New Developments in Magneto-Optic Interferometric Switching

*John W. Pritchard, High Speed Systems Engineering Lab, Iowa State University*

In the next few decades, it is likely that high bandwidth wireless and optical technologies will be placed in the spotlight as the dominant avenues for communication all over the world. It is arguable that this is currently the case, and that the expectation for higher data transfer speeds, more secure and reliable transmission, and longer communication range is on an exponential rise. Thus, much effort and emphasis is being put on these technologies to advance as quickly as possible.

For optical systems, the majority of research has been focused on the realization of all-optical transmission, that is, transmission such that no energy conversions (e.g. optical-electrical) take place in the transmission process. In many cases this has been achieved utilizing electro-optic (EO) and magneto-optic (MO) phenomena in special materials. Here, the use of interferometric techniques can enable optical switching and routing with the help of applied electric or magnetic fields to the special materials as light traverses through them.

There are many challenges in the design of these switches. For magneto-optic interferometric devices, the magnetic field generator tends to be quite large compared to the optical transceivers deployed today. Due to their large size, current and voltage requirements tend to be excessive as well. It is important to continue to reduce the size and power requirement of these devices to ensure compatibility with current systems.

The main goal in this work is to understand and explore the challenges faced by MO device designers, and offer solutions that enhances these devices from an efficiency, switching speed, and responsivity perspective through research, exploration, and discovery. Three different optical interferometer configurations are reported for switching and routing applications: the Mach-Zehnder, Sagnac, and Resonator. Novel enhancements to the speed, power, and sensitivity of the magnetic field generators for these interferometers are proposed, implemented, and reported in this work. Additionally, studies toward a monolithically integrated MO switch are presented which include preliminary design and simulation of on-chip optical rib waveguides, couplers, and magnetic field generators.