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A General Framework of Brain Map and Neuroimaging (Review)

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Abstract— **The brain is the hub of the human organization. It constitutes about one-fiftieth of the body mass and lies within the cranial cavity. Parts are cerebrum, midbrain, pons, medulla oblongata, and cerebellum. Neuro imaging technique is a new promise for brain function and recuperating with cognitive disorders patient. In this tabloid, the execution of a functional Neuro imaging focuses on cognitive disorder that round as a mock-up for therapeutic centre. The opposition of the swot up was to asses neurological outputs of sub cortical stimulation and to uses fmri. It is worn to sensory, language, and memory areas in neurosurgical patients with epilepsy. New insights on fundamental processes are brain plasticity is likely to be exposed.**

Keywords— **Direct Brain Map, Functional Magnetic Resonance Imaging**

I. INTRODUCTION

The brain is the hub of the human organization. It constitutes about one-fiftieth of the body mass and lies within the cranial cavity. Parts are cerebrum, midbrain, Pons, medulla oblongata, and cerebellum. The human brain weighs on average about 3 lb (1.5 kg) [1] with a size of around 1133 cubic centimetres (cm^3) in women and 1265 cm^3 in men [2]. The brain is very soft, having uniformity analogous to pliable gelatine [3]. The grey matter is pinkish in colour and considerably off pallid in the periphery. When the age of the man is 22 it has about 179,000 km and a woman 156,000 km of militated axons in the brain [4].

The brain has the same wide ranging structure as compared to mammals, when it is roofed in the cranium and it is three times larger than the typical creature with a consequent body size [5]. The expansion comes from the cerebral cortex, an elaborate sheet of neural tissue which covers the facade of the forebrain. The piece of the brain devoted to reflection, the occipital lobe, is also greatly enlarged in human beings. Brain has neuronal and non-neuronal cells, ranging from 100 or 120 billion, non-neuronal cells and an in the region of equal number of (~89 10^8) neurons [6], of which about 10 billion (10^{10}) are cortical pyramidal cells, with an approximately equal number of non-neuronal cells [7].

The brain monitors and regulates the body's performance and reactions. It continuously receives sensory in order, and quickly analyses this data and then act in response for that reason by controlling bodily actions and functions. The brainstem controls breathing, heart rate, and autonomic process that are self-governing of cognisant brain functions. The neo-cortex is the core of higher-order thinking,

knowledge, and reminiscence. The cerebellum is responsible for the body's stability, posture, and the harmonization of movement. A number of psychiatric conditions, such as schizophrenia and depression, are thought to be associated with brain dysfunctions, although the brain anomalies are not understood [8].

II. GENERAL FEATURES

Fig. 1. Bisection of the head of an adult man showing the cerebral cortex and underlying white matter.

The chief part of the human brain is cerebral hemispheres and is roofed with a cortical layer [9]. The overriding characteristic of the human brain is corticalization. It is reflecting in profession as well as configuration. In humans the cerebral cortex is so large that it overshadows the other part of brain. The part of brain called cerebellum, which has

1. Medial zone ⟹ Sub cortical motor areas
2. Lateral Zone ⟹ Cortex

When cerebral cortex leaves an animal (eg-rat) after surgical removable the animal is still capable of interacting with the environment [10]. It is a sheet of neural tissue that confines and folded over a large surface area of skull. It has a total surface area of about 1.31 square feet [11] Figure 1.)

III. SOURCE OF INFORMATION

3.1. ELECTRO ENCEPHALOGRAPHY (EEG)

Electroencephalography is a technique in which electrodes are placed on scalp to record the summed electrical activity of the cortex [12].EEG measures mass changes in population synaptic activity from the cerebral cortex, but can only detect changes over large areas of the brain, with very little sensitivity for sub cortical activity. EEG recording can become aware of measures lasting only a few thousand of a jiffy.

3.2. Magneto encephalography (MEG)

Magneto encephalography is a technique in which measuring the electric field around the skull, to measure the magnetic field directly known as magneto encephalography (MEG) [13]. Although this technique is not as fine as Magnetic Resonance Imaging (MRI) but it has matching temporal resolution as EEG.

IV. BRAIN MAP

4.1 Definition

Brain Map is a set of neuroscience techniques predicated on the Map of (biological) quantities.

Brain MAP is a part of Neuro imaging. Brain Map can be conceive as a superior form of Neuro imaging, produce brain images supplement by the consequence of supplementary data processing such as map extrapolative behaviour onto brain regions.

Brain Map techniques are constantly evolving, and rely on the development and refinement of image acquisition, representation, analysis, visualization and interpretation techniques. Functional and structural Neuro imaging are at the core of the Map aspect of Brain Map.

