

Presentation On Merging the Human Brain With Artificial Intelligence (AI) and the Internet

(Mike Gruenfeld - 6/5/19)

Previous presentation: “Presentation On Brain-Computer Interfacing” - 7/4/2018.

Prime Reference: “The Economist” January 6, 2018
(Technology Quarterly Review Section)

Human Brain

- Contains 85 billion neurons.
- Typical neuron has 10,000 connections to other neurons.

Current Goals

- To extract and decode neural signals from the brain in order to mitigate physical disabilities, and control external devices.

Needs

- Paralysis of stroke victims.
- Lou Gehrig’s disease.
- Epilepsy
- Deafness.
- Blindness.
- Parkinson’s disease.
- Severe depression.
- Locked-in syndrome
- Dysphagia: impaired swallowing.
- Aphasia (inability to understand or produce speech).
- Alzheimer’s disease.

Current Invasive Methods

- Since 2004 13 paralyzed people have been implanted with a system called “BrainGate”, using an array of small electrodes (Utah array) implanted onto the motor cortex.
- Utah array electrodes detect 200 neurons that fire when someone intends to move his hands and arms. The signals are sent through wires that poke out of the person’s skull to a decoder, where they are translated into a variety of outputs, from moving a cursor to controlling a limb.
- The BrainGate System has allowed a woman paralyzed by a stroke to use a robotic arm to take her first sip of coffee without help from a caregiver. Also, used by a paralyzed person to type at the rate of 8 words per minute. It has even reanimated useless human limbs.
- Requirements of the Military’s Defense Advanced Research Projects Agency (DARPA) are to target one million neurons (a one million wire device), and to accomplish this by 2021, including a pilot trial using humans.
- A system connecting electrode arrays to the temporal lobe of the brain, and using speech synthesizers with AI, translates thought into intelligible recognizable speech. Direct communication between brain and computer is thereby accomplished with the consequence of permitting people with amyotrophic lateral sclerosis (ALS), or stroke, to regain the ability to communicate.
- A device for stimulating the visual cortex of blind people in order to project images into their mind’s eye. Thereby allowing blind people to “see“, by producing images inside their brains. This project is funded by DARPA with the objective of inputting signals directly into the visual cortex. A chip that contains 65,000 electrodes is placed on top of the visual cortex, while the next

generation chip will house one million electrodes/sensors.

- Cochlear implants convert sound into electrical signals, and sent to an electrode in the inner ear, stimulating the cochlear nerve so that the sound is heard in the brain.

Major Research Organizations

- Neuralink is a technology company, founded by Elon Musk in 2016, that's developing an electro-to-neural brain-computer interface (BCI) for achieving symbiosis between the human brain and artificial intelligence (AI). Included is the intention to upload and download thoughts. Elon Musk is a billionaire entrepreneur who also heads SpaceX, Tesla, and the Boring Company.
- Kernel is a neurotechnology company, founded in 2016 by Bryan Johnson with \$100 million of his personal funds, and is developing an interface to link the human brain with artificial intelligence (AI).
- Military's Defense Advanced Research Projects Agency (DARPA) is funding universities and research institutions to create high resolution brain-computer interfaces whereby to link the human brain with artificial intelligence (AI).

Planned (near-term) Invasive Methods

- "Neurograins" (the size of sugar grains) which can be sprinkled on top of the cortex, or implanted within it, comprise another approach. Each grain, would have a built-in amplifier, the ability to transmit data to an external processor.
- An ultra-thin membrane like porous net made of flexible polymer, studded with sensors. This membrane simulates the flexibility and softness of neural tissue,

and inserting it into the brains of epilepsy patients is now planned.

- An invasive technique that does not require drilling through the skull. A stent-like device, that's studded with electrodes, is passed through blood vessels and positioned in blood vessels that overlie the brain. Human trials are now scheduled to begin.

Future Goals

Expressed by Elon Musk

- As algorithms and hardware improve, artificial intelligence (AI) will greatly exceed biological intelligence.
- Humans must link with machines in order to fight the inevitable onslaught of artificial intelligence; i.e., humans must explore cyborg-like technology.
- Humans must acquire the capability to challenge super-intelligent machines before they turn malevolent.
- Humans without enhanced brainpower would become like house cats to their robot overlords.

Expressed by others

- Humans' biological brain's limitations can not possibly keep pace with the increasingly rapid generation of human knowledge. It's therefore essential to develop a safe, robust, stable, secure, and continuous real-time interface between the human brain and the storage and processing systems that reside in the cloud.
- A neuralnanorobotically enabled brain-computer-internet (B/CI) interface might enable persons to obtain direct and instantaneous access to any facet of cumulative human knowledge. Such a B/CI, sometimes called the “**internet of thoughts**”, will use nanobots positioned at key neural junctions to link biological brains with cloud-based data storage.

- A research team, lead by Nuno Martins at the Lawrence Berkeley National Laboratory, coined the term “neuralnanorobotics” to describe the agglomeration of neural, nano, and robotic technologies that needs to happen before the “internet of thoughts” can come to pass.
- Martins and colleagues envision the injection of nanobots into human vascular systems - Fantastic Voyage-style, and to navigate them to be deposited in specific brain locations.
- A large international team of neurosurgeons, roboticists, and nanotechnologists predicts that the preceding will be accomplished by the end of this century.

Fears and dangers

- We are on a path to a world in which it will be possible to decode people’s mental processes and directly manipulate brain mechanisms underlying intentions, emotions, and decisions.
- There is a danger that brain-computer interfaces (BCI) could be hijacked by rogue artificial intelligence (AI). This could lead to AI controlling the thoughts, decisions, and emotions of BCI-equipped humans.

References

<https://www.economist.com/technology-quarterly/2018-01-06/thought-experiments>

<https://www.facebook.com/ScientificAmerican/videos/april-2019-issue-the-intention-machine/2988446824502610/>

<https://www.sciencedaily.com/releases/2019/01/190129081919.htm>

<https://www.wsj.com/articles/scientists-use-artificial-intelligence-to-turn-brain-signals-into-speech-11556125200>

<https://www.teslarati.com/scientists-use-ai-neural-network-to-translate-speech-from-brain-activity/>

<https://interestingengineering.com/researchers-develop-a-device-that-translates-brain-signals-into-speech>

<https://www.wired.com/story/inside-the-race-to-build-a-brain-machine-interface/>

<https://www.theguardian.com/technology/2018/jan/01/elon-musk-neurotechnology-human-enhancement-brain-computer-interfaces>

<https://medium.com/plugged-in-how-mind-machine-interfaces-will/why-elon-musk-is-betting-on-brain-computer-interfaces-8c3e00f69e2c>

<https://futurism.com/elon-musk-brain-computer-interface-coming-soon>

<https://www.washingtonpost.com/news/the-switch/wp/2016/08/15/putting-a-computer-in-your-brain-is-no-longer-science-fiction/>

<https://medicalxpress.com/news/2019-04-future-human-braincloud-interface-people.html>

<https://chicago.cbslocal.com/2019/03/04/northwestern-neuroscientist-researching-brain-chips-to-make-people-superintelligent/>

