

ELECTRONICS & COMMUNICATION ENGINEERING

TECH CONNECT

June, 2018



**LAKIREDDY BALIREDDY COLLEGE OF ENGINEERING
MYLAVARAM**

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1.MST RADAR

Introduction to Radar

The basic techniques for radar were used for the first time by Sir Edward Victor Appleton in his ionosphere research in the 1920s. The pulse radars are used to detect range and the radar scattering cross-section of a remotely located object (e.g. aircraft). When the detected target is in motion, the returned signal is Doppler shifted from the transmitted frequency and the measurement of the Doppler shift provides the line-of-sight velocity of the target. The radars having this capability are referred to as pulse Doppler radars. In addition to the above, if the location of the target is to be uniquely determined, it is necessary to know its angular position as well. The radars having this capability employ large antennas of either phased array or dish type to generate narrow beams for transmission and reception. There are several pulse radars that have been developed with varying degrees of complexity to meet the demands of application in various fields.

Atmospheric radars

Besides detection and characterization of hard targets e.g. aircraft, radar can be employed to probe the soft or distributed targets such as earth's atmosphere. A kind of radar whose target is earth's atmosphere is called as *atmospheric radar*. The turbulent fluctuations in the refractive index of the atmosphere serve as a target for these radars. This is the one of the features which makes the atmospheric radar unique and different from other kinds of radars. Atmospheric radars are used to measure temperature, pressure, humidity and wind velocities of atmosphere. The atmospheric radars of interest to the current study are known as clear air radars and they operate typically in the VHF (30–300MHz) and UHF (300 MHz–3GHz) bands. Examples of atmospheric radars are ST (Stratosphere Troposphere), MST (Mesosphere Stratosphere Troposphere), Lidar and Meteor radar. Operational atmospheric radars have antennas with diameter of 10-300 m.

There is another class of radars known as weather radars which observes precipitation as its principal target and they operate in the SHF band (3-30 GHz). A major advance has been made in the radar probing of the atmosphere with the realization in early seventies. It is possible to explore the entire Mesosphere-Stratosphere-Troposphere (MST) domain by means of a high power VHF backscatter operating ideally around 50 MHz. It led to the concept of MST radar and this class of radars has come to dominate the atmospheric radar scene over the past few decades.

Principles of MST Radar

MST Radar is used to investigate the motion of the middle atmosphere on all temporal and spatial scales and also to study the interactions among the three different regions of the atmosphere namely, *Mesosphere, Stratosphere, Troposphere*. It is high power phase coherent pulse Doppler radar operating typically around 50 MHz with an average power-aperture product exceeding about $5 \times 10^7 \text{ Wm}^2$. It receives echoes due to the scattering and reflection from variation in radio refractive index of neutral atmosphere which in turn depends on variability of humidity, temperature and electron density induced by turbulence in the lower and middle atmosphere. It provides estimates of atmospheric winds on a continuous basis at high temporal and spatial resolutions required to study of various dynamical processes of the atmosphere. MST radar uses the echoes obtained over the height range of 1-100 km to study winds, waves, turbulence and atmospheric stability.

There are two main techniques.

1. Doppler Beam Swinging (DBS) technique
2. Spaced Antenna Drifts (SAD) technique

1. Doppler Beam swinging technique: This technique uses a narrow beam in at least three directions and measures the Doppler shift of echoes from irregularities. A beam in the Zenith direction and at least two more means in scattered off-Zenith in two perpendicular directions are used to measure the radial velocity in each beam direction.

2. Spaced Antenna Drifts (SAD) technique: This method uses three or more spaced antennas and the received signals are cross correlated to determine the offset of cross-correlation functions, yielding the horizontal velocity components.

