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A new adjustable optical microprobe for the analysis and control of deep brain regions

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Researchers from the IIT- Istituto Italiano di Tecnologia in Lecce, Italy, and the Harvard Medical School in Boston have developed a new optical microprobe able to control brain electrical activity by projecting light on wide volumes or selected portions of the central nervous system. The study was published in *Nature Neuroscience* and represents a first step toward minimally invasive devices for the diagnosis and treatment of neurological and psychiatric disorders and neurodegenerative diseases.

The technology exploits optogenetics, a combination of optics and genetics, to activate or inhibit neuron activity via light beams. One major limitation of optogenetics is the difficulty of distributing light into the brain in a controlled fashion, since tissue opacity does not permit light propagation. Italian scientists sought to overcome this limit. The microprobe, built at the IIT and validated at HMS, is made up of a cone-shaped optical fiber whose tip is about 500 nanometers, 20 times smaller than a neuronal cell, and its design is conceived to adapt the light beam to the cerebral region of interest without moving the device. The versatility of the device allows researchers to irradiate brain areas with tunable light intensity, color, position, direction and frequency.

The minimally invasive microprobe successfully accessed sub-cortical regions, highlighting the link between the electrochemical activity of spatially separated groups of neurons and related effects on locomotion control in animal models. The probe allows researchers to activate or inhibit one or more neural microcircuits at the same time, representing a new paradigm for deep brain optical stimulation.

The final goal of this research project is to develop a very low-invasive device, enabling a direct intervention on the brain to monitor its activity and to restore its proper operation. In the future, the microprobe may be the basis for a new generation of therapeutic and prosthetic devices for the control of neurological disorders and neurodegenerative diseases.

More information: Ferruccio Pisanello et al, Dynamic illumination of spatially restricted or large brain volumes via a single tapered optical fiber, *Nature Neuroscience* (2017). DOI: 10.1038/nn.4591

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