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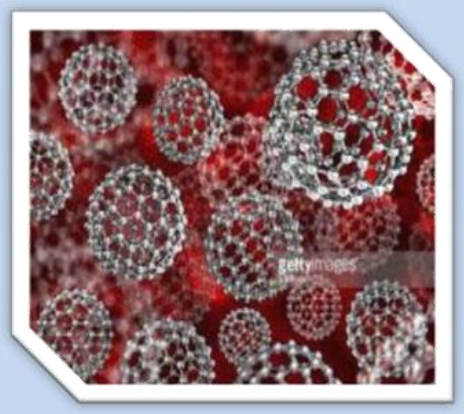
Volume-1

RESEARCH INNOVATIONS

-A Quest for innovative ideas…



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From Principal's Desk

Prof. (Dr.) S.K. Mishra

***I** would like to begin by congratulating the faculty and students of the editorial team for their efforts in bringing out the First issue of the research and Development magazine "Research Innovations". This magazine is a step towards Research awareness which in turn will develop research skills and is designed exclusively for churning out the technical writing skills among staff and students. Since challenges and opportunities are the two sides of the same coin, this magazine challenges students to bring latest technical topics and opportunity to share their knowledge in technical field. This magazine motivates students to grab more knowledge about current trends in field of engineering thereby preparing them for global employment.*

From Dean Research's Desk

Dr. Himanshu Sekhar Moharana

***T**he dedication of all who have come together to grow DRIEMS in the last years has paid off immensely. I would like to express my thankfulness to all of them. The past endeavors definitely pose a sense to help heading them to market. The work rendered by faculty and students in advancing technology to solve the world's biggest challenges is the call of the day, directly could not but help boosting the economy. This magazine motivates the potential readers to grab knowledge about current trends in the field of Research thereby preparing them for global achievements.*

From Editor's Desk

In fact we turn our back towards sun the real source and we create a self shadow and start moving towards treating the shadow as self and start nourishing it. In this witch hunt we achieved a name and fame in the society at the cost of increasing stress and related health issues. Life's main purpose is peace of mind - a product of simple living and high thinking. Happiness can only be achieved by turning our face towards the source. The source enlightens your move to development. Research is the only way that ensures you that you are in the developing path. "Research Innovations" is one novel approach to bring you near to the source.

Prof. Alok Ranjan Biswal
Associate. Professor, ME

R & D at DRIEMS

1. **Production and properties of Nano-fluid of iron tailings from Bolani Iron Mines : A cost effective formulation and its stability**
2. **Preparation and properties of Aluminium-Beryllium alloys using NALCO- Aluminium for space applications**
3. **Finite Element and Genetic Algorithm Based Optimal Vibration Energy Harvesting from Axially Functionally Graded Beam**
4. **Segmentation and Extraction of Brain Tumor Based on Soft- Computing Approach**

Production and properties of Nano-fluid of iron tailings from Bolani Iron Mines : A cost effective formulation and its stability

Abstract

Conventional fluids such as water, ethylene glycol, engine oils are normally used as heat transfer fluids .Several experimentations have been done to increase the heat transfer rate of the fluids. Nanofluids are prepared having appropriate thermo physical properties. Here iron tailingis proposed to be studied for the preparation of Nanofluid. The main purpose of this project is to produce nanopowders out of it for the preparation of a cost effective nanofluid and to study different thermal properties. As per the literatures available, it is interesting to note that we need to focus on materials size analysis, dispersion stability, careful exploration of surface chemistry and thermo-physical properties of Nano particles. The increased thermal conductivity, heat transfer coefficient and viscosity are making nanofluid more promising as compared to normal fluid. By the addition of nano particle in the base fluid (water) greatly affect the thermo-physical properties.

