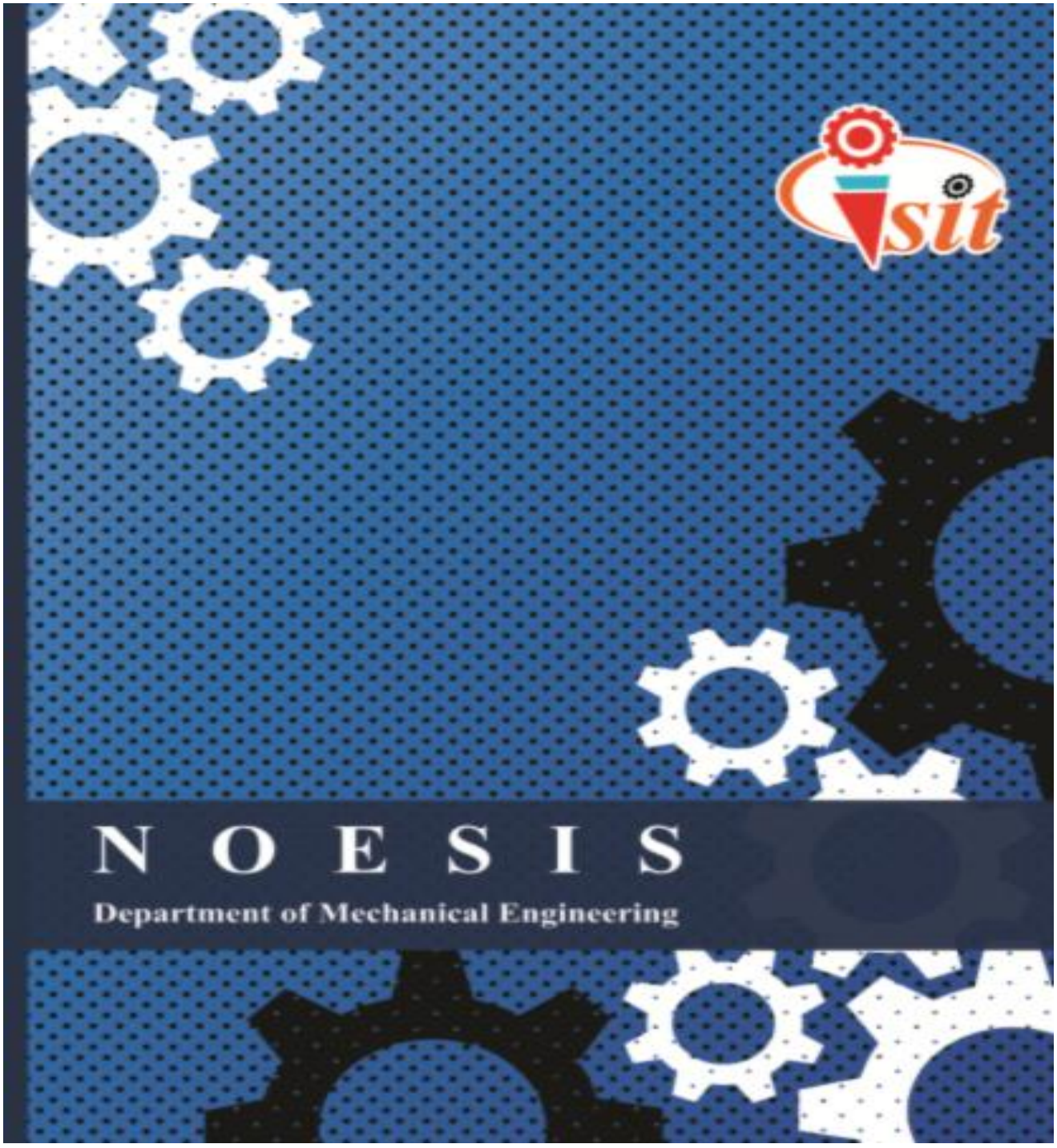
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NOESIS
Department of Mechanical Engineering

Director Message

I am glad to know that Mechanical Engineering Department of Sharad Institute of Technology is bringing out the first technical Magazine '**NOESIS**' for the year 2016 - 2017. Education should not be limited to books but it needs to be full of interaction, exposure and opportunities. In my opinion, co-curricular activities should be made an integral part of education for the overall development of the student. Sharad Institute of Technology has made all efforts towards the core areas of excellence in Technology with facilitating research efforts. I am sure that this technical magazine play important role to improve technical knowledge of students of mechanical engineering department.

Mr. Anil Bagane

Executive Director
SITCoE, Yadrav

Principal Message

I am extremely happy to know that mechanical engineering department publish first technical magazine '**NOESIS**'. I congratulate HoD, faculty and students of mechanical engineering department to publish technical magazine. Technical Education is the backbone of every nation and is the stepping stone for a country to move into the niche of a developed nation. I appreciate all of you for working together as a team. I would like to conclude with the words of A.P.J. Abdul Kalam who has rightly opined,

"Learning gives creativity
Creativity leads to thinking
Thinking provides knowledge
Knowledge makes you great."

I wish a very best of luck to the team of Technical Magazine.

Dr. S. A. Khot

Principal
SITCoE, Yadrav

HoD's Message-

I feel ecstatic to introduce you to this year's first issue of technical magazine prepared by Department of Mechanical Engineering. We at SITCoE promise of increasing the knowledge, enhancing the critical thinking, ability to change information into knowledge and power of analysing the things technically of each and every individual of ever changing society through students.

As a H.O.D., I wish to take the opportunity to assure you that our magazine '**NOESIS**' will try our best to fulfil this promise. This magazine will reflect the intellectual as well as creative ideas of the students. I am sure that it will be a good medium for the faculty and the students to disseminate useful information and update themselves. I strongly believe that it would be an excellent medium through which the world can learn about the potential and achievements of SITians. I join others in appreciating and recognizing the hard work of the editors and the magazine committee in bringing out the magazine and in wishing them success in their Endeavour.

Prof. V. S. Hajare

Head of Mechanical Dept.
SITCoE, Yadrav

Editor's Message

Greetings from the editorial board to the readers of this Magazine '**NOESIS**'. A thought that had been enduring in mind, it becomes real. It is truly an interesting and exciting experience. This Magazine was one such cherished work that had its roots in the persuasion. It would be a snapshot of the various technologies associated with mechanical Engineering. It will serve to reinforce and allow increased awareness, improved interaction and integration among all of us. We would like to place on record our gratitude and heartfelt thanks to all those who have contributed to make this effort in a successful one.

We profusely thank our Honourable Executive Director Mr. Anil Bagane, Principal Dr. S. A. Khot and head of mechanical engineering department Prof. V. S. Hajare for giving support and encouragement and a free hand in this endeavour. This Technical Magazine will be a medium to provide proper acknowledgement and respect all of these efforts and its results.

Mr. A. S. N. Husainy

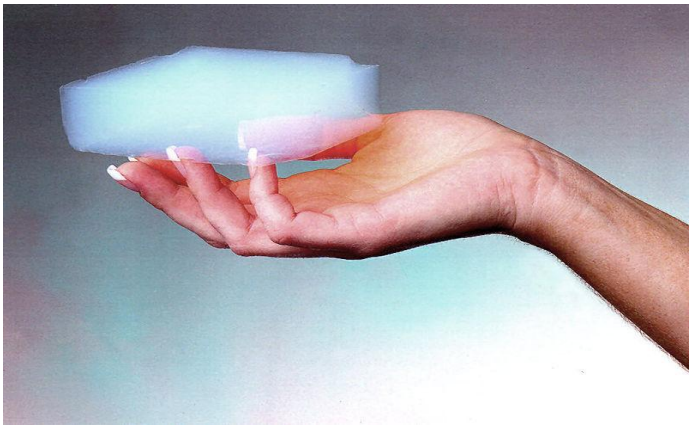
Mechanical Engineering Dept.

Content

Aerogel Technology

Mr.Abhijit Pawar (SE B),Mr.Ashutosh Patil (SE B)

Aerogelis a synthetic porous ultralight material derived from a gel, in which the liquid component of the gel has been replaced with a gas. The result is a solid with extremely low density and low thermal conductivity. Nicknames include frozen smoke, solid smoke, solid air, or blue smoke owing to its translucent nature and the way lightscatters in the material. Aerogel was first created by Samuel Stephens Kistler in 1931, as a result of a bet with Charles Learned over who could replace the liquid in "jellies" with gas without causing shrinkage.



Aerogels are produced by extracting the liquid component of a gel through supercritical drying. This allows the liquid to be slowly dried off without causing the solid matrix in the gel to collapse from capillary action, as would happen with conventional evaporation. The first aerogels were produced from silica gels.

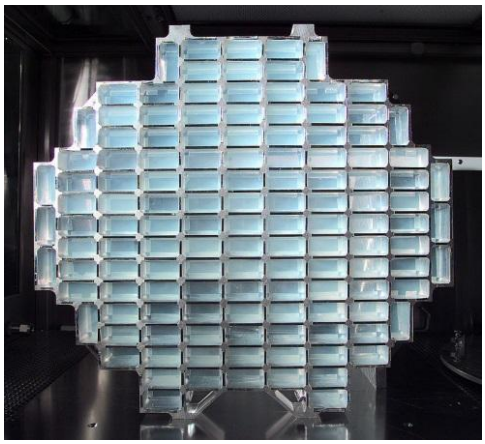
Properties of Aerogel:-

- Aerogel is a material that is 98.2% air. Aerogel has a porous solid network that contains air pockets, with the air pockets taking up the majority of space within the material. The lack of solid material allows aerogel to be almost weightless.
- Aerogels are good thermal insulators because they almost nullify two of the three methods of heat transfer (convection, conduction, and radiation).

- ❖ Aerogels by themselves are hydrophilic, but chemical treatment can make them hydrophobic

Applications:

- ➢ NASA used an aerogel to trap space dust particles aboard the Stardust spacecraft. NASA also use aerogel for thermal insulation of the Mars Rover and space suits
- ➢ The US Navy is evaluating aerogel undergarments as passive thermal protection for divers
- ➢ Dunlop Sport uses aerogel in some of its racquets for tennis, squash and badminton.
- ➢ In water purification, chalcogels have shown promise in absorbing the heavy metal pollutants mercury, lead, and cadmium from water
- ➢ CamelBak uses aerogel as insulation in a thermal sport bottle



The Stardust dust collector with Aerogel blocks. (NASA)

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A Brief Study of Helicopter flight controls

Mr. RohanMagdum (SE A), Mr. PramodKoshti (SE A)

A helicopterpilot manipulates the helicopter flight controls in order to achieve controlled aerodynamic flight. The changes made to the flight controls are transmitted mechanically to the rotor, producing aerodynamic effects on the helicopter's rotor blades which allow the helicopter to be controlled. For tilting forward and back (pitch), or tilting sideways (roll), the angle of attack of the main rotor blades is altered cyclically during rotation, creating differing amounts of lift at different points in the cycle. For increasing or decreasing overall lift, the angle of attack for all blades is collectively altered by equal amounts at the same time resulting in ascents, descents, acceleration and deceleration.

