

Get Ready TO Crack CSIR-NET (SHORT NOTES ON fMRI (Functional Magnetic Resonance Imaging Scan))



f-MRI (Functional Magnetic Resonance Imaging)



Fig. fMRI MACHINE

fMRI SCAN

- An fMRI scan is a functional magnetic resonance imaging scan.
- It measures and maps the brain's activity.
- An fMRI scan uses the same technology as an MRI scan.
- An MRI is a noninvasive test that uses a strong magnetic field and radio waves to create an image of the brain.
- The image an MRI scan produces is just of organs/tissue, but an fMRI will produce an image showing the blood flow in the brain. By showing the blood flow it will display which parts of the brain are being stimulated.

BASIC PRINCIPLE: -

- Functional magnetic resonance imaging can show which part of the brain is active, or functioning, in response to the patient performing a given task, by recording the movement of blood flow.
- All atoms and molecules have magnetic resonance, emitting tiny radio wave signals with movement, because they contain protons.
- F-MRI is used in various behavior analysis by using blood oxygen level dependent- BOLD

- By using Blood oxygen level dependent mapping of regions of a functioning brain is done from the changes in blood oxygen.
- The main method used to generate images is contrast imaging.
- Hemoglobin in blood carries oxygen; oxyhemoglobin, around the brain and when it is used up, it becomes deoxyhemoglobin. Where the oxygen is being used up shows the site of activity in the brain.
- The picture is made by monitoring the ratio of the tiny wave frequencies between these two states whilst the patient carries out a task, e.g., Tapping a finger, which highlights the area of the brain functioning to carry out this task.

Improvement in fMRI

- fMRI has improved over the years
- Example- A spin echo pulse and increased magnetic strength were included, they are basically to produce better recorded images.
- To control variables during measurement various precautions were taken.

FUNCTIONS OF fMRI: -

- fMRI imaging can do comparisons between different specimen groups both quantitatively and qualitatively.
- **We can compare between: -**
 1. **Active Brain and resting brain**
 2. **Developing Brain and aging brain**
 3. **Defective Brain and damaged brain.**

1.Comparisons Done by fMRI with quantitation

- Several methods can be used for fMRI comparisons

i). With a pseudo color scale in the images acquired. different levels of oxygen usage can be determined.

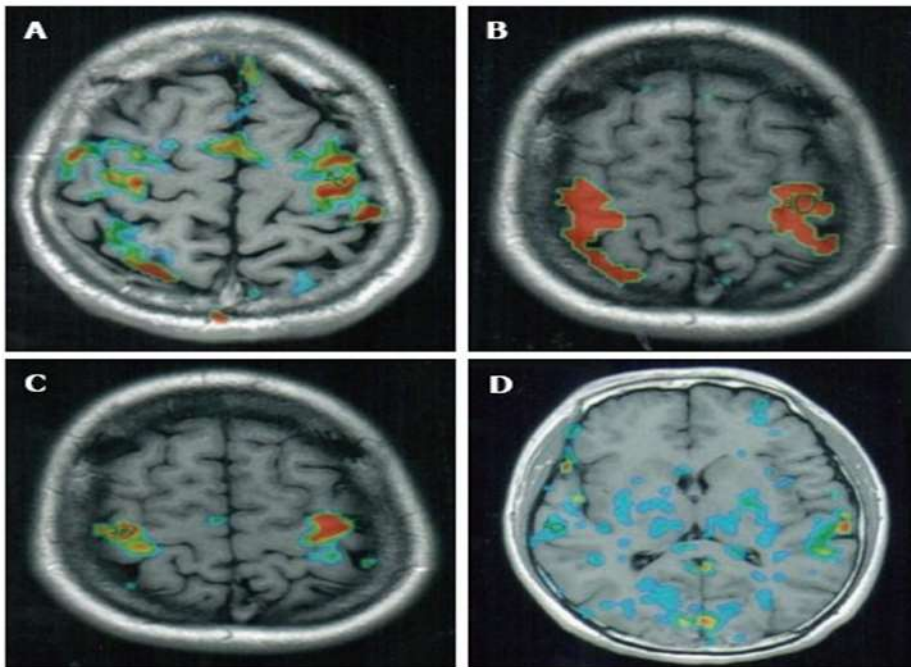
Example-

❖ **Four-color scale**

- A. The **highest level of oxygen** uptake is indicated by **red color**
- B. An **intermediate level** of uptake of oxygen indicated by **yellow color**
- C. The **normal level** of oxygen is shown by **green color**
- D. **Lower than normal level** of oxygen is indicated by **blue color**

The volumes of the differently colored regions in brain can be determined by using these type of color scales.

