Research Assessment #4

Objective: Dive into the field of **neuroengineering**. Discover relevant research ongoing in both fields and how I can provide my services towards it. Form opinions about both fields and decide which one is of better interest for me.

Neuroengineering:

Definition: Neuroengineering can be described as a field that intersects neuroscience, engineering, and computer science. The field works with the nervous system which includes the brain, spinal cord, peripheral nerves and adds engineering to create devices which would help understand, repair, or even mimic the body parts.

Notes from “TEDxGeorgiaTech - Steve Potter - NeuroEngineering: Neuroscience - Applied”:

-> Applies neuroscience concepts

-> A very new field: first conference was in 2003 and the word was first used in the 80s

-> magnetic resonance imagining: can make the brains shape perfectly onto a computer is used for brain scans

-> Neuroengineers design, test and approve devices that work with the neurological body parts.

-> NE includes sensory devices to restore missing function, EX given: two deaf people having a conversation without using sign language because of a device that helps them hear.
-> NE includes smart prosthesis to replace limbs.
-> Uses the electrical stimulation of muscles and paralyzed arms and reanimates the arms to allow people to move
-> NE also includes creating devices to help study the brain
-> Cultured neural networks: on multi-electrode array culture dishes they have a network of about 10,000 rat neurons and electrodes help record and stimulate cultures.
-> Optical neural interfaces: 2 photon fluorescence microscope allows to image cultured neural networks
-> ONI helps cells interact with each other. It's helpful because you can't make animals sit still to image their brain and how it works. ONI basically allows them to continuously film their brain activity.
-> Calcium is a good resource to use to see how neurons talk to each other.
-> Include modulator devices to correct nervous system simulators.
-> MD helps Parkinson's disease, dystonia, tremor, Tourette's syndrome, chronic pain, OCD, and severe depression
-> MD hasn't helped intractable epilepsy
-> Epilepsy not cured (video made 12 years ago so this information can be outdated)
-> Two professors in the video (one of whose names is Robert Gross) want to analyze brains with epilepsy to find solutions for it. One of their prospective solutions is to add electrical stimulations to the part of the brain that is going to have seizures to

basically tire the brain out into not having a seizure. If successful brain surgery that takes a chunk of the brain out of epileptic patients will be unnecessary.

-> The process above if carried out successfully would be called smart modulators once they are built (since the video came out RNS or responsive neurostimulation got FDA approval in 2013 and DBS or deep brain stimulation got its approval in 2018. This means that DBS and RNS both are functional alternatives to brain surgery for epilepsy in the current day)

-> **Magnetic stimulation**: devices you can put just next to the scalp, are non-invasive, send in magnetic pulses which help people with depression.

-> **Haptic and non-invasive interfaces**: you don't need to put electrodes into the brain, you can use sensory motor systems such as our eyes to connect high tech devices to our brains.

-> **Optical recording and optogenetic stimulation**: make brain cells light-sensitive and (in work at the time) fiber optics implanted in brains which stimulate and record brain activity instead of electrodes.

-> **Genetic and Tissue Engineering**: ex. building scaffolds for the spinal cord to help it regrow if broken.

-> **Micro-injection and control release of drugs**: taking a pill or getting an injection that only one part of your brain needs can create a lot of side-effects. This field allows us to inject it into a particular part of the brain to avoid that.

-> **Human Augmentation**: neuroengineering devices can also sculpt the emotions people feel and the way they can act. EX: a girl who had epilepsy and a DBS implanted in her brain said she stimulated contact 1 for when she is doing her regular things at home but contact 4 for when she needs to socialize or party since it helps her be more social. Another EX: a person with a device implanted in them to

help with their tremor claims that although it does help with that it also helps me remember things.
-> Quote used in video: "In a world where we can sculpt our own emotions and personalities, people will no longer be able to say ' I can't help it, that's just how I am'"
-> **Neuro-AI**: aims to improve artificial intelligence using brain principles. Getting knowledge about how the brain works can help make AI better, creating systems that work more like humans.

Assessment:

Through watching the TedxGeorgiaTech video featuring Dr. Steve Potter I was able to get a better understanding of the field of neuroengineering as well as what work is being done within it. Although the video was a bit outdated it gave me an insight into the basis of the subtopics of neuroengineering and what I would be achieving through studying it. I find the nervous system of our body to be fascinating as it is the one thing that makes us human. Other mammals also have access to the brain but ours is unique enough to give us a personality, feel emotions, and even create logical decisions in daily life. To study the brain sounds very exciting and engaging so I definitely like that about neuroengineering. I learned that Neuroengineering is a field that involves understanding brain structures and collecting data about the brain and trying to solve problems with engineering principles, not only creating devices. Technology like smart prosthetics, deep brain stimulation, and brain-computer interfaces provide real benefits. Neural interfaces

record brain activity and treat disorders, while non-invasive magnetic stimulation offers new ways to treat mental health conditions. Neuroengineering has limitless applications, and I am interested in contributing to its future. From researching more about neuroengineering I have definitely learned that I am extremely interested in the functions of the brain and would love to work and learn more about it.

Work Cited:

YouTube, YouTube, www.youtube.com/watch?v=j4SSQcHt220. Accessed 25 Oct. 2024.