Literature Review

The concept of **"nano"** dates back to the year 1959 when a **physicist Richard Feynman** introduced the idea in a Nobel lecture entitled "There's plenty of room at the bottom". In this, he stressed that materials can be formed by manipulating individual atoms. He also predicted that nanotechnology will bring about a scientific revolution in the next century. Today, more than 40 years later, his vision becomes a reality whereby more and more nano-based technologies are being applied in our everyday lives. As an example, Samsung Company is the pioneers in marketing products such as washing machines and refrigerators incorporating nano sized silver as antimicrobial agents. The term "nano-technology" was first used by Norio Taniguchi in 1974, though it was not widely known. Inspired by Feynman's concepts, K. Eric Drexler independently used the term "nanotechnology" in his 1986 book. Engines of Creation: The Coming Era of Nanotechnology, which proposed the idea of a nanoscale "assembler "which would be able to build a copy of itself and of other items of arbitrary complexity with atomic control. Thus, emergence of nanotechnology as a field in the 1980s occurred through convergence of Drexler's theoretical and public work, which developed and popularized a conceptual framework for nanotechnology, and high visibility experimental advances that drew additional wide-scale attention to the prospects of atomic control of matter. Other scientists or researchers have also hinted the birth of this revolutionary technology. One of the co-founders of Intel Corporation, **Gordon E. Moore**, predicted that the number of transistors on a computer chip will double in every 18 months. What this means is that people are looking for finer structures for future technological applications. This prediction is now well known as the "Moore's Law" Therefore it is obvious that in order to response to the need in developing fine and miniature devices, nano science has become a vital and exciting field. This area not only focuses on technology applications but also fundamental understanding.

Through this procedure unidirectional nanostructure such as nanotubes, nanofibers and nanorods were obtained depending on the nature of surfactant used. The materials maintained their γ-alumina phase up to the temperature of 10500C. Zhang and Lockwood [11] invented a fluid media such as oil or water and a selected effective amount of carbon as oil or water and a selected effective amount of carbon nanomaterials necessary to enhance the thermal conductivity of the fluid. One of the preferred carbon materials is a high thermal conductivity graphite, exceeding that of the neat fluid to be dispersed therein in thermal conductivity, and ground, milled, or naturally prepared with mean particle size less than 500 nm, and preferably less than 200 nm, and most prefer less than 100nm. The graphite is dispersed in the fluid by one or more of various methods,

including ultrasonication, milling and chemical dispersion. Carbon nanotubes with graphitic structure are another preferred. The thermal conductivity enhancement, compared to the fluid without carbon material, is proportional to the amount of carbon nanomaterial (carbon nanotubes and /or graphite) added.

Murray invented a system combining the thermal conductivity characteristics of certain nanoparticles with the high specific heat of appropriate fluids to enhance the overall heat transfer characteristics of a heat exchanger. The system comprises a fluid channel disposed in a heat exchanger unit with slurry as the convective heat transfer medium. The slurry comprises an appropriate fluid with field reactive nanoparticles suspended there in; Field emitters are located along the walls of the fluid channel whereby the distribution of nanoparticles within the slurry is manipulated to achieve enhanced heat transfer characteristics. Oldenburg invented compositions comprising Nano rods and methods of making and using the same, the inclusion of nano rods can enhance the thermal conductivity of heat transfer medium. Surprisingly, the addition of nano rods provides substantially greater improvements in thermal conductivity than the addition of other nanostructure.

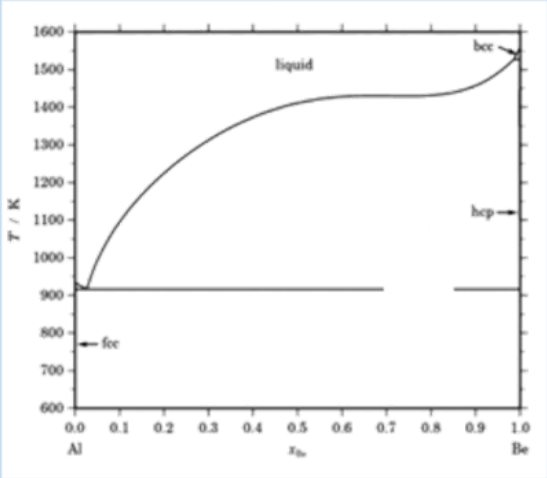
Preparation and properties of Aluminium-Beryllium alloys using NALCO- Aluminium for space applications

