Fast Optical Shutters for Army Switching Applications

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ABSTRACT:

Recent advances in high-speed switching (driven primarily by the telecommunications industry), in Pockels cell technology (driven by pulse-slicing applications), and in magneto-optic materials have led us to investigate the use of electro-optic (EO) and magneto-optic (MO) shutters for use in a particular Army-critical switching application. The obstacles to be overcome in the implementation of these two technologies are, in some sense, complementary. In an EO shutter, the response of the nonlinear material is ultra-fast, but presence of large currents (tens of amperes) and voltages (several kilovolts) places limitations on the speed with which the device can respond. In an MO shutter, in contrast, the considerably smaller currents permit a faster electrical response, but the material response is slower, with the current best reported turn-on time for new magnetic garnets hovering just above 1 ns. Both EO and MO devices may be able to profitably incorporate a high-gain photoconductive semiconductor switch (PCSS) developed some years ago by researchers at Sandia National Laboratories. Indeed, we demonstrated an EO shutter consisting of a commercial, off-the-shelf Pockels cell actuated by the Sandia PCSS earlier this year; the optically triggered rise time of the device was measured to be 1.4 ns. In this presentation, I review the fundamental technical issues associated with fast shutters. I then describe our on-going efforts at ARL to develop magneto- and electro-optic shutters with an overall response time in the sub-nanosecond range.

KEYWORDS: high-speed switching, electro-optic shutter, magneto-optic shutter

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