

Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Optical design of a robotic TV camera probe for minimally invasive abdominal surgery¹ SUSANNA TODARO, Harvey Mudd College, WEIYI HE, DENNIS KILLINGER, University of South Florida — Minimally invasive techniques are a promising new field of surgery; however, they limit the surgeon's access points and maneuverability. In order to increase the number of access points in minimally invasive abdominal surgery, a proposed implantable medical probe braces to the abdominal wall and provides illumination and video signal. The probe is cylindrical, about 25 mm long and 10 mm in diameter. A ring of LEDs on the end of the probe illuminates the tissue, and the resulting image is focused onto an HD video detector. It was necessary to apply beam-shaping reflectors to collimate the light onto a small target area, to avoid illuminating areas not picked up by the video. These reflectors were designed and simulated using the optical ray tracing software TracePro. Two LED chip geometries and three types of reflector geometries were analyzed, and the parameters for each geometry were optimized. For the straight-edged reflectors, the intensity patterns and optimization were compared to experimental results. Although parabolic reflectors produced the best collimation, cone reflectors with a 20-degree half-angle produced significant collimation at a much cheaper price.

¹This work was supported by NSF REU program (award No DMR-1004873).

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Date submitted: 30 Nov 2010

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