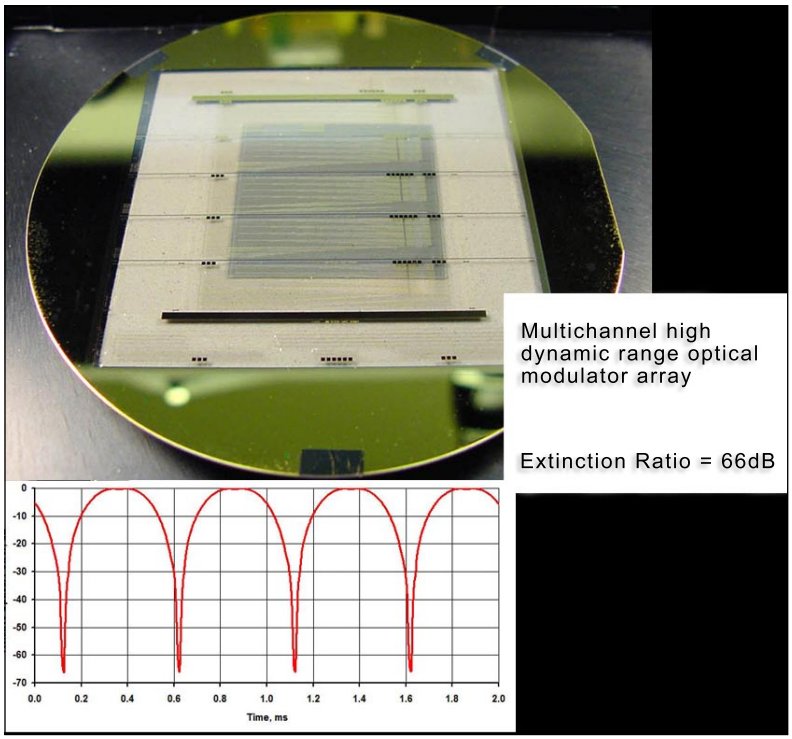
Air Force Research Laboratory|AFRL

Science and Technology for Tomorrow's Air and Space Force

Air Force SBIR/STTR

Success Story

ULTRAHIGH DYNAMIC RANGE OPTICAL MODULATORS FOR LADAR SCENE PROJECTION



AFRL funded the development of ultrahigh dynamic range optical modulators for laser radar (LADAR) scene generators used for sensor testing. Using Mach-Zehnder interferometer (MZI) technology as its platform, the electro-optic modulator device enables a 256 x 256 pixel array of optical sources that deliver nanosecond-timed optical pulses with high dynamic range typical of real scenes.

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Accomplishment

Under an AFRL Phase I Small Business Innovation Research contract, Srico, Inc., developed and successfully tested an ultrahigh dynamic range modulated optical source based on a compact MZI intensity modulator. Srico set a world-record 66 dB extinction ratio for an optical modulator, a ratio of about 4 million to 1. This will enable simultaneous processing of extremely small and extremely large intensity image elements. The Air Force (AF) will be able to represent and simulate real-world scenes 40,000 times better than current practice permits. Srico also demonstrated device operation over a broad spectral band that will allow scene simulations at multiple optical wavelengths with a single system.

To achieve these groundbreaking results, the company used proprietary integrated optic waveguide designs and innovative fabrication processes. The design ensures that the dynamic range available is more than 10,000 times greater than the range commercial MZI modulators permit. The MZI device is capable of integration onto a larger optical chip containing 256 pixels.

Background

Advanced LADAR systems have emerged as a critical next-generation technology for military applications such as target recognition and ground navigation. The AF requires high-performance, low-cost, ultrahigh dynamic scene projector components for testing of LADAR scene generators. Compared with traditional imaging, LADAR offers the advantage of distance information for each pixel. Thus, each frame is really a three-dimensional (3-D) image. Although advanced LADAR systems are widely deployed for terrain mapping and navigation, scientists are developing the technology that will use two-dimensional focal plane array detectors and high-speed embedded computers to offer unprecedented resolution, speed, and usability. For example, computer assembly of multiple 3-D images taken from different vantage points allows high-confidence target identification even when partially obscured.

LADAR scene simulators are an important tool for characterizing missile and aircraft LADAR systems. Scientists use the scene simulator for incremental and final testing of the embedded hardware and software that enable real-time operation of the LADAR system. The scene simulator consists of a scene generator and an optical projection system. The scene generator is composed of software and electronics for generating real-time pixel signals. The optical projection system accepts this electronic drive signal and delivers a modulated optical signal to each pixel of the LADAR detector.

Munitions
Emerging Technologies

Additional Information

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