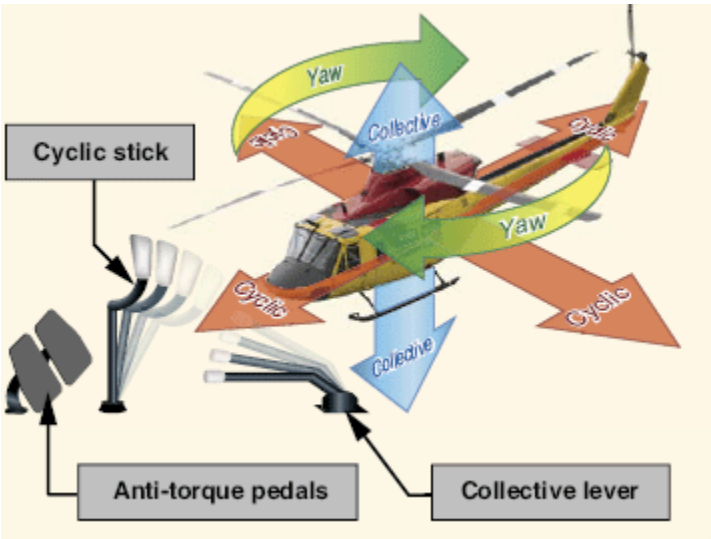
A typical helicopter has three separate flight control inputs. These are the cyclic stick, the collective lever, and the anti-torque pedals. Depending on the complexity of the helicopter, the cyclic and collective may be linked together by a mixing unit, a mechanical or hydraulic device that combines the inputs from both and then sends along the "mixed" input to the control surfaces to achieve the desired result. The manual throttle may also be considered a flight control because it is needed to maintain rotor speed on smaller helicopters without governors. The

governors also help the pilot control the collective pitch on the helicopters main rotors, to keep a stable, more accurate flight.

Controls

Cyclic

The cyclic control is usually located between the pilot's legs and is commonly called the cyclic stick or just cyclic. On most helicopters, the cyclic is similar in appearance to a joystick in a conventional aircraft. But on the Robinson R22, the cyclic is a central pillar that either pilot can manipulate. The control is called the cyclic because it changes the pitch angle of the rotor blades cyclically. That is, the pitch or feathering angle of the rotor blades changes depending upon their position as they rotate around the hub so that all blades will have the same incidence at the same point in the cycle. The change in cyclic pitch has the effect of changing the angle of attack and thus the lift generated by a single blade as it moves around the rotor disk. This in turn causes the blades to fly up or down in sequence, depending on the changes in lift affecting each individual blade.



Collective

The collective pitch control, or collective lever, is normally located on the left side of the pilot's seat with an adjustable friction control to prevent inadvertent movement. The collective changes

the pitch angle of all the main rotor blades collectively (i.e., all at the same time) and independent of their position. Therefore, if a collective input is made, all the blades change equally, and the result is the helicopter increases or decreases its total lift derived from the rotor. In level flight this would cause a climb or descent, while with the helicopter pitched forward an increase in total lift would produce an acceleration together with a given amount of ascent.

The collective pitch control in a Boeing CH-47 Chinook is called a "Thrust Control", but it serves the exact same purpose, except that it controls two rotor systems and applies differential collective pitch into the two rotor systems.[3]

Anti-torque pedals

The anti-torque pedals are located in the same position as the rudder pedals in an airplane, and serve a similar purpose, namely to control the direction in which the nose of the aircraft is pointed. Application of the pedal in a given direction changes the pitch of the tail rotor blades, increasing or reducing the thrust produced by the tail rotor and causing the nose to yaw in the direction of the applied pedal. The pedals mechanically change the pitch of the tail rotor altering the amount of thrust produced.

Throttle

Helicopter rotors are designed to operate at a specific rotational speed. The throttle controls the power produced by the engine, which is connected to the rotor by a transmission. The purpose of the throttle is to maintain enough engine power to keep the rotor speed within allowable limits in order to keep the rotor producing enough lift for flight. In many helicopters, the throttle control is a single or dual motorcycle-style twist grip mounted on the collective control (rotation is opposite of a motorcycle throttle), while some multi-engine helicopters have power levers.

Helicopter controls and effects

Name	Directly controls	Primary effect	Secondary effect	Used in forward flight	Used in hover flight
Cyclic (lateral)	Varies main rotor blade pitch with left and right movement	Tilts main rotor disk left and right through the swashplate	Induces roll in direction moved	To create movement to sides	To move sideways
Cyclic (longitudinal)	Varies main rotor blade pitch with fore and aft movement	Tilts main rotor disk forward and back via the swashplate	Induces pitch nose down or up	To adjust forward speed and control rolled-turn	To move forwards/backwards
Collective	Collective angle of attack for the rotor main blades via the swashplate	Increase/decrease pitch angle of all main rotor blades equally, causing the aircraft to ascend/descend	Increase/decrease torque. Note: in some helicopters the throttle control(s) is a part of the collective stick. Rotor speed is kept basically constant throughout the flight.	To adjust power through rotor blade pitch setting	To adjust skid height/vertical speed
Anti-torque pedals	Collective pitch supplied to tail rotor blades	Yaw rate	Increase/decrease torque and engine speed (less than collective)	To adjust sideslip angle	To control yaw rate/heading

Flight conditions

There are three basic flight conditions for a helicopter: hover, forward flight and autorotation.

Hover

Hovering is considered by some pilots to be the most challenging aspect of helicopter flight to learn.[4] This is because helicopters are generally dynamically unstable, meaning that deviations from a given attitude are not corrected without pilot input. Thus, frequent control inputs and corrections must be made by the pilot to keep the helicopter at a desired location and altitude. The pilot's use of control inputs in a hover is as follows: the cyclic is used to eliminate drift in the horizontal plane, (e.g. forward, aft, and side to side motion); the collective is used to maintain desired altitude; and the tail rotor (or anti-torque system) pedals are used to control nose direction or heading. It is the interaction of these controls that can make learning to hover difficult, since often an adjustment in any one control requires the adjustment of the other two, necessitating pilot familiarity with the coupling of control inputs needed to produce smooth flight.

Forward flight

In forward flight a helicopter's flight controls behave more like those in a fixed-wing aircraft. Displacing the cyclic forward will cause the nose to pitch down, with a resultant increase in airspeed and loss of altitude. Aft cyclic will cause the nose to pitch up, slowing the helicopter and causing it to climb. Increasing collective (power) while maintaining a constant airspeed will induce a climb while decreasing collective will cause a descent. Coordinating these two inputs, down collective plus aft cyclic or up collective plus forward cyclic, will result in airspeed changes while maintaining a constant altitude. The pedals serve the same function in both a helicopter and an airplane, to maintain balanced flight. This is done by applying a pedal input in whichever direction is necessary to center the ball in the turn and bank indicator.

Differential pitch control

For helicopters with contra-rotating rotors - also known as "Coaxial mounted" one over the other on the same rotor shaft (Like a Kamov KA-50), helicopter control requires interaction between the two rotors. However, a helicopter with tandem rotors - counter rotating rotors on different rotor masts (Like a Boeing CH-47 Chinook) uses differential collective pitch to change the pitch attitude of the aircraft. To pitch nose down and accelerate forward, the collective pitch on the front rotor is decreased and the collective pitch on the rear rotor is increased proportionally. Conversely, the synchropter and transverse-mounted rotor - a counter rotating rotorcraft have two large horizontal rotor assemblies mounted side by side, (like a Bell/Boeing V-22 tilt rotor) helicopters use differential collective pitch to affect the roll of the aircraft. All of these configurations use differential cyclic pitch to control movement about the yaw axis, tilting the rotors in opposite directions to cause the aircraft to spin in the direction of the tilted rotors.

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Hand Free Driving

Miss. HasureSailaja A (SE A), Miss. Jadhav Bharati (SE A)

All of us would like to drive our car with a mobile held in one hand, talking to the other person. But we should be careful, we don't know when the car just before us applies the break and everything is gone. A serious problem encountered in most of the cities, National Highways, where any mistake means no 'turning back'! There comes the tomorrow's technology,'Hand free driven car', initializing the modern technological approach in Robotics.

What is the need for safety precaution?

All around the world almost 45% of the accidents occur by mistakes of the driver. Most of these accidents are fatal. The victims of such accidents are either severly injured, some even risk their life by their careless driving. This was the main reason behind this project work put forward by the Delphi-Delco electronic systems and General Motors Corporation. It was called the Automotive Collision Avoidance Systems (ACAS) field operation program.

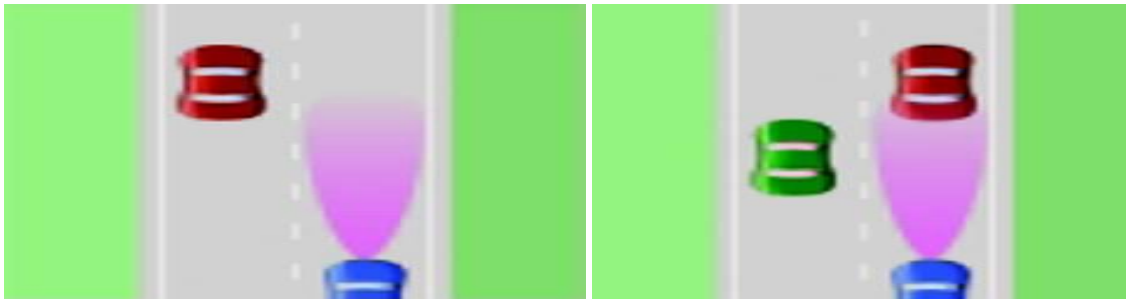
ACAS

It was aimed at integration of the latest technology Forward Collision Warning (FCW) and Adaptive Cruise Control (ACC). The project has two phases. The Phase I started by June 1999, it lasted for about 27 months and II phase started immediately just after the Phase I and expected to be complete by 32 months. The phase I include development and integration of ACC and FCW

systems on the automotive. The phase II includes the deployment fleet on ten cars and field operation test.

FCW

Forward Collision Warning (FCW) System was one of the achievements of the Delphi-Delco Electronic Systems, which was successfully implemented in the (a) 1994 Toyota Lexus LS400 (b) 1994 GM Cadillac Seville, and (c) 1998 Opel Vectra. These vehicles have been modified to provide the basic functionality of fully integrated ACC and FCW systems. Forewarn Smart Cruise Control with Headway Alert uses a mechanically scanning, 76 GHz, long-range radar sensor to detect objects in the vehicle's path up to 150 meters or 402 feet ahead. The system helps to reduce the need for drivers to manually adjust speed or disengage cruise control when encountering slower traffic.



