

Optical True-Time Delays

Phased array antenna systems utilize a large number of antenna elements operated in complex phase relationships to achieve electronic steering of the antenna beam. Traditionally, element phasing involves the use of bulky and expensive switched delay lines at each element. However, ESL researchers are currently developing a new optically-based technique that is massively parallel, providing thousands of delays for hundreds of antenna elements, with very little hardware.

The White cell to Achieve True-Time Delay

The White cell is a system of three spherical mirrors between which beams bounce back and forth. Each light beam (one for every antenna element in the array) circulates through the White cell and produces a specific pattern of spots. Each of those spots lands on a micro-electro-mechanical systems (MEMS) tilting mirror array. Then on each bounce, each beam can be switched between White cells of varying lengths, producing various time delays. ESL has demonstrated several different architectures, including linear, quadratic, quartic and binary devices, some using MEMS and others using liquid crystals. The advantage of the White cell approach is its compactness and small amount of hardware—a MEMS and a handful of lenses of mirrors—to support very large phased array antennas.