Figure shows the functional block diagram of India MST radar system. The main subsystems are

- Antenna and feed network
- Transmitter
- Receiver
- Data acquisition & signal processing computer system

~M.Siva Sankara Rao (Sr. Assistant Professor)

2. Bluetooth 5

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.400 to 2.485 GHz) from fixed and mobile devices. Bluetooth is managed by the Bluetooth Special Interest Group (SIG), which has more than 30,000 member companies in the areas of telecommunication, computing, networking, and consumer electronics. The latest version of the Bluetooth standard introduces a number of improvements that will be of value to many applications. The main changes, which will be discussed in this article, are higher speed, increased range, mesh networking, and improved support for advertising and beacons. Bluetooth 5 remains backwards compatible with earlier versions and also provides better coexistence with other wireless networks. The increased range and faster data rates do not require any more power but cannot be used at the same time. In other words, Bluetooth 5 gives the designer choices for how to optimize between data rate, range and energy use.

Higher speed

Bluetooth 5's enhanced data rate (EDR) supports higher transmission speeds of up to 2Mbps without increasing output power. This means less energy is used to send the same amount of data. Most devices will be flash-based, enabling them to take advantage of this increased speed to perform firmware updates. This is important for security and feature updates, particularly for IoT nodes. The higher data rate will also be valuable for applications where rapid response times are required, such as controlling drones and robotics.

Increased range

Bluetooth 5 has a theoretical range of up to 400 meters for line of sight connections, which probably means about 120 meters in a more realistic environment. This is about four times the range of the previous version at the same power consumption. However, this can only be achieved at lower data rates, so there is a choice between high speed or greater range. For many low-energy applications, the 500 kbps or 125k bps modes will provide sufficient bandwidth.

Mesh networking

Bluetooth was originally defined as a star network where all nodes connect via a central hub. This limits the size and range of the network. A large network would require multiple

hubs with some other, possibly wired, communication between them, which adds to the cost and complexity. Bluetooth 5 introduces support for mesh networking where all nodes can communicate directly with one another, see Figure 1. Messages can be passed through intermediate nodes. This extends the network beyond simple point-to-point wireless connectivity and provides almost unlimited range throughout and even between buildings.

Mesh networking is already supported by other wireless systems such as Zigbee and has been implemented by some manufacturers of Bluetooth devices using proprietary extensions to the standard.

Bluetooth 5 uses a “flooding” mesh. This means that every packet received by a node is copied to all the other connected nodes until it reaches the destination and effective way of spreading information across the mesh network. Every packet will have multiple paths to the destination, which increases reliability. Control can be distributed throughout the mesh using what the Bluetooth SIG calls a “scene”

Improvements to beacons and advertising

Bluetooth 5 provides better support for “connectionless” applications that use beacons, which function without needing to pair with another device. The improved range is useful for beacon applications. The speed increase isn’t as relevant because it is usually the discovery/connection time, rather than the raw data rate, that is important. The basic broadcast packet size is increased to 255 bytes and packets can be chained to create extended advertising data payloads. This means the beacon can transmit more useful amounts of data and new types of data. However, Bluetooth has only three advertising channels and these could soon become congested with advertising packets if they all had large data payloads. There is a new periodic advertisement mode which allows for more synchronized broadcasting of data between devices.

Improved coexistence

There are multiple wireless connectivity solutions all operating in the 2.4 GHz band including cordless phones, baby monitors, Wi-Fi, Zigbee and LTE cellular networks. Bluetooth 5 improves the ability to coexist with these. As well as avoiding channels already in use by Wi-Fi it adds “slot availability masks” that avoid interference with cellular networks. Bluetooth 5 also has an improved channel-sequencing algorithm (CSA

#2) to improve the pseudo-randomness of next hop channel sequencing. This will improve operation in the presence of Wi-Fi and other Bluetooth devices.

The improvements in Bluetooth 5 will enable a new range of applications for beacons. For example retail outlets and exhibitions can use beacons to automatically register people's presence and deliver information about the items the visitor is looking at, including a link with more details or special offers..Bluetooth 5 will also be able to compete in IoT applications, such as smart lighting, which are already dominated by alternatives such as Zigbee.

~D.SWAPNA(17761A04D6)

3.Human Brain

Nervous system is the fundamental communication network in the human body through which many mechanisms are controlled. The senses deliver information to the nervous system that processes the received information to initiate relevant action. The nervous system is composed of billions of nerve cells termed as neurons. The dendrites within the neuron act as antennas to receive information and pass the same to cell body. The nervous system is categorized as central and peripheral. Brain and spinal cord are the constituent parts of central nervous system (CNS) while peripheral nervous system (PNS) is the conglomeration of all other neurons that are not included in the CNS.

