The Design and Construction

of an

Electronically Beam Steered

Phased Array Antenna.

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Abstract.

The design and construction of a simple beam steered phased array antenna was undertaken to demonstrate the operational principles behind such devices. The antenna can be used as a receiver or transmitter, however power requirements dictated that the antenna be tested as a receiver. The design is modular to allow for redevelopment without complete reconstruction. The array is made up of the control module, voltage controlled attenuators and a phase shifting unit. The antenna consists of 16 quarter wave monopoles arranged in a 4X4 square array on an aluminium ground plane. Practical considerations lead to a carrier frequency of 200 MHz.

The heart of a phased array antenna is the phase shifting device. This device controls the direction in which the main radiation lobe propagates. Several phase shifting principles were investigated but time did not allow for an exhaustive investigation of every kind of phase shifter. Initially, a relatively new and novel approach was attempted. When this proved to be unachievable a more traditional (but far less elegant) method was used.

During the phase shifting process, the signal necessarily suffers attenuation as well as the designed phase shift, consequently it is necessary to tailor the signal amplitudes of each array element. The required amplitude control is achieved through the use of 16 voltage controlled attenuators.

A computer package is used to control the phase shifter and attenuators. The design of this package depends on only three factors. The first is the interface between the hardware and the computer (via a serial port in this case). The second factor is the type of control signal the phase shifter and attenuators respond to (in this case a dc voltage). The third factor is the range of voltage required for the phase shifter and attenuators so that their full range can be utilised. This is realised through the use of a microprocessor, a "sample and hold" circuit and several D/A converters.

The antenna and computer control package are essentially independent of each other. If an 8 bit digital phase shifter were to be employed later, the hardware could be used to control this with minimal alteration. In this case the advantage of a modular design is apparent. Various parts of the device can be incrementally improved without alteration to the remaining system. Radical change can be accommodated with minimal adjustments.

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