ACC

Adaptive Cruise Control (ACC) and Forward Collision Warning (FCW) systems require an ability to resolve and identify robustly the existence of both stationary and moving 'target' vehicles that are in the motion path of the Host vehicle. The performance of these systems is affected by their ability (a) to estimate the relative inter-vehicular path motion (i.e.: range, relative speed, radius of curvature, etc.) between the host vehicle, the roadway ahead of the host, and all of the appropriate targets (i.e.: roadside objects, and in-lane, adjacent lane, and crossing vehicles, etc.); and (b) to predict the mutual intersection of these motion paths. In addition, these systems must be robust in the presence of various types of driving behavior (e.g.: in-lane weaving/drift, lane change maneuvers, etc.) and roadway conditions (e.g. straight roads, curved

roads, curve entry/exit transitions, intersections, etc.) that are encountered in the 'real-world' environment.

The target selection approach pursued used a single active forward looking radar sensor augmented with a yaw rate sensor. The forward-looking radar sensor provided target range, range rate, and angular position information. The yaw rate sensor was used to estimate the roadway curvature ahead of the Host vehicle. Delphi's first generation target discrimination algorithms were used to identify overhead bridge objects and to discriminate between moving cars and trucks. The Target / Host kinematics were evaluated to determine target motion status (i.e.: oncoming, stopped, moving, cut-in and cut-out, etc.), and geometric relationships were employed to determine which of the valid roadway objects fell within the Host's forward projected path. The improved algorithms yielded very good results, but they were prone to false alarms during curve entry/exit scenarios and during host lane changes.

VISION BASED SENSOR

The overall goal of the Forward Vision Sensor is to facilitate the development of a robust, real-time forward looking lane tracking system to enhance the overall forward Path Estimation and Target Selection algorithms. The system consists of two components. A video camera, mounted behind the windshield of the vehicle, will acquire images of the roadway ahead of the host. A remotely located image processing unit will then detect and track the position of the lane boundaries in the images, and will provide a model of the changing road geometry. In addition to road shape, the lane tracking system will provide estimates of lane width and of the host's heading and lateral position in the lane. In the Data Fusion Module this information will be fused with road and host data from other sources, such as Scene Tracking and GPS Map, to provide more accurate estimates of road and host state to the Target Selection Module

Although many different vision-based lane detection and tracking systems have been developed worldwide, their primary focus has been on applications such as lane departure warning and lane keeping, where the required range of operation is usually less than 25 meters. Host heading and lateral lane position derived from such systems can be used to reduce the effects of driver hunting and host lane changes on the task of in-path target selection, but the more serious

problems associated with curve entry/exit scenarios remain. To address these, an accurate prediction of the roadway geometry up to 100 meters ahead of the host is desired. The goal of this task was to develop a vision-based lane tracking system that will provide these long-range road curvature estimates as well as complement the Scene Tracking and GPS approaches under development in Tracking and Identification Task.

To develop the robust vision system required for this program, and to take advantage of existing automotive vision technology, three short-range real-time lane tracking systems were identified as potential starting points for this task. Selection of these systems was based on their developer's demonstrated competency in the development, integration, and road testing of these systems, and on their willingness to extend their system to meet the goals of this program. Teams from the University of Pennsylvania (U-Penn), Ohio State University (OSU), and the University of Michigan – Dearborn (UM-D) were each contracted by DDE1 to further the development of their respective systems.

The NHSTA states certain requirements for the system which analyze the road. The requirements state that the system should provide host and road state estimates to within these specified one-sigma accuracy requirements:

1. Lateral position in lane: < 0.2 meters

2. Lane width: < 0.2 meters

3. Heading: < 0.2°

4. Road Geometry: < 0.75 meters at 75 meter range2

The Forward Vision Sensor should produce confidence estimates (which may be a function of range) for the road-geometry and host vehicle state. The system should also report the number of lane markers (i.e. left, right or none) that it has acquired as well as some indication of when a lane change event has occurred. The minimum update rate is 10 Hz with an initial maximum acquisition time of 5 seconds. The system should work on the freeways, freeway transitions, expressways and parkways where the minimum horizontal radius of curvature is 300 meters, and

when the host speed is between 25 and 75 mph. The system will operate in clement weather, in both day and night conditions, and under natural and artificial lighting.

The road surface should be paved, clear, and free from glare, and the road markings should have good contrast. The lane markings can be of single or double lines that are either solid or dashed. A Vision EDV was configured as a test bed for the development and evaluation of the lane tracking systems. GM supplied a 1996 Buick which was outfitted by DDE with a CCD-camera, CAN bus, speed and yaw rate sensors, a vehicle interface processor to format and transmit the vehicle data on the CAN bus, and the video encoder system described above.

This vehicle was provided for the shared use of all vision teams, and has been driven by each to collect the video scenarios that are currently being used for system refinement and validation. During the down-select process, each of the vision systems can be integrated into the vehicle, and data collected from each simultaneously. It requires a 233MHz Pentium MMX processor to process these data collected from the sensors.

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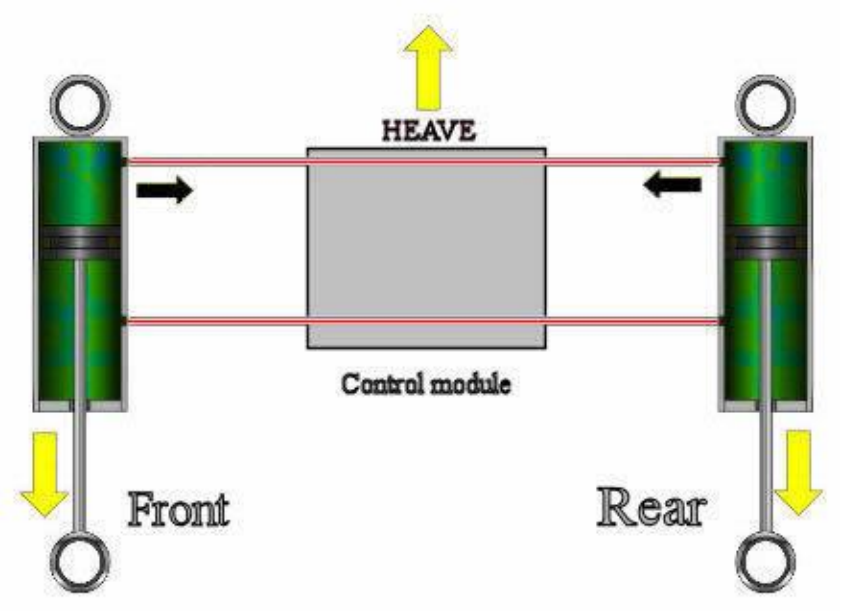
Interconnected Suspension System

Mr. Prasad Hatgine (TE A), Mr. AshpakMujawar (TE A)

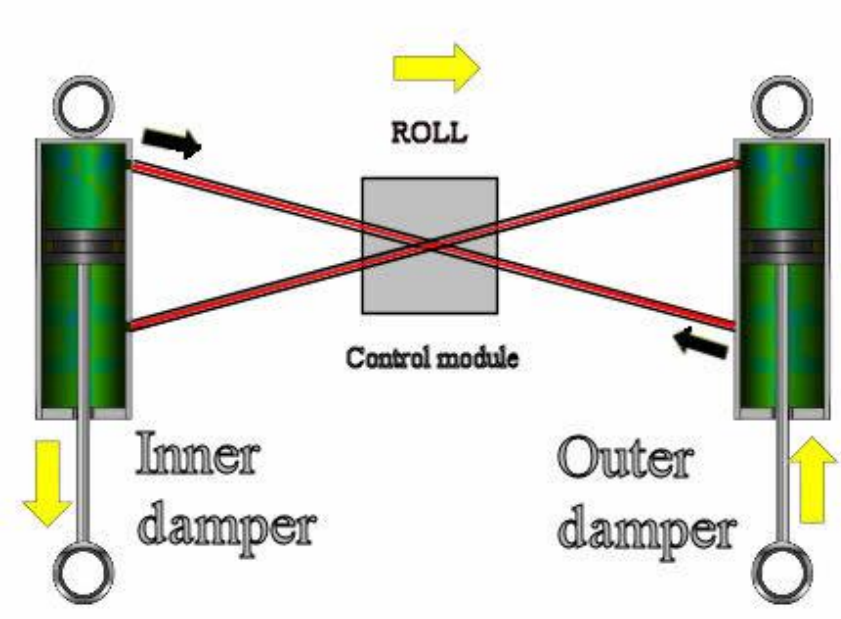
The FRIC or “Front and Rear Inter-Connected” suspension is a system which links the front and rear suspension of the car using hydraulics and aims to give better stability and drivability for the driver, so called stabile an consistent aerodynamic platform. The basic principle behind FRIC suspension is to essentially keep the all four corners of the car at a constant ride height under braking, acceleration and during cornering. The only difference between today’s FRIC system and Williams FW14 and FW14B in the early 1990’s electronically controlled active suspension is that the FRIC system is totally passive and it is not controlled by any electronics. Mercedes idea is inertia based, and doesn't use electrics or mechanical input from the driver to work. The advantages of running such systems is helping with mechanical grip and aiding in a consistent and stabile aerodynamic platform.

In concept and layout the FRIC system is simple. At each end of the car there are three hydraulic elements: a pair of elements attached to each pull/pushrodrocker control roll and a centre element linked to both rockers' control pitch. The heave elements, shown in red, link front-to-rear to control dive under braking.The roll elements, shown in green, link side-to-side for antiroll. Each of these elements is linked left to right and front to rear. In the FRIC, the fluid is displaced not from one chamber to another, but via pipes through a valve block and into the opposite hydraulic unit. How the upper and lower chambers are interconnected left to right make the system react differently to inputs from the suspension. These being a resistance to roll or heave.

1) When the car brakes (in heave), weight shifts forwards and the front suspension compresses and the rear rises. The pressure builds up in one side of the centre element on the front suspension, and this pressure in the hydraulic fluid is transferred to the rear centre element. This increases the spring effect at the front and reduces it at the rear, which means the car will not dive nose down under braking.



2) When the car rolls in a corner, the outer hydraulic elements will compress and the inner elements will rise. With the same effect as when the centre element is in pitch, the hydraulic fluid is transferred from one side to the other to increase the spring effect preventing the car rolling. The upper chamber on one side and the lower chamber on the other side create high pressure. As these chambers are cross connected to the high pressure chambers on their opposite side. This creates resistance between the two systems wanting to displace their fluid. This has the effect of increasing in the cars roll stiffness.



