A Wideband Wide-Angle Time-Domain Electronically Scanned Array Based on Energy Pattern Reconfigurable Elements

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***Abstract*—UWB impulse radiation antennas are suitable for the applications of high-resolution radar imaging, indoor positioning technology and UWB communication, because of their ultra-wideband characteristic. It is well known that the performance of an UWB antenna vary with the frequency. For impulse radiation antennas, it is not sufficient to assess the time-domain performance of the antenna by the parameters in frequency domain. Although the transient behavior of antennas designed to process impulse signals can be described with equal validity both in the frequency domain and in the time domain, both amplitude and phase data need to be prescribed at every frequency over a very wide frequency band. It is cumbersome and nonnutritive. In order to solve this problem, time-domain parameters, such as time-domain radiation energy pattern and fidelity are used to obtain the performance of the impulse radiation antenna directly. UWB impulse radiation array has the advantage of narrow beamwidth. It can improve the resolution of radar imaging, anti-jamming capability and SNR for radar or communication application. In order to control the beam direction flexibly, electrically scanned capability of impulse radiation arrays is important. The power of a pulse radiation array is dispersed on a wide frequency spectrum. Compared with traditional phased array, the impulse radiation array has a wide band and low power. A wideband wide-angle electronically scanned array with energy pattern reconfigurable elements is proposed, and the time-domain characteristics of the array are studied. A wideband energy pattern reconfigurable antenna is designed as the array element. The element uses two pin diodes to operate the main lobe of the energy pattern in three directions (0º and ±40º in the elevation plane) and the 3dB beamwidth of the energy pattern can cover ±70º with three modes. The measured fidelity of the element is larger than 0.8. Based on the reconfigurable element, a 1×8 linear array is designed with uniform spacing. The scanned space is divided into three subspaces, each subspace matches with the three reconfigurable states. By adding a time delay, the array can scan its main lobe of the energy pattern from -70ºto +70º with a gain fluctuation less than 3.5dB in the measurement. The active reflection coefficients are lower than -9dB in 3.5 to 7.9GHz over multiple scan angles. The measured fidelity is larger than 0.75 on the main lobe direction during scanning. Through using the pattern reconfigurable technology, the proposed array realized wide-angle scanning in time domain.**

Keywords—Energy pattern, energy pattern reconfigurable antenna, wide-angle scanned array, ultra-wideband array.