REAL TIME BRAIN SIGNAL ANALYSIS FOR DEEP BRAIN STIMULATION

JOHNS HOPKINS BIOMEDICAL ENGINEERING

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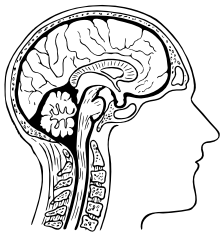
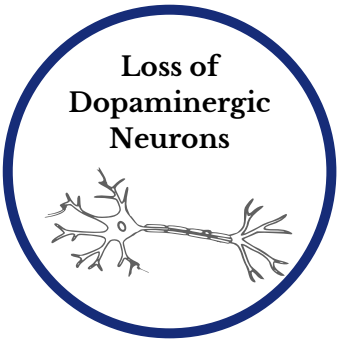


PROBLEM SPACE

Parkinson's disease affects **1% of the population over age 65,** about **10 million people worldwide.**



Disease causes death of dopaminergic neurons leading to abnormal brain signals that lead to:

- tremors and motor symptoms
- cognitive impairment
- expensive treatment costs

Pros

- Treats symptoms well by diminishing abnormal signals

Cons

- Required lifelong
- **Battery implanted in patient must stay on to maintain signal delivery,** even when patient has no abnormal signals, **and must then be surgically replaced every few years!**

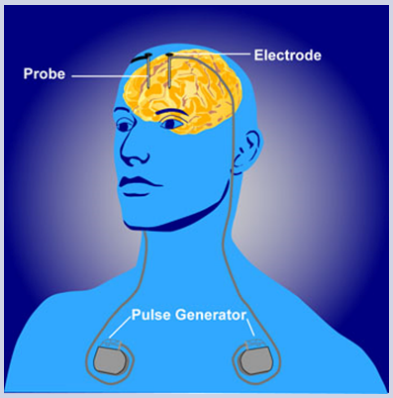


Fig 1. Deep Brain Stimulation Setup on Patient
Note. From *Deep Brain Stimulation,* by Physiopedia, 2022. Copyright 2022 by Physiopedia.

Deep Brain Stimulation (DBS)

- Innovative technology that is implanted in the patient and **delivers electrical pulses to the patient's brain that interfere with abnormal brain signals**

Current methods require the DBS device to be continuously turned on in the patient, diminishing battery life. The goal of this project is to modify the device so it can be selectively turned off inside the patient, conserving battery life and thus reducing the need for future surgeries to replace the battery.

HOW DOES THIS PROJECT ADDRESS THE NEED?

SIGNAL ANALYTICS	REAL TIME	CONSERVES BATTERY
Algorithm analyzes the phase, frequency, and amplitude of the brain signals	Algorithm implementation in VHDL runs **6 orders of magnitude** faster than current MATLAB methods to assess phase, frequency and amplitude	Real time signal analysis allows the device to detect abnormal brain signals, and consequently, the battery can be turned off when abnormal signals are not present
Why it matters: Allows for quantification of brain signal features to assess abnormality of brain signal	**Why it matters:** Allows for real time analysis in the patient brain to monitor for presence of abnormal signals	**Why it matters:** Saving battery life of this implanted device reduces the need for costly surgeries to replace the battery

Physiopedia. (2022). *Deep Brain Stimulation*. Physiopedia. https://www.physio-pedia.com/Deep_Brain_Stimulation