Human brain is the most complicated, well organized structure in the human body that is responsible for sensing, thinking and decision making. Located in the head and protected by skull this organ weighting around 1.5 Kg controls the human body by receiving, analyzing and storing information.

Parts of Human Brain

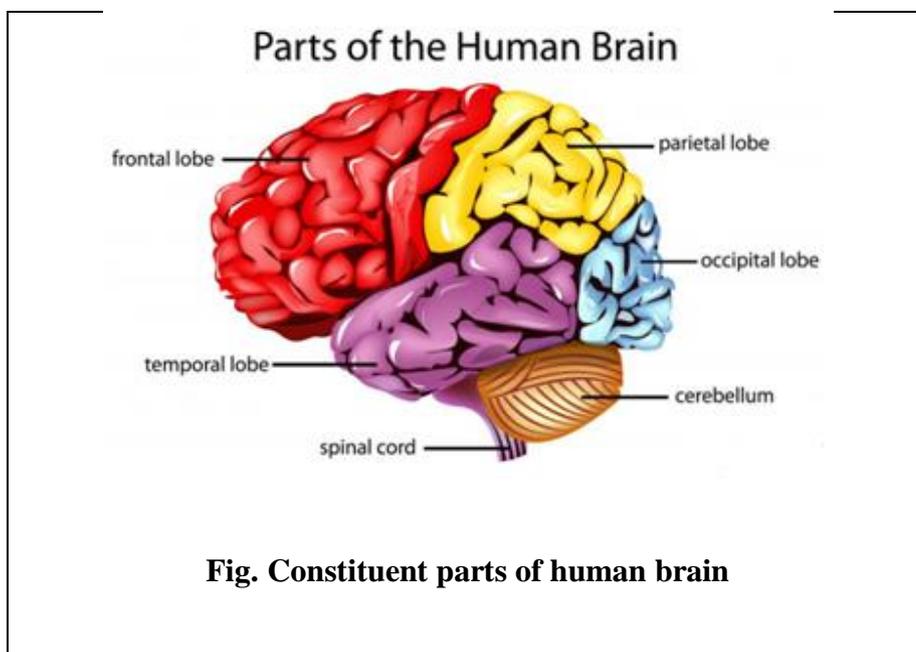
Various parts in the human brain are listed as forebrain, mid brain and hind brain. Cerebrum is the largest portion of brain serving the major functionalities of CNS. Also termed as cerebral cortex, cerebrum controls the functions of thought and action. Along with cerebrum, thalamus and hypothalamus are the other sub organs of forebrain [33,34,76]. Figure 2 visualizes the structure of human brain. The cerebrum is divided left and right hemispheres which are further partitioned into four different lobes to serve different functions. Even though left and right hemispheres look symmetric, their working slightly different from one another. The left portion controls the movement of right hand side muscles while right hemisphere coordinates the left hand side muscular movement. Various sections or lobe present in cerebrum are frontal lobe, parietal lobe, occipital lobe and temporal Lobe.

Forebrain

The forebrain as a whole serves numerous functions of language comprehension, visual processing, movement and recollection of past information. Further, it also coordinates the inputs received from various sensory organs like eyes, ears, and skin along with coordination between various messages received.

Frontal Lobe: The capability of thinking at high level is motivated by this lobe. Biggest of all the lobes of cerebrum, frontal lobe plays a major role in personality, memory formation and decision making. This lobe helps in solving problems and controlling the living environment. Under the circumstances of any damage to this lobe, abnormality of reduced facial movements and less vocabulary are observed [72, 76,90].

Temporal Lobe: The major functionality of this lobe is linked with auditory system that enables to hear and comprehend the speech heard. The structures responsible for forming long term memory, reside in medial temporal lobe. Any atrophy of this lobe will affect the formation of new memories or may even lead to temporary amnesia. Damage to left temporal lobe will have impact on identification of words while right side injury affecting the talking capability.



Parietal lobe: Stimuli from sensory organs are derived from this lobe and are integrated to obtain meaningful information. Constructional disability and body ignorance are the symptoms observed for casualty of this lobe. Located above the occipital lobe, this lobe receives inputs from skin via thalamus.