4.2 Principle

The principle and objective of brain Map is;

1. To sympathetic the rapport between configuration and purpose in the human brain.
2. Scientists in this meadow hunt for gain information of the corporeal process that motivates human impression, thought consciousness in addition to cognition.
3. These results are straight away pertinent to surgical involvement, to the propose of medical intervention and to the dealing of mental and psychiatric disorders.

4.3 Mechanism of Brain Map

An elastic cap with 19 sensors is placed on the head and the sensors are connected to the recording device. A special conductive gel is squeezed into each of the 19 sensors in the cap. This preparation takes approximately 15 minutes. The actual recording might take from 10 to 30minutes.

A patient may be instructed to keep his eyes open or closed during parts of the recording, or asked to perform a mental task, such as reading or simple math. It is important to sit very still during the recording [14].

4.4 Disorders

1. Dyslexia and Autism.
2. Neurological, Neurosurgical and Psychiatric Disorders.
3. Memory Disorders.
4. Dementia.
5. The Epilepsies.
6. Depression.
7. Schizophrenia.

V. TECHNIQUE

5.1 Positron Discharge Tomography

It is a nuclear medicine imaging that produces a three-dimensional image of functional processes in the body. Positron-emitting radionuclide is a system which detects pairs of gamma rays emitted in a roundabout way into the body on a biologically active molecule. Three-dimensional descriptions of tracer attentiveness within the body are then constructed by processor stop working.

In positron discharge tomography (PDT) imaging, When fluorodeoxyglucose (FDG)-PET is used for handy brain Map, the patient perform a task and cerebral metabolism, as deliberate by FDG uptake, is considered and compare to uptake under control circumstances [15].

5.2 Advantage

1. Any brain function that can be called upon with a behavioural task can be studied by PET
2. PET image will be dependent on specificity of the behavioural and control task paradigm and implementation.

5.3 Disadvantage

1. PET embrace a deprived indication to clamour ratio when compare with functional MRI.
2. Poor temporal resolution unsettled.
3. Chronological hindrance in measure metabolic changes as a proxy for neuronal change.
4. It is very expensive, dedicated equipment and personnel for production of tracer.
5. PET has the disadvantage not differentiating essential from participating areas.

5.4 Uses:

1. Used in preoperative arrangement, together with coupé and somatic sensory Map [16], [17].
2. It has also used in neurological diseases such as Alzheimer's disease [18], neurological injury such as fondle [19].
3. It has also used in neurosurgical scheduling [20], [21].
4. PET is also used to demarcate areas of uncharacteristic brain function.

5.4 ***Functional magnetic resonance imaging*** (Fmri)

5.2.1. Definition

It is a type of specialized MRI scan used to measure the hemodynamic response (change in blood flow) related to neural activity in the brain or spinal cord of humans or other animals. It is one of the most recently developed forms of Neuro imaging. Since the early 1990s, Fmri has come to dominate the brain Map field due to its relatively low invasiveness, absence of radiation exposure, and relatively wide availability.

5.2.2. Fmri Paradigm

The activity of brain cannot detect by Fmri and it can become aware of dissimilarity of brain activity. During the Fmri image acquisitions, the patient is asked to perform several tasks or emotions. Each of these conditions is repeated several times and can be separated by rest periods. The amalgamation of these circumstances is called a functional MRI paradigm. The stimuli are usually audio-visual but can involve more complex systems.

5.2.3. **BOLD effect**

The detection of brain areas which are used during a condition is based on the Blood Oxygenation Level Dependent (BOLD) effect, which creates a variation in the EPI images' signal linked in each area during each condition[22][23].

5.2.4. Analysis Of Fmri

- *This signal change is very low and cannot be directly detected.*
- *Statistical methods must be used to identify the voxels in which the signal varies according to the paradigm.*
- *Threshold functional MRI activation maps can be overlaid in colour on a high resolution anatomical MR image*
- *Brain Magic performs a user-friendly analysis of clinical Fmri images.*

5.2.5. **Applications of functional MRI**

- *Presurgical MAP of eloquent brain areas.*
- *Assessment of plasticity after a brain injury*
- *Assessment of patients with disorders of consciousness.*
- *MAP of complex function in normal and pathological condition.*
- *Monitoring of treatment response*
- *Neuron marketing*
- *Lie detector*
- *Mind reading*

5.2.6. Advantage

It can none invasively documentation brain signals devoid of risks of ionising emission inherent in other

scanning methods.

- It has high spatial resolution. 2–3 mm is typical but resolution can be as good as 1mm.
- Fmri is widely used and benchmark data-analysis approaches have been urbanized which allow researchers to evaluate grades across labs.
- Fmri produces persuasive images of brain "activation".

