. Electron.*, E80-C, 1211-1220, Sept. 1997] [R. J. Pogorzelski, *Microwave and Guided Wave Letters*, 10, pp. 478-480.] [J. Shen and L. W. Pearson, 2001 Nat. Radio Sci. Mtg, Boston, MA] A linear phase distribution can be established in which the rate of phase progression is controllable via adjustment of the tuning (free running frequency) of the oscillators on the perimeter of the array. The set of oscillator output signals is suitable for excitation of an array of radiating elements equally spaced on a Cartesian grid thus producing a steerable radiated beam.

In this paper a triangular array based on this principle is proposed. The oscillators are coupled to nearest neighbors on a triangular grid rather than a Cartesian one. This implies that each oscillator is directly coupled to six others instead of four. The boundary of the array is an equilateral triangle. (Rhombic and hexagonal boundaries are also possible but are much less convenient to analyze in the manner presented herein.) Analysis of the dynamic behavior of the proposed array is carried out using a linearized continuum model. [R. J. Pogorzelski, P. F. Maccarini, and R. A. York, *IEEE Trans.*, MTT-47, 463-470, April 1999] Solution of the resulting partial differential equation over the triangular region is facilitated by the use of the eigenfunctions of a triangular waveguide. [P. L. Overfelt and D. J. White, *IEEE Trans. MTT-34*, 161-167, Jan. 1986] It is shown that the array behavior is isotropic and that, while the response of the array is slower than that of the corresponding Cartesian array, individual oscillators in a triangular array may be tuned further from the ensemble frequency without losing lock than is the case in a Cartesian array. The detuning of the oscillators necessary to effect beam steering is shown to be constant along the edges of the array as is the case in the Cartesian array.