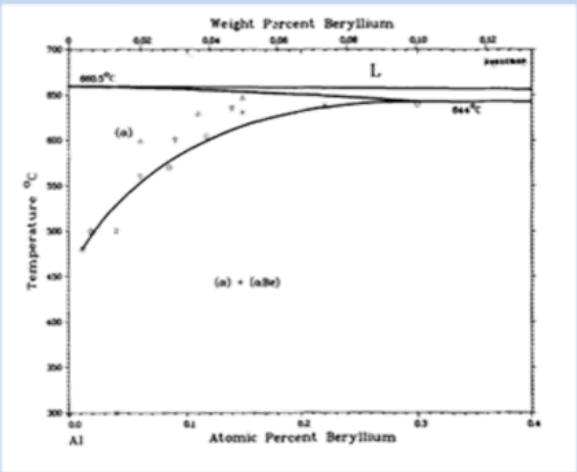
Dr. Himanshu Sekhar Moharana
Dean Research

Abstract
The properties of an alloy greatly depend on the quality of the base material. NALCO aluminium is known to be of high quality and is expected to exhibit superior physico mechanical properties. Properties such as thermal, fatigue, corrosion etc. show marked improvement depending on the purity of Aluminium. Aluminium-Beryllium alloys for space applications belong to a family of low density - high elastic modulus is under development in order to meet the growing demand of advanced aerospace designs. These alloys are Aluminium based with 10 to 75% Beryllium and combine the high specific stiffness of beryllium with the ductility, ease of fabrication. Densities ranging from 2.0 to 2.58g/cc with excellent strength and ductility are expected by the use of high quality Aluminium of NALCO. The molten metal route will be used in this investigation and property evaluations including fatigue and microstructure will be made.

Introduction
This document is part of Sub volume B5 'Binary Systems. Part 5: Binary Systems Supplement of Volume 19 'Thermodynamic Properties of Inorganic Materials' of Landolt- Bornstein - Group IV 'Physical Chemistry'. It provides an overview of the thermodynamic properties and the mixing behaviour of the binary system Aluminium – Beryllium The behavior of aluminum alloy at elevated temperature is studied. Fatigue failure is a major failure mode of failure where the cyclic load is applied to the machine element. Hence certainly it is important to know the fatigue behavior Fatigue behavior of aluminum alloy at elevated temperature is studied. Fatigue failure is a major failure mode of failure where the cyclic load is applied to the machine element. Hence certainly it is important to know the fatigue behavior of the machine element at elevated temperature; aluminum alloy is excessively used in industry like in aerospace automobile and miniatures industries etc,

because of it s non corrosive property and light in weight. The fatigue behavior of 2024 – T4 Aluminum alloy is investigated under room and elevated temperatures and it is observed that the fatigue strength of 2024 – T4 Aluminum alloy at elevated temperature is reduced by a factor 1.2 – 1.4 compared with dry fatigue strength Al2024–Beryl particulate composites were fabricated by stir casting by varying the weight percentage of beryl particulates from 0 wt% to 10 wt% in steps of 2 wt%. The cast Al2024 alloy and its composites have been subjected to solution zing treatment at a temperature of 495°C for 2 hrs, followed by ice quenching. Micro structural studies were carried out to determine the nature of the structure. The Brinell hardness test was conducted on both the Al2024 alloy and its composites before and after solution zing. Pin-on disc wear tests were conducted to examine the wear behavior of the Al2024 alloy and its composites. Sliding wear tests were conducted at various applied loads, sliding velocities and sliding distances. The results reveal that the wear rate of the composites is lower than that of the matrix alloy. The wear rate increased with an increasing applied load and sliding distance, and decreased with increasing sliding velocity The Weight-saving materials are becoming increasingly important, especially in the automotive and aerospace industries. Design engineers would like to make more extensive use of light metals such as aluminium, titanium, magnesium and their alloys; however, these materials tend to have poor wear resistance. Previous treatments and coatings applied to aluminium alloys, for example by traditional processes such as hard anodising and thermal spraying, have suffered from the low load support from the underlying material and/or insufficient adhesion, which reduces their durability. Also, although TiN-, CrN- or DL Ccoated aluminium alloys (using various PVD methods) can achieve a high surface hardness, in practice, they often exhibit poor performance under mechanical loading, since the coatings are usually too thin to protect the substrate from the contact conditions





Objectives

- Preparation of a number of novel Al-Be alloys with NALCO high purity Aluminium.
- Assessment of physico- mechanical properties of the produced alloys of varying compositions.
- Studies of Corrosion behaviour of the produced alloy.
- Optimisation study to obtain a combination of wear resistance, ductility, UTS etc.

