# A DEMONSTRATION OF THE USE OF COUPLED OSCILLATORS IN AN AGILE BEAM RECEIVER

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Agile beam phased array antennas in which the aperture phase distribution is derived from an array of mutually injection locked electronic oscillators were originally proposed and developed by York and his students. [R. A. York, IEEE Trans., MTT-41, pp.1799-1809, Oct. 1993] [P. Liao and R. A. York, IEEE Trans., MTT-41, pp. 1810-1815, Oct. 1993] More recently, considerable additional work has been reported. [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, Nov. 2000] [J. Shen and L. W. Pearson, Nat. Radio Sci. Mtg, Boston, MA, July 2001] These studies concern transmit-only arrays. A corresponding receive array concept was described and demonstrated by Cao and York in a five element linear array. [1995 IEEE AP-S Symposium Digest, 1311-1314] Here we report a laboratory demonstration of this concept in a fifteen element linear array of oscillators using a phase diagnostic system to monitor the phase distribution across the array.

The operation of such a receive array is based on the fact that, in a linear array of mutually injection locked oscillators, one may induce linear phase tapers across the aperture by anti-symmetrically detuning away from the ensemble frequency only the end oscillators of the array. Thus, if each oscillator output is mixed with the signal received by a corresponding element of the receive aperture, the linear phase taper due to the angle of incidence of the wave impinging on the aperture can be removed by the phase taper of the oscillator array effectively steering the receive beam. The experiment reported here involves an array of fifteen L-band (1.265 GHz) oscillators mutually injection locked via coupling of their tank circuits with transmission lines terminated in resistor networks. A set of on-axis incident wave induced element signals (at 1.950 GHz) is simulated by means of a signal generator and a fifteen-way power divider. Each of these element signals is then mixed with the corresponding oscillator output and the resulting intermediate frequency (685.2 MHz) signals are combined via a fifteen-way power combiner. The receive beam is characterized by steering it through this simulated normally incident wave and plotting the output of the power combiner versus the interoscillator phase difference. The results agree quite well with the theoretical prediction.

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