TWO DIMENSIONAL PHASED ARRAY BEAMSTEERING VIA PERIMETER DETUNING OF COUPLED OSCILLATOR ARRAYS

R. J. Pogorzelski
Mail Stop 138-307
Jet Propulsion Laboratory
Calif. Institute of Technology
4800 Oak Grove Drive
Pasadena, CA 91109

Linear arrays of coupled electronic oscillators have been used in experiments designed to control the aperture phase of a one dimensional phased array antenna. The linear phase progressions across the aperture necessary to produce steering of the beam may be induced by merely detuning the end oscillators in the array in an antisymmetric manner. [R. A. York, IEEE Trans., MTT-41, pp.1799-1809][P. Liao and R. A. York, IEEE Trans., MTT-41, pp. 1810-1815] A continuum model of the dynamics of such an array has been developed in which the aperture phase is governed by a second order partial differential equation of diffusion type. Solution of this equation yields considerable insight into the behavior of the array. [R. J. Pogorzelski, P. F. Maccarini, and R. A. York, IEEE AP-S Symposium Digest, Atlanta, GA, June 1998, pp. 462-465.]

The present work concerns extension of the continuum model to two dimensions. The resulting two dimensional diffusion equation is solved via the Laplace transform to yield an analysis of the dynamics of a two dimensional phased array controlled by a two dimensional array of coupled voltage controlled oscillators (VCOs). It is shown that the beam of the array can be steered in two dimensions by appropriate tuning of the oscillators on the perimeter of the array. This represents a considerable simplification of the beam steering electronics in that, for an M by N array, one need only control 2M+2N-4 oscillators as opposed to the usual MN. Moreover, no phase shifters are required. One need only control the voltages applied to the tuning ports of the perimeter oscillators. A convenient way to do this is to use a computer controlled digital to analog converter board which provides a programmable voltage for each of the oscillators on the perimeter. Computed examples illustrate the dynamic; i.e., time varying, behavior of the far field during the beam steering transient as predicted by the two dimensional continuum model.

National Radio Science Meeting

January 4-8, 1999 ▸ University of Colorado at Boulder
Boulder, Colorado ▸ http://cires.colorado.edu/ursi

This open scientific meeting is sponsored by the U.S. National Committee for the International Union of Radio Science (URSI). It is being held in cooperation with the following IEEE organizations: Antennas and Propagation Society and its Wave Propagation Standards Committee, Circuits and Systems Society, Communications Society, Electromagnetic Compatibility Society, Geoscience and Remote Sensing Society, Information Theory Group, Instrumentation and Measurement Society, Microwave Theory and Techniques Society, and the Nuclear Science Society.

Papers on any topic of interest to a commission are welcome. In particular, papers on the special topics listed below are solicited. Contact the commission chairperson for further information.

A COMMISSION A - Electromagnetic Metrology

Ch.: John D. Norgard, (719) 262-3548
FAX (719) 262-3589
EMAIL norgard@eas.uccs.edu

- Microwave to submillimeter measurements/standards
- Quantum metrology and fundamental concepts
- Time and frequency
- Time domain metrology
- EMC and EM pollution
- Noise
- Materials
- Bioeffects and medical applications
- Antenna
- EM-field metrology
- Impulse radar
- Planar structures and microstrip circuits
- Interconnect and packaging

B COMMISSION B - Fields and Waves

Ch.: Donald R. Wilton, (713) 743-4442
FAX (713) 743-4444
EMAIL wilton@uh.edu

- Antennas
- Arrays
- Complex media effects
- Guided waves
- High frequency techniques
- Interaction and coupling
- Inverse scattering
- Microstrip devices and antennas
- Numerical methods (differential equations)
- Numerical methods (integral equations)
- Numerical techniques (other)
- Rough surfaces and random media
- Scattering
- Theoretical electromagnetics
- Transient fields, effects, and systems
- Wireless devices and systems
- Ultra-wideband electromagnetics
- Wireless communications
- Advanced materials for EM applications
- Personal, mobile, and cellular communication systems
- Numerical methods in electromagnetics and plasmas (with H)

C COMMISSION C - Signals and Systems

Ch.: David Thomson, (908) 582-6877
FAX (908) 582-2379
EMAIL djt@research.bell-labs.com

- Beam forming and matched field processing
- Spectrum estimation
- Tomographic and inverse-theory methods
- Environmental problems in cellular communications systems
- Low total energy communications and signal processing methods
- System identification
- Wavelets
- Applications

D COMMISSION D - Electronics and Photonics

Ch: Robert Mattauch, (804) 828-0190
FAX (804) 828-4269
EMAIL rjmattau@saturn.vcu.edu

- Optoelectronic techniques, devices, and materials
- Cryogenic electronic devices and circuits
- Optical transmission and interconnection
- Microwave millimeter wave and submillimeter wave devices & ckts.
- High speed devices and circuits
- Mesoscale devices and associated materials
- Vacuum microelectronics