Methodology

1. Preparation of Al-Be alloy through molten metal route in bottom pouring furnace having composition in the range of 10-30% and cast in ingot mould in the natural atmosphere.
2. Chemical analysis of the Al-Be alloys.
3. Study of physico-mechanical properties of Al-Be alloy
   I. Tensile and Compressive Strength (UTS) with % age of elongation etc.
   II. Hardness Test
   III. Fatigue Strength
   IV. Tribological Properties(Wear resistance)
4. Corrosion Studies
5. Study of alloy Structures
   i. Optical
   ii. SEM
   iii. TEM
6. Phase Analysis by XRD
7. Structural Property Correlation
8. Making the Al-Be alloys in vacuum furnace (Provisions may kindly be made to conduct the experiments either at NML, Jamshedpur or IIT, Kharagpur)

Finite element and genetic algorithm based optimal vibration energy harvesting from axially functionally graded beam

Prof. Alok Ranjan Biswal, ME Department

Abstract

Energy harvesting technology has the ability to create autonomous, self-powered systems which do not rely uponthe conventional battery for their operation. The term energy harvesting is the process of converting the ambient energy surrounding a system into some useful electrical energy using certain materials. Among several energy conversion techniques, the conversion of ambient vibration energy to electrical energy using piezoelectric materials has great deal of importance which encompasses electromechanical coupling between mechanical and electrical domains. The energy harvesting systems are designed by incorporating the piezoelectric materials in the host structure located in vibration rich environment. The work presented in this dissertation focuses on upgrading the concept of energy harvesting in order to engender more power than conventional energy harvesting designs.

The present work deals with first the finite element (FE) formulation for coupled thermo-electro-mechanical analysis of vibration energy harvesting from an axially functionally graded (FG) non-prismatic piezolaminated cantilever beam. A two noded beam element with two degrees of freedom (DOF) at each node has been used in the present FE formulation. The FG material (i.e. non-homogeneity) in the axial direction has been considered which varies (continuously decreasing from root to tip of such cantilever beam) using a proposed power law formula. The various cross section profiles (such as linear, parabolic and cubic) have been modelled using the Euler-Bernoulli beam theory and Hamilton's principle has been used to solve the governing equation of motion. The simultaneous variations of tapers (both width and height in length directions) have been incorporated in the mathematical formulation. The FE formulation developed in the present work has been compared with the analytical solutions subjected to mechanical,

electrical, thermal and thermo-electro-mechanical loading. Results obtained from the present work shows that the axially FG nonprismatic beam generates more output power than the conventional energy harvesting systems. Further, the work has been focussed towards the nonlinear vibration energy harvesting from an axially FG non-prismatic piezolaminated cantilever beam. Geometric nonlinear based FE formulation using Newmark method in conjunction with Newton-Raphson method has been formulated to solve the obtained governing equation. Moreover, a real code GA based constrained optimization technique has also been proposed to determine the best possible design variables for optimal power harvesting within the allowable limits of ultimate stress of the beam and voltage of the PZT sensor. It has been observed that more output power can be obtained based on the present optimization formulation within the allowable limits of stress and voltage than that of selection of design variables by trial and error in FE modelling.

Modelling of cross section profiles of the beam

Three different cross-sectional profiles are considered to study the responses of the piezo laminated beam. They are:

