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Undergraduate Research Experience In Infrared Laser Beam Profiling
(Physics / Arts and Sciences)

Soft, diffuse lighting is very suitable for illuminating a room, but there are many applications for which a tightly focused beam is more appropriate. When giving a presentation, a laser pointer directs the eyes of the audience to the appropriate position, and if a laser is used for surgery, it is desirable to have a very sharply defined cut. Broad beams that are shaped more like a floodlight than a pinpoint make it difficult to focus on the correct spot on the screen or run the risk of damaging surrounding tissue in the medical procedure. Ideally, the output beam from a laser has a uniform profile—the intensity is relatively constant across the beam—and diverges very slowly—the spot size grows very slowly with increasing distance from the source. While it may seem straightforward to measure the size of a visible spot, it is sometimes a challenge to determine the precise edges of the beam. In addition, the human eye is not as sensitive to the fluctuations in intensity that may occur across the profile. These complications are even more of an issue when dealing with infrared light that is beyond the range of human vision and require detectors that are more sensitive than the eye.

The undergraduate research supported by this project will be used to develop techniques to accurately quantify the shape and intensity of the output from infrared semiconductor lasers. Measurements will be made using a photodetector and an infrared camera, and the results will be combined and compared to provide a detailed spatial profile of the output beam. One of the primary tasks will be integration of the infrared camera into the LabVIEW data acquisition platform so that beam measurements may be synchronized with the optical or electrical driving of the laser, enabling both spatial and temporal data to be collected. The undergraduate researcher will be motivated to learn the meaningful parameters in characterizing the quality of a laser output beam and will make vital measurement of infrared lasers by integrating existing equipment. The techniques developed will be available for future research in the laboratory and for dissemination through publications and an Honors thesis.