

ON THE BANDWIDTH OF COUPLED OSCILLATOR BASED PHASED ARRAYS

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Recently, several researchers have reported studies of phased array antennas in which the aperture phase distribution is derived from an array of mutually injection locked electronic oscillators. [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, *Nat. Radio Sci. Mtg*, Boston, MA, July 2001] This raises the question of how the bandwidth of such an array may differ from that of a conventional phased array. (For present purposes we exclude the case of a so-called true time delay array.)

First, we distinguish between the operating bandwidth and the instantaneous bandwidth of the array. Here we deal only with the instantaneous bandwidth since the operating bandwidth is in essence that of the corresponding conventional array being determined by the operating range of the electronics and that of the radiating aperture. The instantaneous bandwidth of a conventional phased array is dependent upon the bandwidth of the radiating elements and the frequency scanning properties of the array. These are also factors determining the bandwidth of an oscillator array based antenna. However, in addition to these, the bandwidth of the oscillator-based antenna is determined by the dynamic characteristics of the *oscillator* array. To be sure, the dynamic behavior determines the attainable rate of scan but, more relevant to our present discussion, it also determines the rate at which the output signal can be phase or frequency modulated without undue distortion. [R. J. Pogorzelski, J. S. Acorn, and M. S. Zawadzki, *Nat. Radio Sci. Mtg.*, Boulder, CO, Jan. 2000] The dynamic properties of the oscillator array are determined by the number of oscillators and the complex inter-oscillator coupling strength. In this paper, the factors influencing array bandwidth are evaluated in terms of their relative impact on the data rate which the antenna will support, a performance parameter which is taken to be the appropriate measure of antenna instantaneous bandwidth.