$$A_b(x) = A_0\left(1 - c_b\frac{x}{L_b} - c_h\frac{x}{L_b}\right)^2$$

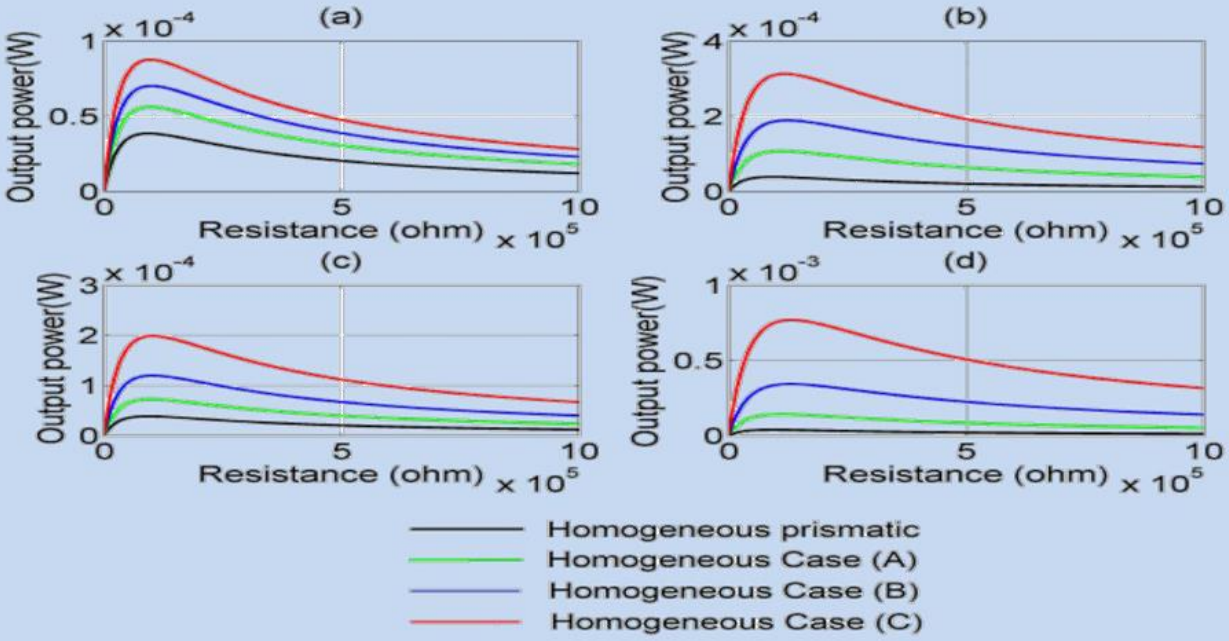
$$A_b(x) = A_0\left(1 - c_b\frac{x}{L_b} - c_h\frac{x}{L_b}\right)^3$$

and $$A_b(x) = A_0\left(1 - c_b\frac{x}{L_b} - c_h\frac{x}{L_b}\right)^3$$

The width and height taper ratios of the beam are denoted as c_b and c_h respectively, which could vary in the range such that$0 \le c_b \le 1$ and $0 \le c_h \le 1$. When $c_b = c_h = 0$, the beam will become a uniform one and when $c_b = c_h = 1$ the beam would taper to a point at $x = L_b$, which is only a theoretical limit. The transverse cross-sectional area of the beam near the clamped end is A_0, which gradually decreases towards the free end.

Responses of prismatic and nonprismatic homogeneous beams

The output voltage and power responses of the homogeneous prismatic and modelled non-prismatic beams (Case (A), Case (B) and Case (C)) are compared and presented in Figures **Error! Reference source not found.** and**Error! Reference source not found.**. FromFigures **Error! Reference source not found.** and**Error! Reference source not found.**, it has been noticed that more voltage and power can be obtained for homogeneous nonprismatic beams (Cases (A), (B) and (C)) compared to homogeneous prismatic beam for all taper ratios. It is also observed that more than 40% of output power can be obtained with increase in c_h thanc_b.



Variation of output power with external load resistance of homogeneous prismatic beam (c_b=0.0, c_h=0.0) and homogeneous nonprismatic beam for (a) c_b=0.1, c_h=0.1 (b) c_b=0.1, c_h=0.3 (c) c_b=0.3, c_h=0.1 and (d) c_b=0.3, c_h=0.3.

Conclusion

The two noded FE based axially FG (based on proposed power law) non-prismatic (such as linear, parabolic and cubic) piezolaminated cantilever beam has been analysed for output power under thermo-mechanical loading using Hamilton's principle. Further, the nonlinear finite element based analysis of axially FG non-prismatic piezolaminated beam has been performed using classical beam theory with Von-Karman's nonlinear strain-displacement relationships for output power. A real coded GA based constrained optimization scheme with simulated binary crossover and parameter based mutation has been developed for optimal design variables in order to maximize the output power. A complete computer code starting from FE based axially FG non-prismatic piezolaminated beams under thermo-mechanical loading for output power, nonlinear FE based axially FG nonprismatic piezolaminated beams under mechanical loading and optimal output power from the axially FG non-prismatic piezolaminated beams has been developed. The developed code has been validated before using it for analysis and design of proposed axially FG beams for output power. After validation of the developed code the detailed analysis has been carried out for all proposed cross section profiles.