Occipital lobe: This lobe distributed between two hemispheres and located beneath the parietal lobe acts as a centre for processing visual information. Any injury to this lobe or degeneration of cells within will have the problem of visual impairment. The objects that are viewed may have different geometry than perceived.

Mid and hind brain

While the sensory organs sense the information and forebrain processes the same, the mid brain comprised of tectum and tegmentum, acts as a gateway to pass the information. In addition, tectum assists in controlling the movement of the sensory organs along with neck muscles. Estimation of the future position of the body and maintaining balance within it are the major responsibilities of the hind brain. Cerebellum which is the second biggest part of the brain is a sub structure of hind brain.

~G.L.N.Murthy (Associate Professor)

4. Python For Signal Processing

Python is a general-purpose language, which means it can be used to build just about anything, which will be made easy with the right tools/libraries. Professionally, Python is great for backend web development, data analysis, artificial intelligence, and scientific computing. Many developers have also used Python to build productivity tools, games, and desktop apps, so there are plenty of resources to help you learn how to do those as well.

Python programming on Arrays, Matrices

To use a compiled scientific library, the memory allocated in the Python interpreter must somehow reach this library as input. Furthermore, the output from these libraries must likewise return to the Python interpreter. This two-way exchange of memory is essentially the core function of the Numpy (numerical arrays in Python) module.

Numpy Arrays and Memory:

Some interpreted languages implicitly allocate memory. For example, in MATLAB, you can extend a matrix by simply tacking on another dimension as in the MATLAB, This works because MATLAB arrays use pass-by-value semantics so that slice operations actually copy parts of the array as needed. By contrast, Numpy uses pass-by-reference semantics so that slice operations are views into the array without implicit copying.

Numpy Matrices:

Matrices in Numpy are very similar to Numpy arrays, but they implement the row column matrix multiplication as opposed to element-wise multiplication. If you have two matrices you want to multiply, you can either create them directly or convert them from Numpy arrays.

Numpy Broadcasting:

Numpy broadcasting is a powerful way to make implicit multidimensional grids for expressions. It is probably the single most powerful feature of Numpy and the most difficult to grasp. Proceeding by example, consider the vertices of a two-dimensional unit square in Listing, Broadcasting works in multiple dimensions also.

Matplotlib:

Matplotlib is the primary visualization tool for scientific graphics in Python. Like all great open-source projects, it originated to satisfy a personal need. At the time of its inception, John Hunter primarily used MATLAB for scientific visualization, but as he began to

integrate data from disparate sources (e.g. internet, file systems) using Python, he realized he needed a Python solution for visualization, so he singlehandedly wrote Matplotlib.

IPython:

IPython originated as a way to enhance Python's basic interpreter for smooth interactive scientific development. In the early days, the most important enhancement was "tab-completion" for dynamic introspection of workspace variables. For example, you can start IPython at the command line by typing `ipython` and then you should see something like the following in your terminal: The combination of dynamic tab-based introspection and quick interactive help accelerates development because you can keep your eyes and fingers in one place as you work. This was the original IPython experience, but IPython has since grown into a complete framework for delivering a rich scientific computing workflow that retains and enhances these fundamental features.

IPython Note Book:

As one have noticed investigating Python on the web, most Python users are web-developers, not scientific programmers, meaning that the Python tool chain is very well developed for web technologies. The IPython Notebook supports high-quality mathematical typesetting using MathJax, which is a JavaScript version of most of LATEX, as well as video and other rich content. The concept of consolidating mathematical algorithm descriptions and the code that implements those algorithms into a shareable document is more important than all of these amazing features.

Computer Algebra:

Sympy is a pure Python module for computer algebra. It has benefited from "Google Summer of Code" sponsorship and grown into a powerful computer algebra system for Python. Furthermore, it has spawned many sub-projects that make it faster and integrate tighter with Numpy and IPython (among others). Alternatively, the Sage project is a consolidation of over 70 of the best open source packages for computer algebra and related computation. The IPython Notebook is tightly integrated with Sympy and provides mathematical typesetting for Sympy so that the implemented computer algebra is readable as a publication-quality mathematical document. Use `ipython --profile=sympy`.