(As shown in image of fMRI below)



2. Comparisons done by fMRI with qualitative evaluation

- During a particular type of movement when a brain gets activated can be determined by fMRI.
- The activated areas during any activity might be nonspecific, so in that case investigators must carefully consider each site of activation to determine.
- To do so the investigator must take at least 6 individuals for accurate comparisons between activities of different individuals' brains.

Brain Activity measured by Following process by fMRI

- fMRI looks at blood flow in the brain to detect areas of activity.
- The main source of energy for brain is glucose, but glucose is not stored in the brain. So, when parts of the brain need energy to perform an action, more blood flows in to transport glucose to the active areas, thus more oxygen-rich blood enters the area.
- Example, when we are speaking there is glucose and oxygen-rich blood flowing to the part of our brain designated to speaking.
- The brain activity is mapped in squares called voxels (represent thousands of neurons). Color is then added to the image to create a map of the brain.
- **A specific task is asked to perform to the patients during an fMRI scan. This increase oxygen-rich blood flow to a certain part of the brain.**

Tasks asked to perform-

- 1. Tap the thumb against their fingers**
- 2. Look at pictures**
- 3. Answer questions on a screen**
- 4. Think about actions based off a picture (ex: they see a picture of a chair and think about actions like sit on the chair, buy a chair like this, design of chair), etc.**
- 5. For the tasks where the patient is asked a question, most of the time the patient is told to just think about the answer that way the speech part of the brain is not activated.**

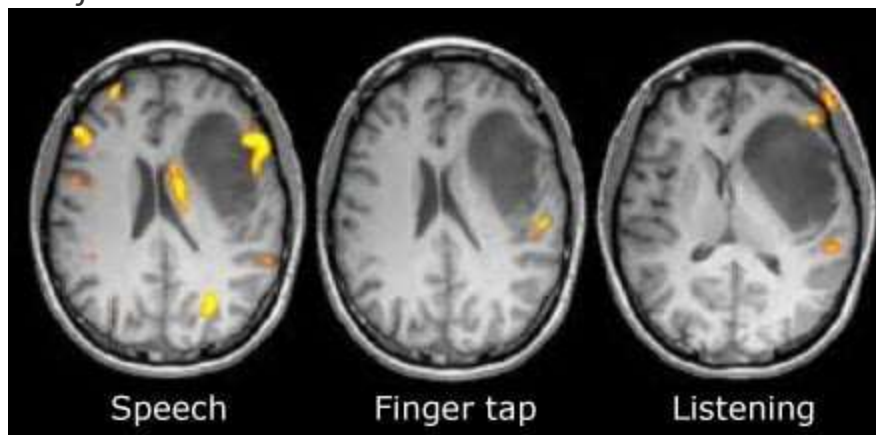


Fig. Images of brain during speech, finger tapping and listening

Advantages

- fMRI helps map a patient's brain before they go into brain surgery.
- fMRI map help doctors to **understand** the regions of the brain linked to **critical functions such as speaking, walking, sensing, or planning.**
- scan provides about the makeup of an individual's brain to prevent serious injuries.
- It also determines that if surgery is even a possible or not.
- One more advantage is that the image produced by the fMRI scan is very high resolution.

Disadvantage

- fMRI studies of brain cancer, lesions and other brain pathologies of both humans and animals are still to be explored.
- Using fMRI, we face difficulty in cognitive studies interpretation. This can only be overcome by imaging large numbers of samples
- Getting an fMRI scan is a very expensive procedure.
- A minor negative is the machine can only capture a clear image if the person being scanned stays completely still.
- only the blood flow can be looked not at individual neuron's activities.

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