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Optogenetic dissection of neural circuit underlying locomotory decision-making in Caenorhabditis Elegans[1] ASKIN KOCABAS, Harvard University, ZENGCAI GUO, SHARAD RAMANATHAN — Despite the knowledge of the physical connectivity of the entire nervous system of C.elegans, we know little about how neuronal dynamics results in decision-making. Detailed understanding of functional and dynamic relations of the neural circuitry requires spatiotemporal control of the neuronal activity. Recent discoveries of light gated ion channels have allowed temporal optical control of neural activity. However, excitation of a specific neuron from among many expressing the channel has been a challenge. By combining optogenetic tools, micro mirror array technology and fast real time image processing, we have developed a technique to activate specific single or multiple neurons in an intact crawling animal while tracking its behavior. Using this setup we traced the neural pathway controlling the gradual turning of the animal during the locomotion. We found that the activity of a specific neuronal circuit that receives inputs from sensory neurons is coordinated with head movement. This coordination allows the animal to turn left or right based on the variation of sensory stimulus during head movement. By directly modulating the activity of the neural circuit, we can force the animal to turn in a specific direction independent of sensory stimuli.

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