`--pylab=inline` to start IPython Notebook with integrated Sympy support. The IPython Notebook also supports Sage.

Interfacing With Compiled Libraries:

Python for scientific computing really consists of gluing together different scientific libraries written in a compiled language like C or Fortran. Ultimately, you may want to use libraries not available with existing Python bindings. There are many, many options for doing this. The most direct way is to use the built-in `c types` module which provides tools for providing input/output pointers to the library's functions just as if you were calling them from a compiled language. This means that you have to know the function signatures in the library exactly—how many bytes for each input and how many bytes for the output. You are responsible for building the inputs exactly the way the library expects and collecting the resulting outputs. Even though this seems tedious, Python bindings for vast libraries have been built this way.

C python and SWIG are just two of the ways to create Python bindings for your favorite compiled libraries. Other notable options include FWrap, f2py, CFFI, and weave. It is also possible to use Python's own API directly, but this is an undertaking best left to professional coders. Although not mainly an interface option, the project is alternative implementation of Python that implements a just-in-time compiler (JIT) and other powerful optimizations that can substantially speed up pure Python codes. Extending to include Numpy and the rest of the scientific tool chain is well underway, but is still not appropriate for newcomers to Python.

~P.Sathwik(17761A0447)

5.SPECT

Single-photon emission computed tomography (SPECT) can provide three-dimensional functional images of the brain following the injection of one of a series of radiopharmaceuticals that crosses the blood--brain barrier and distributes according to cerebral perfusion, neurotransmitter, or cell density. Applications include differentiating between the dementias, evaluating cerebrovascular disease, preoperative localization of epileptogenic foci, diagnosing movement disorders, and evaluation of intra cerebral tumours, while also proving a useful research tool. Unlike positron emission tomography (PET), SPECT imaging is widely available and can be performed in any department that has access to a rotating gamma camera.

SPECT has received increasing attention as radiopharmaceuticals that reflect perfusion, metabolism, and receptor and cellular function have become widely available. Perfusion single-photon emission computed tomography of the brain provides functional information useful for the diagnosis and management of stroke, dementia, and epilepsy. Single-photon emission computed tomography has been applied to myocardial, skeletal, hepatic, and tumor scintigraphy, resulting in increased diagnostic accuracy over planar imaging because background activity and overlapping tissues interfere far less with activity from the target structure when tomographic techniques are used. Single-photon emission computed tomography is substantially less expensive and far more accessible than positron emission tomography and will become an increasingly attractive alternative for transferring the positron emission tomography technology to routine clinical use. In addition, singlephoton emission computed tomography has unique applications that are increasingly finding their way into the routine practice of clinical nuclear medicine.

The clinical use of SPECT has grown steadily over the last decade. SPECT is now an essential technique for certain studies such as cerebral blood flow imaging. Many other common nuclear medicine studies give better results when they are performed with SPECT. These include myocardial perfusion imaging with thallium-201 or the new technetium-99m perfusion agents, myocardial infarct imaging with infarct-avid agents, imaging of tumors or infections with agents such as gallium-67 or indium-111 WBC's, and certain cases of bone imaging. Still other studies such as liver/spleen imaging, most brain studies, and perhaps renal imaging may benefit from SPECT even though planar imaging gives satisfactory results. Future developments in 3D display

techniques and faster computers may extend the clinical usefulness of SPECT to other areas such as pulmonary perfusion imaging and gated cardiac blood pool imaging.

~Kota Madhu(15761A0421)

6.Reusable Launch Vehicle

With the development of technology, so many satellites are launching into the space from different countries. The first satellite launched into the space was Sputnik-1, by Russia on 4th October 1957 and the first Indian satellite was Aryabhata, launched on 19th April 1975. A satellite is nothing but an artificial body placed in an orbit that moves around a planet in order to collect the information.