❖ **Advantages of ICS:-**

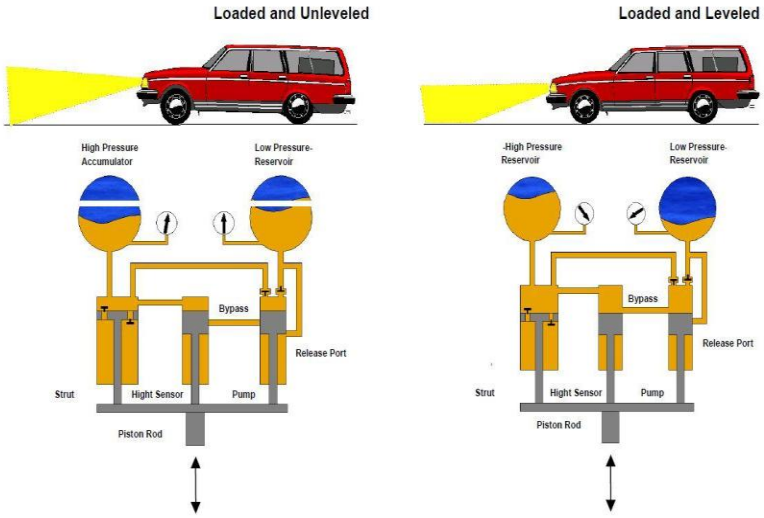
Benefit of the FRIC is that the teams can run the cars very low and with very high down force levels. Also, as the pitch and roll movements of the car are minimized, the tires have to face lesser load and thus, the system also aids in tire management process. With the FRIC suspension, the cars can be run with a stiffer suspension while not compromising the overall driving comfort for the driver. So, in a way, it indirectly aids the overall aerodynamics of the car and gives a driver more comfort and drivability.

Self Leveling Suspension

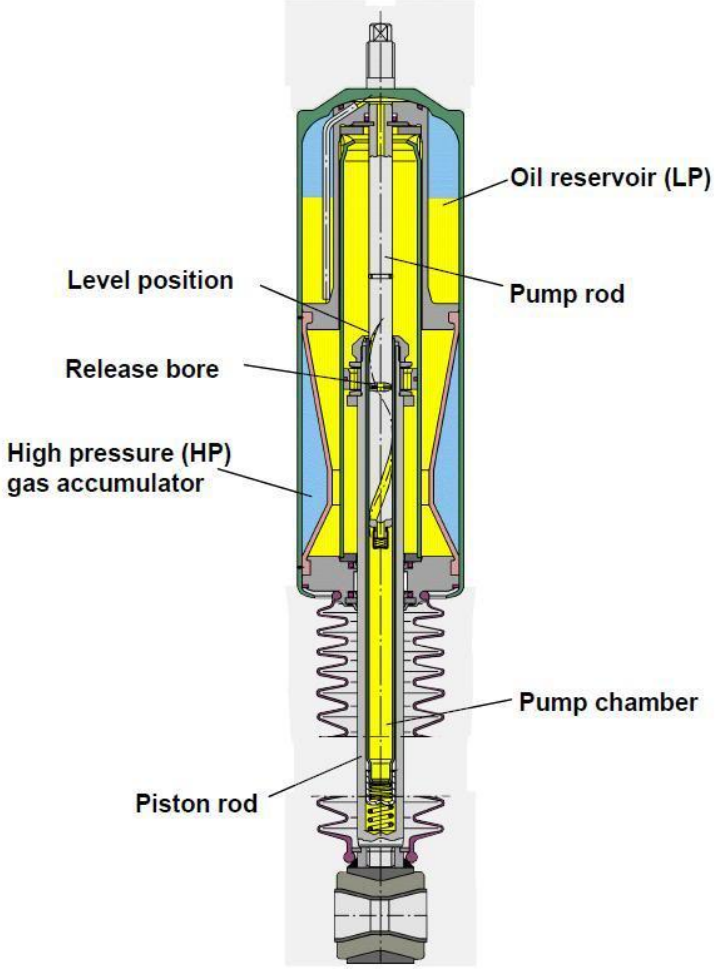
The Self-Leveling-System (SLS) adjusts the ride height of the rear end when it is loaded to keep the rear end at the proper riding level. The springs and the SLS maintain the unloaded height. The SLS maintains height when loaded by pressurizing the system which lifts the rear. The springs, struts, and accumulators work together to dampen road bumps.

Construction: - The system is made up of several parts; there is a diagram at the end of this post that shows all the parts. Here are the main components and what they do.

1. **Pump** - supplies pressure to lift the rear.
2. . **Fluid Reservoir** - for maintaining fluid level.
3. **Leveling Valve** - the brains of the operation, it tells the system whether to lift or lower the rear end.
4. **Accumulators** (pressure reservoir) - Helps dampen the changes in pressure due to bumps on the road.
5. **Struts** - Works much like a normal shock for dampening bumps but is able to be adjusted by pressure from the system to change the ride height.



NIVOMAT - Main elements



Working: - The pump is always creating pressure and pushing fluid through the system. The leveling valve maintains the level of the rear end. It does this by maintaining pressure or diverting it to raise or lower the rear. When the car is unloaded and sitting at the proper ride height the leveling valve is in the Neutral position. In the neutral position the struts and accumulators are still pressurized which maintain the unloaded height along with the springs. The valve maintains the neutral position pressure in the struts and the accumulators by not allow the pressure to bleed off and also directs the pressure that the pump creating to back to the reservoir. When a load is put into the back, the lever arm on the valve is deflected into the Fill position which diverts the pressure and fluid flow to the struts and accumulators. This pressure expands the struts which lift the rear until the lever arm is in the neutral position again, a check valve in the leveling valve keeps the increased pressure from bleeding off until the arm is deflect into the Return Flow position. When the load is removed, the arm on the leveling valve is moved to the Return Flow position which allows the increased pressure in the system to drain off, until the valve returns to the Neutral position and the rear of the car to its normal unloaded ride height.

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Thermo-acoustic Refrigeration

Mr. Vaibhav Patil (TE A), Mr. ManojUndure (TE A)

Introduction:

For creating comfortable home environments to manufacturing fast and efficient electronic devices, air conditioning and refrigeration remain expensive, yet essential, services for both homes and industries. However, in an age of impending energy and environmental crises, current cooling technologies continue to generate greenhouse gases with high energy costs. Thermoacoustic refrigeration is an innovative alternative for cooling that is both clean and inexpensive. Through the construction of a functional model, we will demonstrate the effectiveness of thermoacoustics for modern cooling.

Refrigeration relies on two major thermodynamic principles. First, a fluid's temperature rises when compressed and falls when expanded. Second, when two substances are placed in direct contact, heat will flow from the hotter substance to the cooler one. While conventional refrigerators use pumps to transfer heat on a macroscopic scale, thermoacoustic refrigerators rely on sound to generate waves of pressure that alternately compress and relax the gas particles within the tube. The model constructed for this research project employed inexpensive, household materials. Although the model did not achieve the original goal of refrigeration, the experiment suggests that thermoacoustic refrigerators could one day be viable replacements for conventional refrigerators.

Sound Waves and Pressure:

Thermoacoustics combines the branches of acoustics and thermodynamics together to move heat by using sound. Thermoacoustics is based on the principle that sound waves are pressure waves. These sound waves propagate through the air via molecular collisions. The molecular collisions cause a disturbance in the air, which in turn creates constructive and destructive interference. The constructive interference makes the molecules compress, and the destructive interference makes the molecules expand. This principle is the basis behind the thermoacoustic refrigerator. One method to control these pressure disturbances is with standing waves. Standing waves are natural phenomena exhibited by any wave; such as light, sound, or water waves. In a closed tube, columns of air demonstrate these patterns as sound waves reflect back on themselves after colliding with the end of the tube. When the incident and reflected waves overlap, they interfere

constructively, producing a single waveform. This wave appears to cause the medium to vibrate in isolated sections as the traveling waves are masked by the interference. Therefore, these "standing waves" seem to vibrate inconstant position and orientation around stationary nodes. These nodes are located where the two component sound waves interfere to create areas of zero net displacement. Due to these node and antinodes properties, standing waves are useful because only a small input of power is needed to create a large amplitude wave. This large amplitude wave then has enough energy to cause visible thermoacoustic effects. All sound waves oscillate a specific amount of times per second, called the wave's frequency, and are measured in Hertz. For our thermoacoustic refrigerator we had to calculate the optimal resonant frequency in order to get the maximum heat transfer rate.

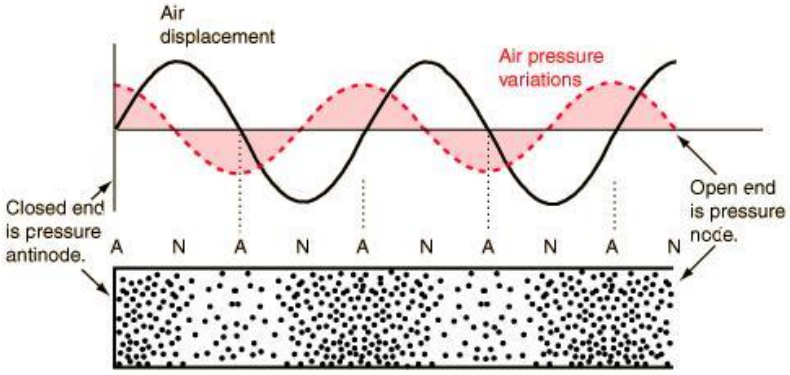
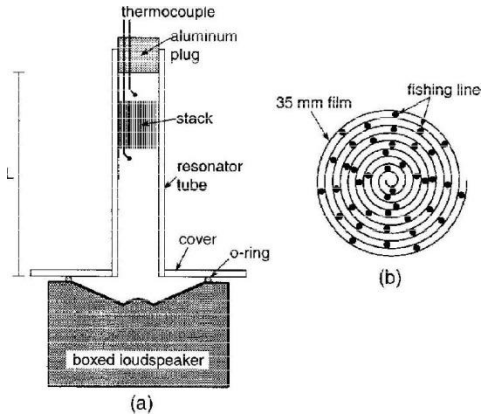


Figure 1: showsthe relationship between the phase of the wave, the pressure

Construction of Thermoacoustic Refrigerator:



(a) Schematic diagram of the demonstration thermoacoustic refrigerator; (b) cross section of thestack showing how the film layers were separated by fishing line.

An inexpensive tabletop thermoacoustic refrigerator for demonstration purposes was built from a

boxed loudspeaker, acrylic tubing and sheet, a roll of 35 mm film, fishing line, an aluminum plug, and two homemade thermocouples. Temperature differences of more than 15 °C were achieved after running the cooler for several minutes. While nowhere near the efficiency of devices described in the literature, this demonstration model effectively illustrates the behavior of a thermoacoustic refrigerator. The thermoacoustic refrigerator demonstration described in this note is of the standing wave variety, and consists of a quarter-wavelength resonator (an open-closed tube) driven by a loudspeaker. While this is the easiest resonator shape to build, it is the least efficient of the standing-wave type refrigerators. Since the primary purpose of this apparatus is to demonstrate the action of an acoustic refrigerator; efficiency was not a primary concern. The resonator for this refrigerator was a 23 cm length of acrylic tubing with an inner diameter of 2.2 cm. The length defines the resonance frequency ofthe system, which was 385 Hz for our apparatus. A hole was cut in the center of an acrylic cover sheet and the tube was glued to the cover sheet, which was then placed over the speaker. The speaker was a4-inch boxed speaker capable of handling 40 W, and a 4-inch diameter o-ring was used to provide a seal around the edge of the speaker. An aluminum plug was milled to fit snugly into the end of the tube, forming the closed end. The most important part of an acoustic refrigerator is the stack, which consists of a large number of closely spaced surfaces aligned parallel to the length of the resonator tube. The stack for this apparatus was constructed, by winding a roll of 35-mm photographic film around a central spindle so that adjacent layers of the spirally wound film provide the stack surfaces. Lengths of 15-lb nylon fishing line separated adjacent layers of the spirally wound film stack so that air could move between the layers along the length of the stack parallel to the length of the resonator tube.

