

Abstract Submitted
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A remote control for the *C. elegans* nervous system ANDREW M. LEIFER, CHRISTOPHER FANG-YEN, ARAVINTHAN D. T. SAMUEL, Harvard University — We demonstrate a closed-loop optogenetic illumination system to stimulate or inhibit arbitrary patterns of neurons and muscle in a freely roaming worm. Transgenic worms that express light-sensitive ion channels in neurons or muscle are used. A microscope with a video camera records the worm's posture and motion. As the worm moves unrestrained, custom real-time image processing software analyzes the worm's position and estimates the location of targeted muscle and neuron cells. For each frame captured by the camera, the software generates an illumination pattern and directs a digital mirror device to shine laser light onto the targeted cells. The system can illuminate an arbitrary spatial and temporal pattern and thus can selectively inhibit or stimulate different sets of cells during the course of a single experiment. The image processing software is very fast and analyzes a 1024 by 768 pixel image containing a worm in less than 10ms. The system has been tested using worms expressing Channelrhodopsin and Halorhodopsin in both neurons and muscle. Preliminary results from an investigation of the *C. elegans* motor circuit are shown.

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