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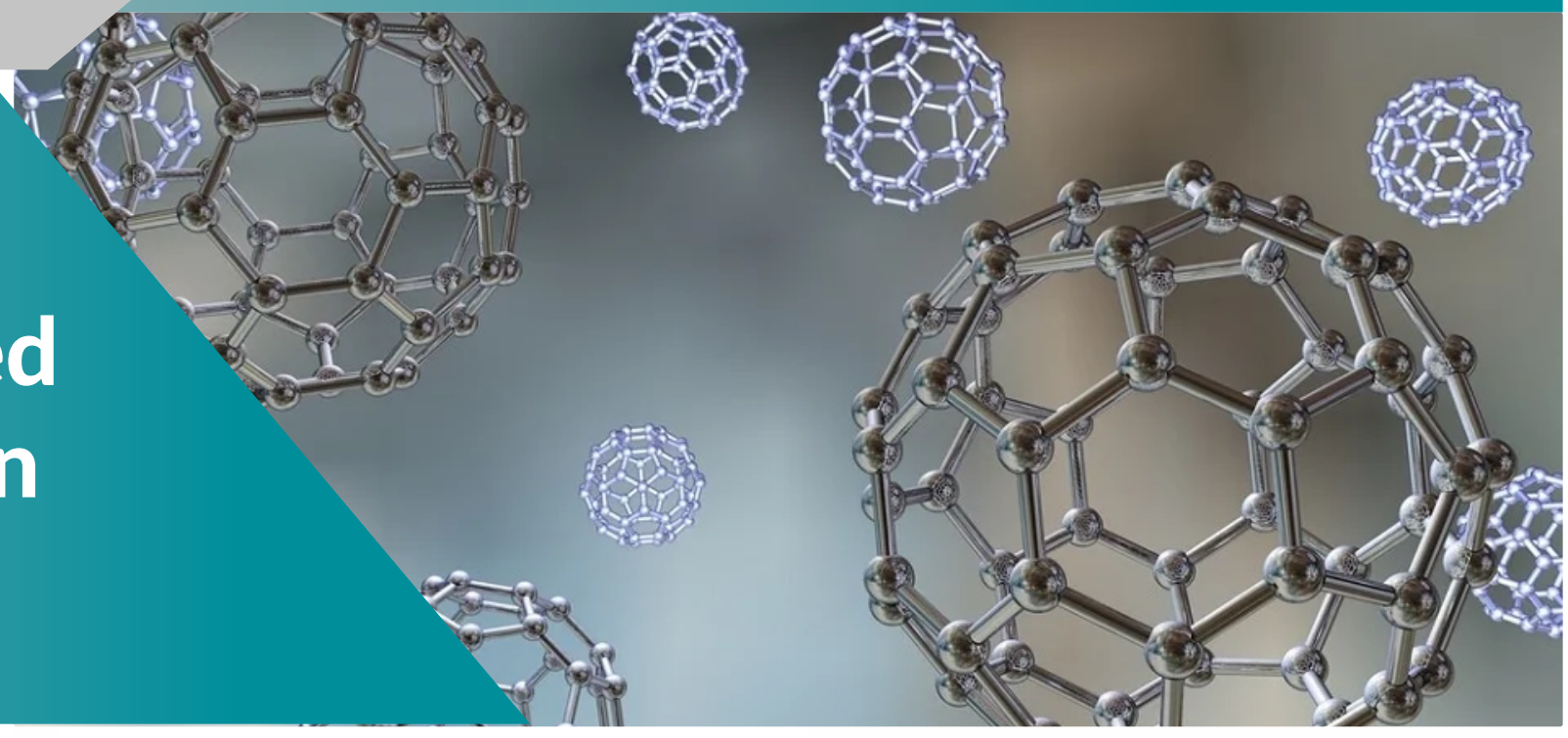
USPION-Assisted Brain Stimulation



Problem

Currently, the only effective treatment for a variety of brian diseases is a fully invasive procedure called Deep Brain Stimulation. Apart from requiring a full open-brain surgery, Deep Brain Stimulation poses numerous side effects and potential mishaps due to human error.

Solution

Our proposed solution involves the use of USPIONs in order to artificially stimulate the neural activity deep in the brain. The USPIONs connected to the neurons are able to be oscillated by external magnetic fields, further generating an electrical field that can stimulate the neuron. In addition to stimulation, our solution involves the use of Magnetic Particle Imaging to effectively detect the magnetic properties of USPIONs in order to model the brain data and produce three-dimensional images.

The Process

Nanoparticle Binding - Neuronal Stimulation - Magnetic Particle Imaging

Nanoparticle Binding

Ultrasmall superparamagnetic iron oxide nanoparticles, USPIONs, are configured and then bound to certain neurons in the brain. The USPIONs are injected into the bloodstream, from which their targeting ligands take over and bind to biomarkers on individual neuron cells, in a process called Targeted Drug Delivery.

Neuronal Stimulation

Penetrating the skull using rTMS, repeated transcranial magnetic stimulation, coils to wirelessly transmit low-energy magnetic fields. The frequency of the field generates AC signals in the USPION, which then oscillates to produce an electric field. These fields affect the ion channels of the respective neuron, either polarizing or depolarizing the neuron.

Magnetic Particle Imaging

Exposing the NPs to certain magnetic fields generated by the coil in the mph scanner to cause electrical induction in the receiving coils, representing the acquired information about the tracer material

Impact

Our solution can either cure or provided much more effective treatments for **all brain diseases associated with the limbic system**, due to the nanoparticle is initially bound to the neurons that cause the disease. This includes memory disorders like Alzheimer's and Parkinson's, neurodegernative diseases like Dementia and