Possible Modifications:

One of the major problems that we had was the heat build up at the top of the tube. Most of the possible modifications we thought of involved of dissipating the heat from the top of the tube. In the original design the aluminum plug was responsible for conducting heat

from of the top end of the tube into the surrounding air. However, the aluminum proved to be unable to dissipate enough heat, because as we ran the experiment the temperature of the bottom section soon reached room temperature. This is because heat will only be transferred from the cold region of the bottom end to the hot region of the top when the temperature gradient created by the sound waves is greater than the temperature difference between these two regions. When

too much heat is in the system the bottom temperature stays at the surrounding temperature, while the area on the top of the tube becomes very hot. One possible way to dissipate more heat is to increase the surface area of the cap by cutting grooves into each end of the aluminum plug. The increased surface area gives air particles a larger area to collide into the aluminum plug and transfer heat, allowing for there to be more collisions at a single time, thus increasing the rate of heat conduction of the aluminum plug from the top end of the tube into the surrounding air.

Applications:

Thermal management has always been a concern for computer systems and other electronics. Computational speeds will always be limited by the amount of noise produced by computer chips. Since most noise is generated by waster heat, computer components and other semiconductor devices operate faster and more efficiently at lower temperatures. If thermoacoustic cooling devices could be scaled for computer applications, the electronic industry would realize longer lifetimes for microchips, increased speed and capacity for telecommunications, as well as reduced energy costs. Also in ice-cream company's experiment has successfully done.

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Introduction of Micro Air Vehicles

Mr. RohitKarale (BE C), Mr. Mahesh Gurav (BE C)

1. INTRODUCTION

There has been recent interest in unmanned air vehicles with a largest linear dimension no greater than 6 inch Micro air vehicles (MAVs) are intended to operate in close proximity to a point of interest without being detected and should provide surveillance teams with critical information in a rapid-deployment urban-environment mission scenario. Micro Air Vehicle is a small flight vehicle that uses lift-generating mechanism different from the mechanism used for larger aircraft. These machines are used to perform a variety of mission including reconnaissance, surveillance, targeting, tagging etc in hazardous locations and for bio-chemical sensing in defence sector. The design features and the configurations of MAVs are different from that of normal aircrafts. The speed of MAV is very low and the size is less than 38.10 cm length, width or height. MAVs are not the small versions of ordinary aircrafts but are affordable fully functional, military capable, small flight vehicles in a class of their own.

Figure 1.1: A Micro Air Vehicle (MAV) flies over a simulated Combat area during an operational test flight.

The mechanism used for the flapping wing is a six-link mechanism, which is designed from nature i.e. from the motion of the wings of a type of insect called Encarisa Formosa. The advantage of this special mechanism is that, it is having more lift compared to a fixed wing mechanism. Also it can increase the lift without increasing the vehicle speed. Since the proposed mechanism helps for lift generation and not for the full 3-d movement this model have not been used for more functions. The future work will be for designing for the forward motion and also for reducing the weight by using light materials.

1.1 COMPARISON WITH OTHER AIR VEHICLE

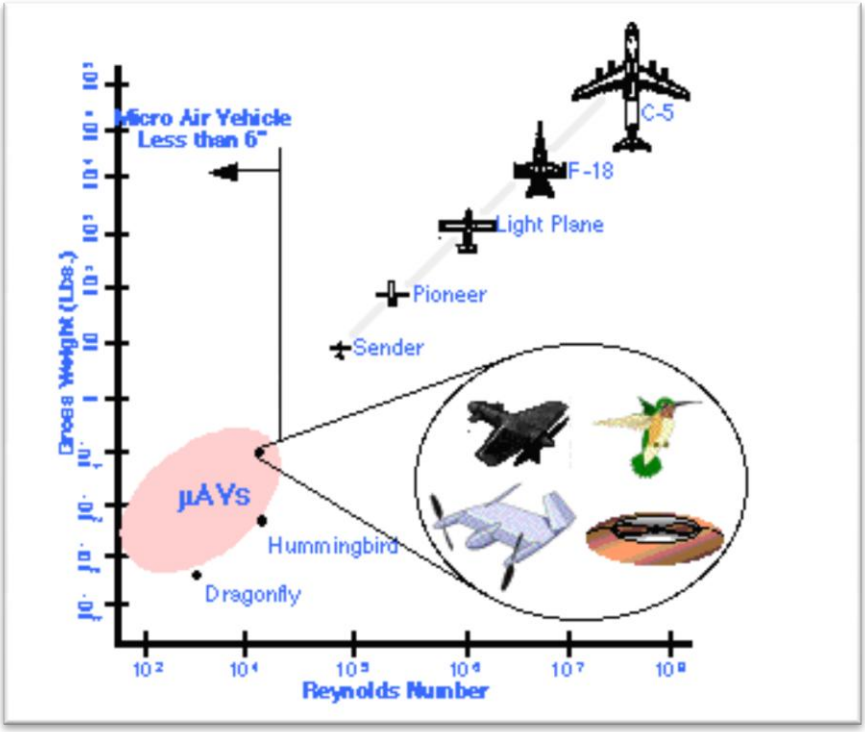

Figure 1.2: The micro Air Vehicle Flight Regime Compared to Existing Flight Vehicles

The low Reynolds number regime is significant in that it projects a fundamental shift in physical behaviour at MAV scales and speeds - an environment more common to the smallest birds and the largest insects. While naturalists have seriously studied bird and insect flight for more than half a century, our basic understanding of the aerodynamics encountered here is very limited. Neither the range - payload performance of bees and wasps nor the agility of the dragonfly is predictable with more familiar high Reynolds number aerodynamics traditionally

used in UAV design. And if our understanding of low Reynolds number effects is limited, our ability to mechanize flight under these conditions has been even more elusive. With the small size of the MAV come high surface-to-volume ratios and severely constrained weight and volume limitations. The technology challenge to develop and integrate all the physical elements and components necessary to sustain this new dimension in flight will require an unprecedented level of multi functionality among the system components. The traditional "stuffing the shell" paradigm of conventional aircraft design is not likely to be workable for MAVs. Yet to be developed, Micro Air Vehicles will be roughly one-tenth the scale of the Sender, and the weight of a six-inch, fixed-wing MAV may be only 50 grams or so, just one one-hundredth the weight of the Sender. The above figure illustrates the difference in size. Yet MAVs must be capable of staying aloft for perhaps 20 to 60 minutes while carrying a payload of 20 grams or less to a distance of perhaps 10 km. finding high density sources of propulsion and power is a pivotal challenge. And while the Sender is a conventional, moderate aspect-ratio, fixed wing aircraft, MAVs may require more unusual configurations and approaches ranging from low aspect-ratio fixed wings to rotary wings, or even more radical notions like flapping wings.

1.2 COMPARISON BETWEEN FIXED WING, ROTARY-WING AND FLAPPING-WING DESIGNS

Micro air vehicles are either fixed-wing aircraft, rotary-wing aircraft (helicopter), or flapping-wing (of which the ornithopter is a subset) designs; with each being used for different purposes. Fixed-wing craft require higher, forward flight speeds to stay airborne, and are therefore able to cover longer distances; however they are unable to effectively manoeuvre inside structures such as buildings. Rotary-wing designs allow the craft to hover and move in any direction, at the cost of requiring closer proximity for launch and recovery. Flapping-wing-powered flight has yet to reach the same level of maturity as fixed-wing and rotary-wing designs. However, flapping-wing designs, if fully realized, would boast a manoeuvrability that is superior to both fixed- and rotary-wing designs due to the extremely high wing loadings achieved via unsteady aerodynamics

1.3 PRACTICAL IMPLEMENTATIONS

The Tamkang University (TKU) in Taiwan recently (in Jan., 2010) realized automatically control of the flight altitude of 8-gram flapping-wing MAV. The MEMS Lab in the TKU has been developing MAVs for several years and since 3 years ago the Space and Flight Dynamics (SFD) Lab has joined the research team for the development of autonomous flight of MAVs. The MAVs developed in the TKU are 20 cm in wing span and 8 gram in weight. Instead of traditional sensors and computational devices, which are too heavy for most MAVs, the SFD combines stereo-vision system and ground station to control the flight altitude. This seems to be the first flapping-wing MAV of weight under 10 grams which realizes autonomous flight (or partly autonomous flight).The TU Delft University in the Netherlands has developed the (in 2008) smallest ornithopter fitted with a camera, the Delfly Micro, the third version of the Delfly project that started in 2005. This version measures 10 cm and weighs 3 grams, slightly larger (and noisier) than the Dragonfly it was modeled after. The importance of the camera lies in remote control when it is out of sight and eventually completely autonomous flight. This version has, however, not yet been successfully tested outside, although it performs well indoors. Robert Wood at Harvard University developed an even smaller ornithopter, at just 3 cm, but this craft is not autonomous in that it gets its power through a wire and is led along a rail.

2. CONSTRUCTIONS AND WORKING DETAILS

2.1 CONSTRUCTION

Thus far we have relied on an Edisonian approach to design our aircraft. No mathematical models would have lead to the development of our new concept. In order to use this approach we made some significant advances in the construction methods so that design iterations could be made quickly and each design could be thoroughly tested.

Following step-by-step construction techniques used to fabricate a MAV fuselage and wing are described here.

2.1.1 FUSELAGE CONSTRUCTION

Step1. A drawing is made of the fuselage panels to act as a guide for placement of the carbon fibre.

Step2. The drawing is taped onto the fiat tool.

Step3. Transparent skin material (Vacuum bag material) is then placed over the drawing.

Step4. Unidirectional carbon fibretape is cut into long narrow tacky strips.

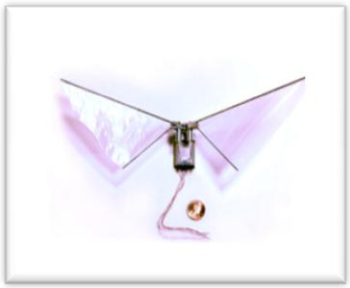

Figure 3.1: Initial wing designs

Step5. The carbon fibre strips are placed on the transparent skin material manually using the drawing as a guide or by automated process. Multiple layers are used in places where high stiffness is required. Overlap at the corners assures a mechanically sound joint.

Step6. Hinge material is placed between layers of carbon fibre at the location of the control surfaces.

Step7. Nonporous Teflon release film is then placed over the assembly.

Step8. The assembly is then placed into a vacuum bag and subsequently into a vacuum oven for cure.