5.2.7. ***Disadvantages***

- The images produced must be interpreted carefully, since correlation does not imply causality, and brain processes are complex and often non-localized.
- The BOLD signal is only a tortuous measure of neural activity, and is therefore susceptible to influence by non-neural changes in the body. This also means that it is tricky to read positive and negative BOLD response.
- BOLD signals are most muscularly related with the participation to a prearranged area rather than with the output. It is so possible that a BOLD signal could be in attendance in a given area even if there is no single unit activity.
- fMRI has often been used to give you an idea about commencement localized to specific regions, thus minimizing the distributed nature of processing in neural networks.
- The BOLD retort can be pretentious by a variety of factors, including: drugs/substances; age, brain pathology, local difference in neurovascular coupling, concentration, amount of carbon dioxide in the blood; etc.

VI. ELECTROCORTICOGRAPHY

It is the direct footage of electrical potentials connected with brain commotion from the cerebral cortex.

6.1 Application and Uses

- The application of electrocorticography is the localization of the central sulcus by means of phase reversal somatic sensory evoked potentials [24].
- The EEG is recording of the summed post-synaptic potentials of pupations of cortical neurons.
- The EEG may be recorded by means of extra cranial (scalp) electrodes or intracranial electrodes.
- On the basis of the scalp EEG and other data, sites are selected for implantation with either depth or subdural electrodes.
- Depth electrodes are implanted using stereotactic guidance and are most commonly used to monitor the medial temporal lobe.

VII. MAGNETO ENCEPHALOGRAPHY

7.1 Definition

It is a non-invasive technique of measure brain activity by measuring the magnetic field that convoy neuronal activity.

7.2 Introduction to Magneto encephalography

- ✓ MEG is based on magnetic field change rather than voltage changes.
- ✓ The cohort and proliferation of ion current is based on neural commotion.
- ✓ Bio magnetometer is a technique of current flow by number of neurons firing which is of detect at the scalp surface.

  Rezai report MEG brain Map data for both motor and sensory are three-dimensional space [25].

7.3 How It Works

In this technique MEG starts with recording of the magnetic field and is generated by the neural activity of brain by this neural activity magnetic fields are detected by this technology that is based upon the detector called as super conducting detector. When the magnetic field are analyse the location of the neural sources of brain, these neural sources are super imposed as MRI for surgical.

7.4 Advantage

1. Process intellect purpose.
2. High precision-millimetre declaration.
3. Non–invasion.
4. straightforward to use.
5. MEG has a major advantage to adaptable many functions eg. Sensory, memory cortex, language

7.5 Disadvantage

- ➢ Magnetic fields generate by neural bustle are exceptionally pathetic.
- ➢ Only dexterous of picking up signals from the facade of the cortex.

- Neurons positioned in the rock bottom of cortical fold have dendrites oriented in a way that gives climb to demonstrable magnetic fields outer surface of the skull.
- The MEG signals of interest are extremely small, several orders of magnitude smaller than other signals in a typical environment that can obscure the signal. Thus, specialized shielding is required to eliminate the magnetic interference found in a typical urban clinical environment.

7.6 Features

- The MEG has better spatial resolution (2 mm) and is not attenuated by the scalp [26].
- MEG is also a reimbursable procedure, both for epileptic focus localization and for functional MAP.

7.7 Uses

1. Used in surgical evaluation of epilepsy patients to localize epilepto-genic foci [27].
2.The use MEG has more recently expanded to stereotactic and image-guided surgery to aid in the safe resection of lesions adjacent to eloquent cortex[28][29].

7.8 Applications to Specific Functions

1. Motor MAP [30].
2. Language Lateralization [31].
3. Language Localization [32].

VIII. CONCLUSIONS

The conclusion of brain Map is to planning the relationship between functional brain areas. The brain Map is safe for neurological outcome. One of the recent advanticity is plasticity. The amalgamation of functional imaging with traditionalist imaging, image-guidance, and intraoperative imaging systems will direct to our aptitude to execute more absolute and accurate resections. Functional brain Map stand to ultimately change the way intracranial development are treated by create a brain occupation that not only defines articulate areas but also illuminate probable purposeful target.

IX. ADVANCES IN BRAIN MAP

Cover a wide range of topic like brain function Map; from basic neuroscience to clinical applications. It provides a significant overview of brain Map research and will be useful reading for the neuroscientist who intends to clarify the brain function using physiological or imaging techniques. Techniques used include EEG, ERP, PET, SPECT, MEG, MRI, FMRI.

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