Segmentation and Extraction of Brain Tumor Based On Soft- Computing

Approach Prof. J. Mehena, Associate Professor, ENTC

Abstract

In medical imaging, segmentation of tissues and structures plays a vital role in many image analysis applications developed for medical diagnosis. Image segmentation helps in diagnosis of brain diseases and helps in quantitative analysis of MRI images such as measuring accurate size and volume of extracted portion. Exact measurements in brain diagnosis are difficult because of

different shapes and sizes of tumor. Treatment plans and evaluation of disease progression of that disease affect specific tissues or structures, lead to loss and abnormalities. An accurate, reliable, automatic segmentation of these tissues and structures can improve diagnosis of brain diseases. Manual segmentation is bias and usually accurate but is impractical for large datasets. Automatic segmentation techniques can be useful for clinical applications, if they have ability to segment like an expert, excellent performance for diverse datasets, reasonable processing speed for large datasets because it is tedious and time consuming. In this research work an algorithm of image segmentation based on soft- computing approach will develop which will be effective for the segmentation and extraction of brain tumor.

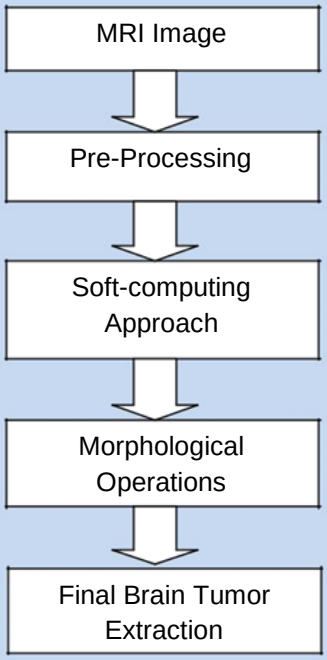
Introduction

Brain tumor is one of the major causes for increasing mortality among children and adults. A tumor is a neoplasm which is formed by an abnormal growth of cells. Brain tumors can be separated into two general categories depending on the tumors origin, their growth pattern and malignancy. Tumors that arise from cells in the brain or from the covering of the brain are called primary brain tumors. Tumors occur, when cancer cells spread to the brain from a primary cancer in another part of the body are called secondary brain tumors. It has been concluded from the research point of view that most of the developed countries the number of people suffering and dying from brain tumors has been increased to 300 per year during past few decades.The best type of imaging to diagnosis most types of brain tumors is MRI. This technique is basically used to detect the differences in the tissues which have a far better technique as compared to computed tomography. So MRI makes a very special one for the brain tumor extraction.

MRI is one of the best technologies currently being used for diagnosing brain tumor. MRI method has higher resolution which is approximately 100 microns. At present MRI is the method of choice for early detection of brain tumor in human brain (Dubey et al., 2009). MRI is an advanced medical imaging technique used to produce high quality images of the parts of brain and the nerve tissues in multiple planes without obstruction by overlying bones. From these high resolution images, one can derive detailed anatomical information to examine the development of human brain tumor and discover abnormalities. Brain tumor is diagnosed at the earliest stages with the help of the MRI image. Brain MRI is the most opted procedure mainly for the brain disorders. It provides clear images of the brainstem and posterior brain which are difficult to view on a CT scan. It is also useful in the diagnosis of demyelinating disorders. Further the evaluation of flow of blood and flow of cerebrospinal fluid is possible with this non-invasive procedure. MRI can distinguish tumors, inflammatory lesions and other pathologies from the normal brain anatomy. However, MRI scans are used to avoid the dangers of interventional procedures like angiograph and of repeated exposure to radiation as required for CT and other X-ray examinations.

Proposed Segmentation and Extraction Technique

The proposed technique for the extraction of brain tumor consists of the following processes as shown in Figure. Pre-processing, soft computing approach, morphological operations and resulting in the brain tumor designate confirmation.



Flow Chart of Segmentation and Extraction Technique

This research work proposed is an soft-computing technique for the extraction of brain tumor of MR images based on segmentation and morphological operator. Brain tumor extraction in magnetic resonance imaging has becoming an emergent research area in the field of medical imaging system. Extraction involves detection, localization, tracking, enhancement and recognition of the tumor from the MR brain images. Brain tumor extraction helps in finding the exact size and location of tumor.