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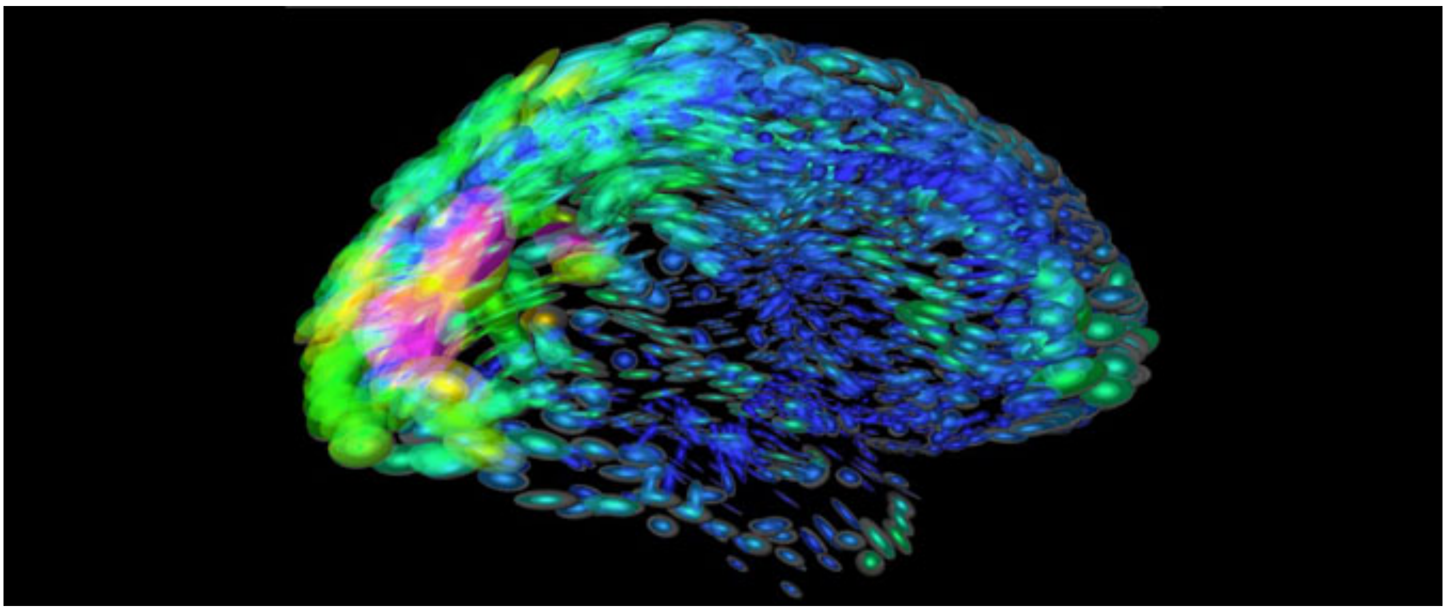
Darpa exploring implants to treat brain injuries

By Katie Drummond | 10 May 2010 | Categories: Wired Science



An estimated 10 to 20 percent of troops coming home from Iraq and Afghanistan are suffering from traumatic brain injuries, or TBIs. Now the US Pentagon's rolling out an initiative to treat the condition: brain implants that one researcher likens to "replacement parts" for damaged gray matter.

"When something happens to the brain right now, there's so little that the medical community can do," Krishna Shenoy, associate professor of electrical engineering and bioengineering at Stanford University, told Wired. "Our goal is to understand -- and then be able to change -- how a brain responds to trauma."

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No surprise that military extreme science agency Darpa is behind the project, which is called REPAIR, or Reorganisation and Plasticity to Accelerate Injury Recovery.

Yesterday, it announced an initial two-year round of $14.9 million (£7.3 million) in funding for four institutions that will collaborate on the brain-chip project. All in, it'll involve 10 professors and their research teams, working in neuroscience, psychiatry, brain modelling and even semiconductors.

Significant progress has already been made in understanding brain injury. Scientists can create conceptual, mathematical models of brain activity, and are also able to record the electrical pulses emitted by individual neurons in the brain, which offers insight into how those neurons communicate. That knowledge has spurred rapid progress in neural-assisted prosthetic devices, a program that Shenoy collaborated on with Geoffrey Ling, the same Darpa program manager behind REPAIR.

But what experts can't yet do, Shenoy said, is alter those electrical pulses to turn brain circuits on or off. His team will use optogenetics, an emerging technique that involves emitting light pulses to precisely trigger neural activity, to develop an implanted TBI treatment device.

"Before this, emitting light into the brain would be like hitting it with a hammer," Shenoy said. "What we're doing now is pin-pointing a single neuron, and that neuron will naturally change its activity depending on the cue."

The implants developed by the project will likely be composed of electrodes or optical fibres, and will sit on the surface of the brain. They'll read electrical signals from neurons, and deliver appropriate light pulses to stimulate other brain regions in response. The implants would allow the brain to operate normally, by acting as substitutes for areas that were damaged or "unavailable."

First up for Shenoy and company are optogenetic tests on mice, rats and eventually monkeys, to better understand how different regions of the brain interact. For example, how one area of the brain knows which signals to send to other parts. Once they've got that down, the researchers hope to develop chips that essentially mimic those interactions, so that an implant can "read a signal from region A, bypass damaged area B, and get that signal to C," Shenoy said.

And while Darpa's interested in ailing vets, the implants could have broad civilian application, including help for those who've suffered a stroke or undergone surgery to remove a brain tumour. If all goes according to plan, Shenoy expects implants for lab animals within four years.

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