A rocket that is used to place the satellite into a particular orbit is known as launch vehicle. Generally, there are two types of launch vehicles. If a launch vehicle carries the satellites into the space and places the satellite into a particular trajectory and the parts that can be removed from the rocket at each stage will be returned back to the earth is called RLV (Reusable Launching Vehicle). These parts will be used for the next purpose, as the materials used for making the rockets and satellites are very expensive. By using the parts again, it can reduce the cost. So, RLV (Reusable Launching Vehicles) are less expensive compared to ELV (Expandable Launching Vehicles).

The development of a system which can enter into the space at lower cost is required for the further development of space industries. The RLV's usually called Space plane is being developed by many countries which increases the space tourism. Research is going on RLV technologies which reduce the risk of developing a RLV. Falcon 9, Falcon Heavy of SpaceX is partially reusable vehicle. Hope our RLV developers will develop completely reusable vehicles in the next coming generations.

~M. Sravani(15761A0427)

7.Skull Stripping

Numerous medical imaging techniques are basically aimed at providing the visual representation of internal structures of human body. The knowledge about the structural atrophy of human brain helps in understanding the reason behind various behavioral related problems. As mentioned in earlier chapters, magnetic resonance imaging is prominently used for non invasive study of human organs.

All the substructures that were present in MR images are not required for each and every application. Even the tissues that were retained must also be delineated from one another to ease further analysis. The main objective of the current work is to extract Hippocampus in the medial temporal lobe and to classify the images for abnormality. All non brain regions must be suppressed unless which segmentation accuracy will be affected. Non brain removal plays a crucial role in wide variety of applications like tumor detection, study of brain anatomy and classification of individual tissues. Due to the presence of large volume of MR image data, manual segmentation is not accurate. Various structures in the brain MRI differ in their intensity values. The way they appear will be determined by the approach used for imaging. In T1 weighted MRI, white matter looks light while in T2 weighted it is dark gray. Similarly the fat present in bone marrow looks brighter in T1 than in T2 weighted. Thus for removing the unwanted structures like skull scalp etc, a reference intensity level is needed to discriminate between brain and non brain regions. In the next section a detailed knowledge about thresholding is provided that is meant for removing the non brain regions.

Thresholding

Thresholding is defined as the process of modifying the intensity values of a given image based on reference intensity value called as threshold. Due to the ease in implementation, thresholding is the most widely used segmentation approach irrespective of the availability of sophisticated algorithms. Based on the allocated gray level values, the resulting image after thresholding can be either gray scale image or a binary image. At the basic level, the process of thresholding yielding binary image can be represented as

$$g(x,y) = 1 \quad \text{if } f(x,y) > T$$

$$= 0 \quad \text{if } f(x,y) \leq T$$

Where T is the threshold, $f(x,y)$ is the input image and $g(x,y)$ is the resulting binary image. The threshold value is derived for the entire image and the process is carried out throughout the image; it is called as global thresholding. However, this will not result in good results due to the fact that image characteristics are not fixed over the entire image. In such a case, the image is divided into numerous sub images before calculating the threshold meant for extracting the desired object and this approach is called as local thresholding. The delineation process in such a situation will have multiple thresholds instead of single threshold. Further, even in global thresholding more number of thresholds can be derived from the knowledge of probability distribution of intensity values. Under the circumstances of more number of thresholding the resulting image will be a monochrome image or a color image if the process is carried out for each channel comprising the final image. The transformation in such a methodology will be of the form

$$\begin{aligned} g(x,y) &= r_1 \quad \text{if } f(x,y) \leq T_1 \\ &= r_2 \quad \text{if } T_1 < f(x,y) \leq T_2 \\ &= r_3 \quad \text{if } T_2 < f(x,y) \leq T_3 \\ &= r_4 \quad \text{if } f(x,y) > T_4 \end{aligned}$$

In the above mentioned sample thresholding approach, T_1, T_2, T_3, T_4 are the computed thresholds while r_1, r_2, r_3, r_4 are the allocated gray level value

Selection of threshold

Identifying a value, that can discriminate between different objects only possible only when the variability in the gray level values is known. Getting the knowledge about intensity distribution is achieved by means of histogram. The histogram of an image will give information about the number of times each gray level in an image is present. A single histogram will exist for monochrome images while three histograms will be defined for RGB images. The probability distribution of intensity values can be determined from the histogram. By observing the histogram, characterization of given image can be made i.e whether the image is of dark, light, low contrast or of bright nature. Base on the count of each bin or gray level value, there will be deep valleys or crests in the distribution function of the image. For a bimodal histogram, the threshold will be the minima that are

located at the deep valley between two peaks. In case of multi modal histogram, various thresholds are defined that are the minima between each every consecutive two peaks.

