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Title: Novel Optical Biological Control Tools: Towards Enabling Integrative Analysis of Neural Systems

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Over the last several years we have developed a suite of genetically-encoded reagents that enable powerful neural activation and silencing in response to pulses of light. Recently, for example, we have revealed a set of novel reagents that enable powerful, multi-color silencing of neural populations in the awake behaving brain. In order to enable these tools to be used for systematic analysis of the causal contribution of specific cell types, pathways, and brain regions to neural computations, behaviors, and pathologies, we have additionally developed hardware to enable neural circuits to be perturbed in a three-dimensional fashion. We explore how these tools can be used to enable systematic analysis of neural circuit functions, exploring the properties of neural circuits that mediate emotion, sensation, and movement, and that play roles in neurological and psychiatric disorders. We also discuss the translational potential of such tools to potentially enable novel ultraprecise neuromodulation therapies, resulting from our recent assessment of the safety and efficacy of optical neural control tools in the non-human primate brain.