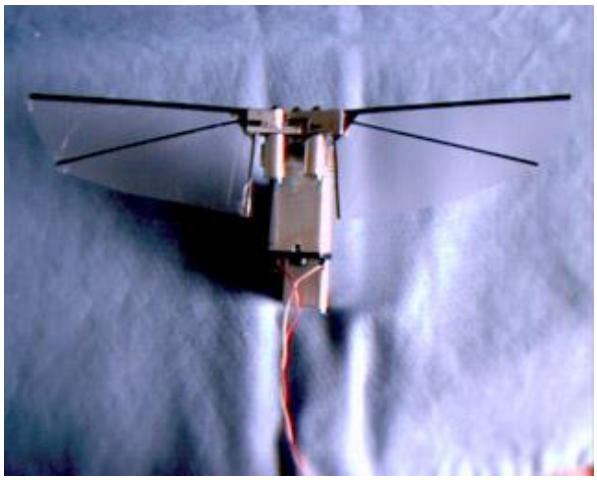

Figure 2.2: New wing design

Step9. Aider the cure cycle is complete; the parts are removed from the bag. The fuselage panels are then cut out.

Step10. The parts are glued together with cyanoacrylate adhesive.

Step11. Kevlar thread is used to lash the parts together. Without lashing, the glue joints would fail.

Step12. The motor, servos, receiver, control rods and horns are installed.

2.1.2 WING CONSTRUCTION

Step1. A drawing is made of the wing plan form to act as a guide for carbon fibre placement.

Step2. The drawing is taped onto a curved tool.

Step3. A layer of nonporous Teflon release film is placed over the drawing.

Step4. Unidirectional carbon fibre tape is cut into long narrow tacky strips.

Step5. The carbon fibre strips are placed on the release film using the drawing as a guide. Multiple layers are used in places where high stiffness is required. Overlap at the comers assures a mechanically sound joint.

Step6. Nonporous Teflon release film is then placed over the assembly.

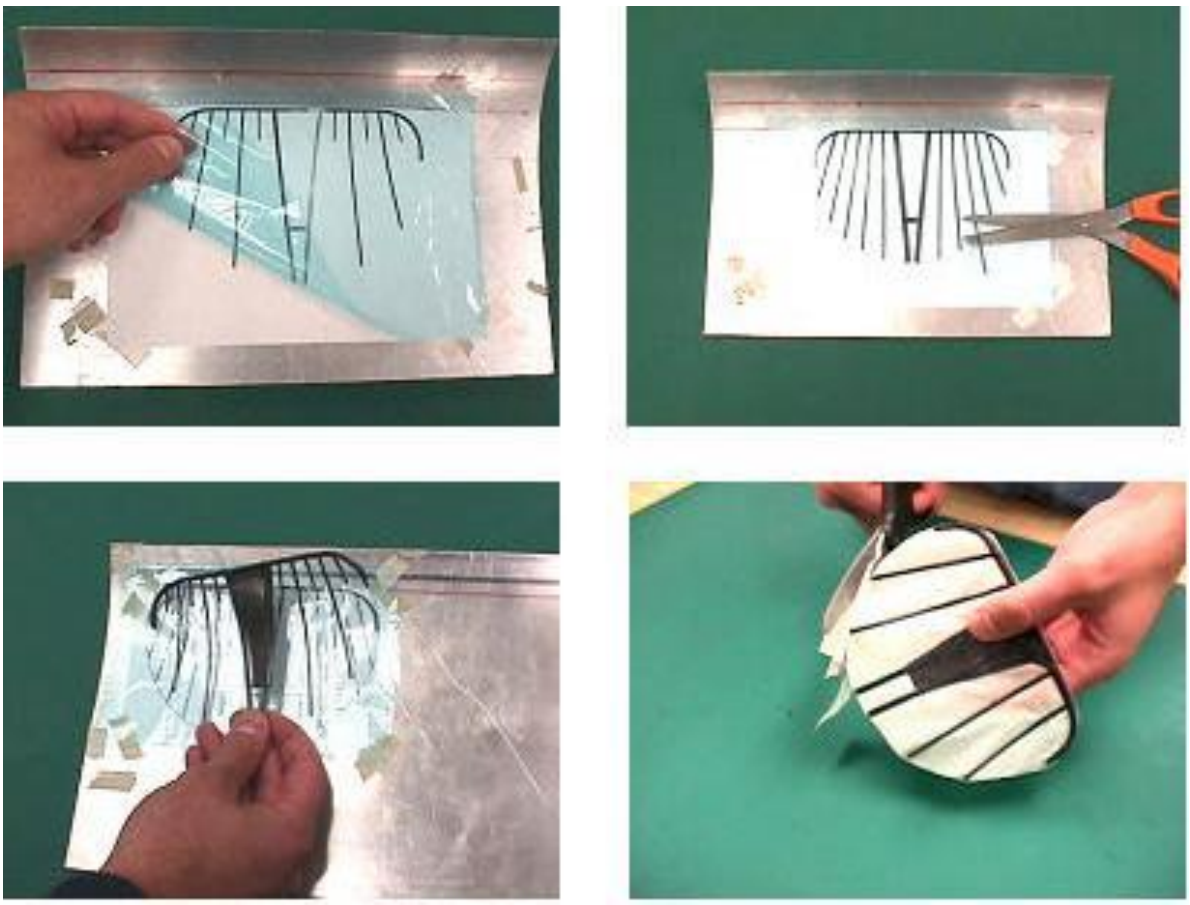

Figure 2.3: Illustration of the wing construction process.

Step7. The assembly is then placed into a vacuum bag and subsequently into a vacuum oven for cure.

Step8. After the cure cycle is complete, the carbon fibre wing skeleton in separated from the tool.

Step9. Spray mount adhesive is applied to the skeleton.

Step10. Thin latex rubber material is then applied to the wing.

Step11. Cyanoacrylate adhesive is used to reinforce the bond line.

Step12. Excess latex rubber is trimmed away.

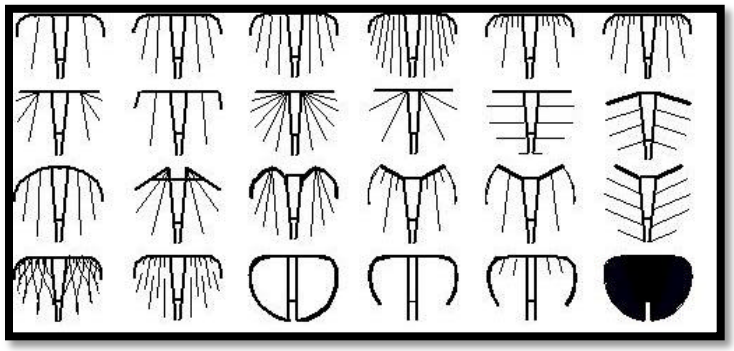

Figure 2.4: Illustration of different carbon fibre skeletons tested in flexible wing development.

2.2 COMPONENT SELECTION

2.2.1 MOTOR

Early on the decision was made to pursue electric propulsion over an internal combustion engine. Preliminary calculations of fuel consumptions for the smallest available combustion motor; furthermore, an electric solution has the weight advantage of powering all components off one common power source. In addition, an electric motor is more reliable and does not pose the difficulties of a moving center of gravity caused by an emptying fuel tank. Micro-R/C motors have a larger power output than the commercial motors we considered but at the cost of increased weight

2.2.2 BATTERIES

Most R/C vehicles use rechargeable nickel cadmium (Ni-CAD), nickel zinc (Ni-Zn), or nickel metal hydride (Ni-MH) batteries because of their high current draw, long life and very slight recharge memory. Rechargeable batteries are preferred for this type of application because they are cost effective and would not need to be removed from the plane. However these

batteries are very heavy and are designed for long life. The ideal batteries would fit completely inside the wing of the MAV. To fit inside the wing the battery would need to be very thin, less than 8mm in one dimension. The only batteries of that size and shape did not meet the electrical requirements of the motor. These batteries are available in 3 and 6 volts with different sizes and capacities.

2.2.3 PROPELLER

(A) GEOMETRY

There are two dimensions that are used to describe propellers, diameter and pitch. These two dimensions can be seen in Figure below. Diameter is simply the length from tip to tip of the propeller. The pitch is the length the propeller would move forward in one revolution in an ideal fluid. It can be explained as similar to the wavelength of a wave, the distance moved in one cycle. The pitch of the propeller is dependent on the angle of twist of the blades on the prop. On most propellers however the angle of the blades changes with the position on the radius of the prop.

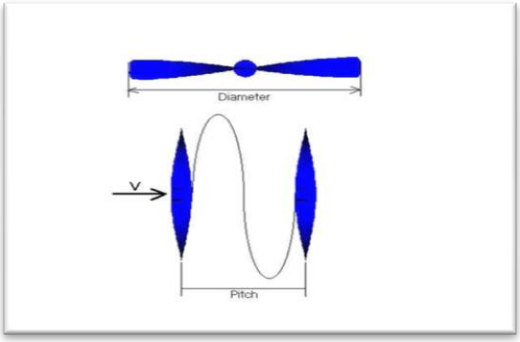

Figure 2.5: Schematic of Propeller Dimension

(B) CHARACTERISTIC

The propeller supplies the thrust for the propulsion system. The thrust that is created by the propeller is difficult to predict because there a several inter-related parameters that effect the thrust. Parameters include are prop dimensions, flow speed, prop angular velocity, air density, and prop efficiency. The equation for propeller efficiency is:

$$EFFICIENCY=VT/P$$

Where V is the plane velocity, T is the output thrust, and the P is the power output of the motor.

(C) TESTING AND SELECTION

Many propellers are designed for specific motors, or rpm, while others are designed for specific size planes. This necessitates experimental testing in selecting a prop for aplane. At the start of the component selection process the propeller selectionwas driven by both the weight and diameter, which affect the maximum dimension of theMAV. When motors were first purchased for the MAV, several different propellers, in thecorrect size range, were also purchased for testing.

2.2.4. RECEIVER

A receiver is the part of the plane that receives the information from the pilot controlled transmitter. Receivers have an antenna attached to them and also have a power input plug and output plugs to the servo flap controllers. The type of receiver required by the Hi-Tech transmitter was FM channel 37. The weight was the most important parameter to the design, providing the receiver was compatible with the transmitter. Some of these receivers have a speed controller built into them for controlling the motor speed. Speed controllers are not entirely necessary for a model plane but do allow the pilot to "throttle back", which can save battery life significantly.

2.2.5 ANTENNA

The antenna that comes with a receiver is usually a 39 inch light wire antenna soldered to the receiver. This antenna is designed to hang off the back of the plane and receive the communications. It seemed however that this type of antenna would create a noticeable drag force at this scale of aircraft. For that reason alternate antenna designs were researched. Upon further reading it was found that the antenna was stiff and was 5 inches long.The normal antenna is just a wire connected to the receiver. This antenna is simply an inductor and small capacitor wired in parallel at the base of the wire antenna. The capacitor and coil effectively tune the receiver to pick up a 72 MHz signal from the transmitter, at a much shorter length than normal.