The process of obtaining the histogram for a given image will assist in deriving a clear partition between various objects in the image. In particular, when dealing with magnetic resonance images, the back ground and the noise must be suppressed to the maximum extent for achieving the desired tissue of interest unless which inaccurate segmentation results will occur. There is a possibility that non idealness of image acquisition environment as well as bias effect may result in wrong selection of threshold. Insufficient illumination conditions also have impact in the process as the threshold selection process is affected due to corrupted histogram. Following Figure shows the axial and coronal sections of MR image of human brain. The multi modal distribution of the intensity values of the same views can be seen through images (c) and (d) respectively. It can be observed that the distribution is composed of valleys and peaks that are even though not deeper but can be used for selecting the threshold values which however, need not be accurate due to the unclear separation between various regions. When compared to axial view, the histogram of the sagittal section has more intensity values in the middle of the gray scale. Entropy or mutual information is used as the criterion functions to define threshold in those situations where the histogram peaks are not clearly separable, unless which incorrect classification of pixels will occur and there is a possibility of overlapping of objects.

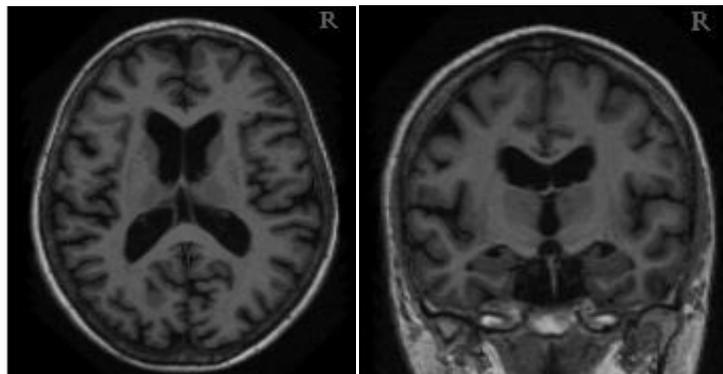
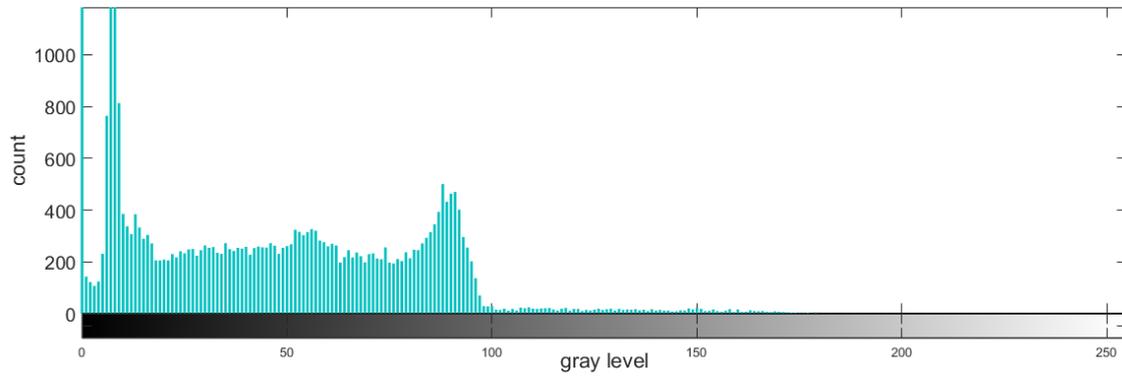
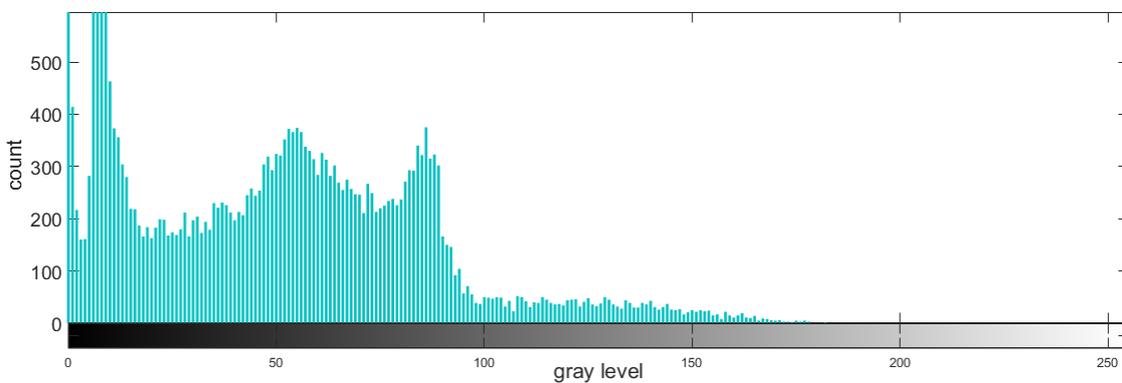


