

Wide-Scan Angle Extended Resonance Phased Array

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Summary

Phased arrays have broad applications for both commercial and military segments, including advanced radars, cellular base stations, satellite communications, and automotive collision avoidance radars. The phased array systems can scan the beam electronically at a fast rate, but require complex integration of many circuits, including many expensive solid-state, MEMS or ferrite based phase shifters, control lines, and power distribution networks. The resulting systems are complex, bulky and have high losses. One of the critical elements for electronically scanned phased array antennas is a phase shifter. It typically contributes to a significant amount of the cost of producing a phased array antenna and it is not uncommon for the cost of the phase shifters to represent nearly half of the cost of the entire electronically scanned array. This excessive cost has limited the deployment of electronically scanned antennas and restricted their use to expensive and specialized systems, such as military radars and certain commercial systems such as cellular telephone base stations. Any substantial reduction in the cost of phased array systems will allow much wider deployment of them in commercial arena.

Conventional linear phased arrays (capable of scanning in azimuth or elevation) require one phase shifter circuit for each antenna element. In two dimensional scanned arrays, the number of required phased shifters is even larger. Each phase shifting circuit is connected to bias lines and the associated driver circuitry for its phase control. Independent of the type of phase shifter used, design of phased array systems is considered to be complicated and costly mostly due to the number and cost of phase shifting elements required.

Extended resonance technique is a method for power dividing which has been used for in power amplifier [1], low phase noise oscillators [2] and phased arrays [3]. In this technique phase shifting is also achieved through power dividing. Extended resonance phased arrays [3] do not need a separate power splitter and phase shifters compared to conventional phased array systems, resulting in substantial reduction in the circuit complexity and cost.

In this paper, an improved circuit topology for extended resonance phased array is introduced. In the proposed design, larger phase shift between antennas can be achieved. This enables the phased array to steer the beam at larger scan angle.

References

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