References-

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- Mr T. Spoerry and, Dr K.C. Wong,*Design And Development Of A Micro Air Vehicle* , University of Sydney NSW 2006

Energy Labeling of Air-conditioner by Using 5-Star Rating

Mr. Karan Kadolkar (BE A), Mr. VinayakShinde (SE B)

BEE Star Rating and Labeling of Air Conditioners

In May 2006, Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power launched Standard and Labeling Program of electrical home appliances including air conditioners. Under this program, for the benefit of general public, the appliance manufactures could voluntarily affix a Star Label on their appliances showing the level of energy consumption by the appliance both in terms of absolute values as well as equivalent number of stars varying from one to five, in accordance with BEE stipulation. The greater the number of stars on the label, higher the appliance energy efficiency and lower its electricity consumption. Affixing BEE star label has been made mandatory for Room ACs from January 2010.

Energy Efficiency of Air Conditioner:

Efficiency of a room air conditioner is normally measured as Energy Efficiency Ratio (EER), which is the ratio of the cooling output, measured in British thermal units (Btu) per hour, to the power input (in Watts, and includes all inputs to compressor, fan motors and controls) to operate AC at standard rating conditions. This means a higher the EER, the more efficient the air conditioner is. At times, EER is defined a little differently. The cooling

capacity instead of being denoted in Btu/hr is also denoted in Watts (1Btu/ hr = 0.293 Watts). Thus EER is represented as Watts/ Watts or as a number without any units. (**1TR = 12,000 Btu/hr = 3,024 Kcal/hr = 3,517 Watts)**

Saving Bill Chart:

Cooling Capacity	Annual Cost	Annual Energy Bill Saving over zero star AC(Rs)				
TR	0 Star	1 Star	2 Star	3 Star	4 Star	5 Star
0.75	5,537	462	853	1,189	1,479	1,733
1.00	7,383	616	1,138	1,585	1,972	2,311
1.50	11,074	925	1,707	2,377	2,958	3,466
2.00	14,765	1,233	2,276	3,170	3,944	4,621
2.50	18,456	1,541	2,845	3,962	4,930	5,777
3.00	22,148	1,849	3,414	4,754	5,916	6,932
* Electricity Charges: Rs 3.05 per KW hr						

Above chart give the brief idea about annual energy saving by using one star to five stars over Zero star. We take an one example If we are using 1 Tone of A.C. then the annual cost of it is 7383Rs .If we are use One star of A.C. instead of Zero star then we can save 616Rs, in the same way that if we are use Five star of A.C.then we can save 2311Rs, means 2311Rs are reduce from Zero star cost.

Energy Saving Tips:

•Use5-star A.C. which is advance in good heat exchanging capacity, best quality of cu windings.

• Use ceiling or table fan as first line of defense against summer heat, as running cost of using an AC could be 25 times or more than that of a ceiling fan.

• Keep windows and doors of air-conditioned rooms closed as often as possible.

• Avoid outside air intake: Since outdoor air is warmer and contains more heat and moisture than the conditioned air and thus it increases electricity consumption. Keep in mind that natural leakage through windows and doors will generally supply sufficient outdoor air for assuring comfort conditions and minimizing odor.

• Remove obstructions (e.g., furniture, piled books, etc.) to air passage to the unit. AC operates most efficiently when intake and discharge airflows are free from nearby obstacles.

• Set AC thermostat settings properly: AC uses 3 to 5 percent less energy for each degree set above 22°C, therefore set AC's thermostat at a temperature as high as is comfortably possible (25 - 26°C) in the summer. Smaller the difference between the indoor and outdoor temperatures, lower will be the electricity consumption.

• Consider using an interior ceiling fan in conjunction with your AC to spread the cooled air more effectively within the room. Using fan allows you to set the thermostat temperature higher and thus reduces the energy consumption.

• Do not set your thermostat at a colder setting than normally needed when you turn on your air conditioner; it does not cool your room any faster and could result in excessive cooling and unnecessary expense.

• Do not place lamps, televisions or other electric appliances near AC. As these appliances generate heat, and the thermostat senses heat from these appliances causing the air conditioner to run longer than necessary.

• Clean the air-conditioner filter regularly: A dirty air filter reduces airflow and may damage the unit. Clean filters enable the unit to cool down quickly and use lesser energy. A filter that slides out easily facilitates easier cleaning.

• Clean outdoor coils when they become dusty. Efficiency of AC degrades in dusty conditions, and especially when layers of dirt and mud are evident.

• Give the annual maintenance contract of AC directly to the manufacturer or its authorized company which has trained and well-qualified technical staff.

• Always insist that the maintenance technician measures total current drawn (in Amperes) by AC. Higher the current value greater is the electricity consumption.

Conclusion:

More star (up to 5) means more saving of energy and money, it will very beneficial to customer. And it will help to move INDIA is in developing way.\

References:

- www.mnre.Com
- www. Bureau of energy efficiency.Com

Solar Powered Vehicle

Miss. TukshettiShubhangi(SE A), Miss. TruptiChogule(BE B)

In the present situation energy crisis is an important unsolvable problem so we must find out some other ways to trust all sources such as solar energy, hydro power, tidal power, wind power etc. Using solar power to produce electricity is not the same as using solar to produce heat. Solar thermal principles are applied to produce hot fluids or air. Photovoltaic principles are used to produce electricity. A solar panel (PV panel) is made of the natural element, silicon, which becomes charged electrically when subjected to sun light.

Solar panels are directed at solar south in the northern hemisphere and solar north in the southern hemisphere (these are slightly different than magnetic compass north-south directions) at an angle dictated by the geographic location and latitude of where they are to be installed. Typically, the angle of the solar array is set within a range of between site-latitude-plus 15 degrees and site-latitude-minus 15 degrees, depending on whether a slight winter or summer bias is desirable in the system. Many solar arrays are placed at an angle equal to the site latitude with no bias for seasonal periods.

This electrical charge is consolidated in the PV panel and directed to the output terminals to produce low voltage (Direct Current) - usually 6 to 24 volts. The most common output is intended for nominal 12 volts, with an effective output usually up to 17 volts. A 12 volt nominal output is the reference voltage, but the operating voltage can be 17 volts or higher much like your car alternator charges your 12 volt battery at well over 12 volts. So there's a difference between the reference voltage and the actual operating voltage.

BASIC PRINCIPLES

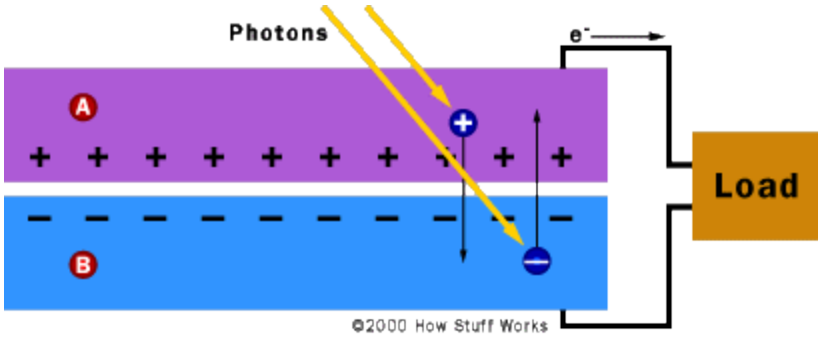
When Light Hits the Cell When light, in the form of photons, hits our solar cell, its energy frees electron-hole pairs. Each photon with enough energy will normally free exactly one electron, and result in a free hole as well. If this happens close enough to the electric field, or if free electron

and free hole happen to wander into its range of influence, the field will send the electron to the N side and the hole to the P side. This causes further disruption of electrical neutrality, and if we provide an external current path, electrons will flow through the path to their original side (the P side) to unite with holes that the electric field sent there, doing work for us along the way. The electron flow provides the current, and the cell's electric field causes a voltage. With both current and voltage, we have power, which is the product of the two.

Operation of a PV cell

Silicon in Solar Cells

A solar cell has silicon with impurities -- other atoms mixed in with the silicon atoms, changing the way things work a bit. We usually think of impurities as something undesirable, but in our case, our cell wouldn't work without them. These impurities are actually put there on purpose. Consider silicon with an atom of phosphorous here and there, maybe one for every million silicon atoms. Phosphorous has five electrons in its outer shell, not four. It still bonds with its silicon neighbor atoms, but in a sense, the phosphorous has one electron that doesn't have anyone to hold hands with. It doesn't form part of a bond, but there is a positive proton in the phosphorous nucleus holding it in place.



When energy is added to pure silicon, for example in the form of heat, it can cause a few electrons to break free of their bonds and leave their atoms. A hole is left behind in each case. These electrons then wander randomly around the crystalline lattice looking for another hole to fall into. These electrons are called free carriers, and can carry electrical current. There are so few of them in pure silicon, however, that they aren't very useful. Our impure silicon with phosphorous atoms mixed in is a different story.

It turns out that it takes a lot less energy to knock loose one of our "extra" phosphorous electrons because they aren't tied up in a bond -- their neighbors aren't holding them back. As a result, most of these electrons do break free, and we have a lot more free carriers than we would have in pure silicon. The process of adding impurities on purpose is called doping, and when doped with phosphorous, the resulting silicon is called N-type ("n" for negative) because of the prevalence of free electrons. N-type doped silicon is a much better conductor than pure silicon is.

Actually, only part of our solar cell is N-type. The other part is doped with boron, which has only three electrons in its outer shell instead of four, to become P-type silicon. Instead of having free electrons, P-type silicon ("p" for positive) has free holes. Holes really are just the absence of electrons, so they carry the opposite (positive) charge. They move around just like electrons do.

N-type Plus P-type Silicon

The interesting part starts when you put N-type silicon together with P-type silicon. Remember that every PV cell has at least one electric field. Without an electric field, the cell wouldn't work, and this field forms when the N-type and P-type silicon are in contact. Suddenly, the free

electrons in the N side, which have been looking all over for holes to fall into, see all the free holes on the P side, and there's a mad rush to fill them in.

Before now, our silicon was all electrically neutral. Our extra electrons were balanced out by the extra protons in the phosphorous. Our missing electrons (holes) were balanced out by the missing protons in the boron. When the holes and electrons mix at the junction between N-type and P-type silicon, however, that neutrality is disrupted. Do all the free electrons fill all the free holes? No. If they did, then the whole arrangement wouldn't be very useful. Right at the junction, however, they do mix and form a barrier, making it harder and harder for electrons on the N side to cross to the P side. Eventually, equilibrium is reached, and we have an electric field separating the two sides.

How Solar Cells Work

We probably seen calculators that have solar cells -- calculators that never need batteries, and in some cases don't even have an off button. As long as you have enough light, they seem to work forever. You may have seen larger solar panels -- on emergency road signs or call boxes, on buoys, even in parking lots to power lights. Although these larger panels aren't as common as solar powered calculators, they're out there, and not that hard to spot if you know where to look. There are solar cell arrays on satellites, where they are used to power the electrical systems.

You have probably also been hearing about the "solar revolution" for the last 20 years -- the idea that one day we will all use free electricity from the sun. This is a seductive promise: On a bright, sunny day, the sun shines approximately 1,000 watts of energy per square meter of the planet's surface, and if we could collect all of that energy we could easily power our homes and offices for free.