Fig.(a) MR image-Axial view

(b) MR image - Coronal View



(c)Histogram of the Histogram- Axial iew



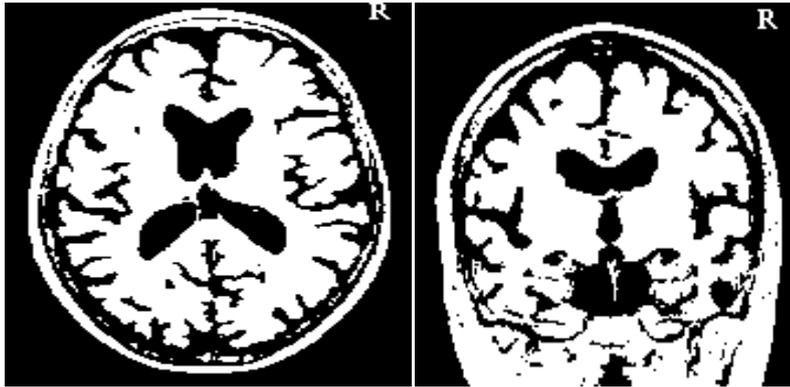
(d)Histogram of the Histogram- Coronal view

Fig. Histograms of axial and coronal MR images indicating multi modal distribution**Global thresholding**

In majority of the images, there will be a clear distinction between the back ground and objects or tissues of interest (in MR images) facilitating the use of a single threshold for the entire image. Whenever there exist a clear separation between various regions with in a given image, the process of thresholding will involve choosing an initial value of threshold and dividing the image is into two individual regions. At later steps, the average intensity value of each region is computed and averaged to define a new threshold and so on. Otsu's method is the most prominently sought global thresholding approach that aimed at maximizing the variability between various regions of an image.

The distribution of intensity values is initially normalized in the process of threshold selection. The inter class variance is computed with the help of mean intensity value of the entire image. That value of the gray level for which, variance is maximum is chosen as the threshold. The axial and coronal images shown in Figure 4.1 (a) and (b) when processed with the Otsu's method have resulted in segmentation results as shown in

Figure (a) and (b) respectively. It can be observed that even though the process of thresholding in this manner converted the image into binary image successfully, the desired task of brain extraction is not achieved. The only advantage that was gained from this technique is that any noise present in the back ground can be successfully removed. However, as noise can be removed at the time of filtering itself, Otsu's method of thresholding is not useful in the removal of the skull.



(a) Segmented image- Axial

(b) Segmented image – Coronal

Fig. Segmentation after deriving the threshold using Otsu's method

Local Thresholding

In this approach, the threshold value is not computed for the entire image, as the image intensity distribution will never exhibit same behavior over the entire image. Thus for effective delineation of objects comprising the image, local threshold are derived for each sub image and the segmentation process is carried out. In this process, the entire image is partitioned into non overlapping sub images and the mean and variance of each small sub region are used for threshold computation. Even though this methodology is computationally expensive, the availability of digital hard ware and advanced algorithms will compensate for the same.

~Mr.P.Venkateswara Rao (Assistant Professor)