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Ultrasonic Techniques for hidden corrosion detection

Miss. MrunaliniShinde (SE A), Miss. AnuradhaChogule(BE A)

Corrosion is one of the serious problem affecting airforce and other aviation industries. It affects the aircraft on its wings, surface, between joints and fasteners. The presences of corrosion underneath the paints of surface and between joints are not easy to be detected. The unnoticed presence of corrosion may cause the aircraft to crash leading to human and money loses.

To detect the corrosion present on the metal surface, various methods and tests are used. These tests conducted should be such that it does not destroy or disassemble the plane to parts or damage its surface. Hence for the further use of the plane, Non-destructive tests (NDT) are carried out.

NON-DESTRUCTIVE TESTS

Non-destructive testing as the name suggests is testing procedure without any damage to the part being tested. The various non-destructive testing methods used are:

1) Visual inspection

2) X-ray inspection

3) Die (liquid) penetration inspection

4) Magnetic particle inspection

5) Eddy current inspection

6) Ultrasonic inspection

Ultrasonic inspection is conventionally used for corrosion detection in aircraft wings. But the conventional inspection method carries with it certain defects like:(i) It scans perpendicular to

the surface and hence rate of scanning (from point to point) is less and hence highly time consuming.

(ii) Conventional method is not capable of detecting disbonds between layers and cracks at fastener holes.

These defects are over come by a newly developed inspection method using guided ultrasonic waves.

Guided waves demonstrate an attractive solution where conventional ultrasonic inspection techniques are less sensitive to defects such as corrosion/disbonds in thin multilayered wing skin structures and hidden exfoliation under wing skin fasteners. Moreover, with their multimode character, selection of guided wave modes can be optimized for detection of particular types of defects. Mode optimization can be done by selecting modes with maximum group velocities (minimum dispersion), or analysis of their wave mode structures (particle displacements, stresses and power distributions). Guided Lamb modes have been used for long range/large area corrosion detection and the evaluation of adhesively bonded structures.

Ultrasonic guided waves are promising but require procedure development to ensure high sensitivity and reliable transducer coupling and to provide a mechanism to transport the probe(s) over the area to be scanned. This paper describes some practical inspection setups and procedures based on guided wave modes for corrosion damage detection in single and multilayered wing skin structures and exfoliation detection immediately adjacent to fasteners in aircraft wing skin. It describes the results of their application to detection of corrosion in simulated and real components of aircraft wing skin.

Using a tone burst system, the wave modes are selected, excited and tested in pulse echo and pitch catch setups. Launch angles were obtained from the calculated dispersion curves. Theoretical group velocities were compared to tested group velocities to confirm the excited modes at frequency thickness product and launch angle. The simulated corrosion in single and multilayered wing skin structures and exfoliation located under several rivets was successfully detected. Some guided Lamb modes proved to be more sensitive to corrosion type defects and produced better results

CORROSION DETECTION WITH GUIDED WAVES

Guided Lamb modes are dispersive waves and their velocities are a function of the frequency thickness product. Therefore, any material changes such as corrosion/exfoliation or lack of adhesion between two layers will affect the propagating mode amplitude, velocity, frequency spectrum and its time of flight.

RF waveforms from guided modes going through a corroded area have a relatively low transmitted signal amplitude and time of flight shift, while noncorroded areas are associated with stable time of flight and high received signal amplitude.

Inspection of lap splice joint with guided waves in a pitch catch setup permits a selected guided wave mode to travel from the sender toward the receiver probe, producing relatively low amplitude RF signal when corrosion exists between the two bonded parts. Otherwise, if there is no corrosion, the excited mode will leak into the second joint producing relatively high amplitude RF signal (Figure 1). In a pulse echo setup, a low RF signal is obtained in the presence of corrosion and high RF signal is obtained for absence of corrosion.

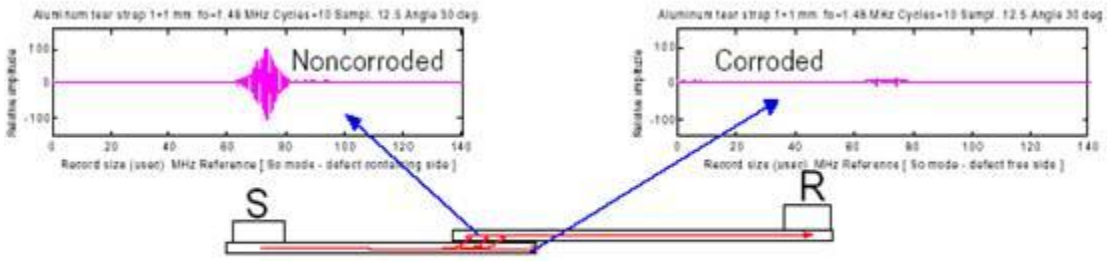

Figure 1. Transmission results from a) noncorroded area b) corroded area

Fatigue cracks and exfoliation under the shadow of fastener heads in aircraft skin structures can be detected using ultrasonic guided waves. Guided modes are selected and launched from outside the exfoliated and hidden area to interrogate the interested rivets. In pulse echo setup, the received mode associated with RF signals include indications and reflections from exfoliation.

EQUIPMENT AND INSTRUMENTATION

The system used in our experimentation is Tektrend's PANDA® Guided Wave System (Figure 2). The new PANDA® Guided Wave System unit is an advanced modular and portable automated scanning system. It can be configured for conventional UT and ET transducer positioning, providing C scan images. The PANDA® can be configured for guided wave inspection, providing cost effective, practical nondestructive evaluation.

Figure 2. Guided wave testing system

The PANDA Automated Scanning System is self contained in a single unit in which all the electronic boards are mounted in the system computer workstation. It offers advanced analysis and interpretation capabilities, where intelligent scans can be performed with a pre designed intelligent classifier. The system contains tools to tag signals for export to an integrated pattern recognition package. The positioning control, ultrasonic control, data acquisition, display and analysis software are all integrated into a single software package, ARIUS IV®.

The Guided Wave System is hosted on flexible rail to allow scanning of curved surfaces and to enable complete automation of the ultrasonic field inspection. An adaptable spring loaded piston design for holding transducers is mounted on the Y axis scanning arm, which moves on the X¬-axis. The system is fitted to the inspected surface with a vacuum control system. The PANDA® Arm can operate in vertical and horizontal orientations and scan contoured and edged surfaces. Measurement can be made in pulse echo as well as pitch catch modes with piezoelectric

transducer probes (optional with EMAT probes) with 0.005 and 0.002 inch maximum scanning accuracy and resolution with a maximum scanning rate of 6 inches/second at maximum resolution.

The transducer probes are driven by a tone burst pulser to excite narrow band guided wave modes and to provide high power to launch the wave over long distances. With tone burst excitation, the operating frequency and the pulse characteristics of the transmitter can be controlled in a repeatable manner.

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Vacuum Breaker system

Miss. MrunaliniShinde (SE A), Miss. AishwaryaPati(SE A)

A moving train contains energy, known as kinetic energy, which needs to be removed from the train in order to cause it to stop. The simplest way of doing this is to convert the energy into heat. The conversion is usually done by applying a contact material to the rotating wheels or to discs attached to the axles. The material creates friction and converts the kinetic energy into heat. The wheels slow down and eventually the train stops. The material used for braking is normally in the form of a block or pad.

The vast majority of the world's trains are equipped with braking systems which use compressed air as the force used to push blocks on to wheels or pads on to discs. These systems are known as "air brakes" or "pneumatic brakes". The compressed air is transmitted along the train through a "brake pipe". Changing the level of air pressure in the pipe causes a change in the state of the brake on each vehicle. It can apply the brake, release it or hold it "on" after a partial application. The system is in widespread use throughout the world.

An alternative to the air brake, known as the vacuum brake, was introduced around the early 1870s, the same time as the air brake. Like the air brake, the vacuum brake system is controlled through a brake pipe connecting a brake valve in the driver's cab with braking equipment on every vehicle. The operation of the brake equipment on each vehicle depends on the condition of a vacuum created in the pipe by an ejector or exhauster. The ejector, using steam on a steam locomotive, or an exhausted, using electric power on other types of train, removes atmospheric pressure from the brake pipe to create the vacuum. With a full vacuum, the brake is released. With no vacuum, i.e. normal atmospheric pressure in the brake pipe, the brake is fully applied.

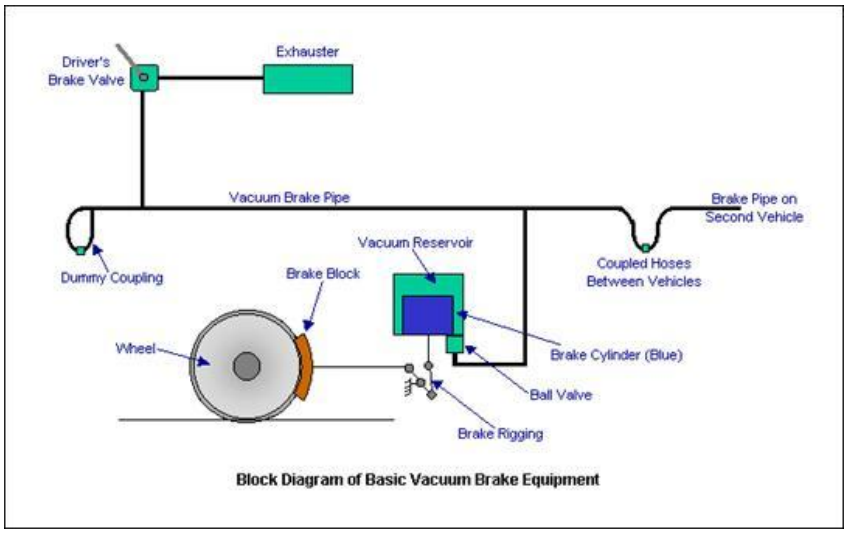
The pressure in the atmosphere is defined as 1 bar or about 14.5 lbs. per square inch. Reducing atmospheric pressure to 0 lbs. per square inch creates a near perfect vacuum which is measured as 30 inches of mercury, written as 30 Hg. Each 2 inches of vacuum therefore represents about 1 lb. per square inch of atmospheric pressure.In the UK, vacuum brakes operated with the brake

pipe at 21 Hg, except on the Great Western Railway which operated at 25 Hg. The vacuum in the brake pipe is created and maintained by a motor-driven exhauster. The exhauster has two speeds, high speed and low speed. The high speed is switched in to create a vacuum and thus release the brakes. The slow speed is used to keep the vacuum at the required level to maintain brake release. It maintains the vacuum against small leaks in the brake pipe. The vacuum in the brake pipe is prevented from exceeding its nominated level (normally 21 Hg) by a relief valve, which opens at the setting and lets air into the brake pipe to prevent further increase.

The momentum of a moving body increases with weight and speed of the body as these factors increase improvements in the brake become so important. The adhesion of the wheels and speed of the train are the main factors that determine the total retarding power. If the coefficient of friction becomes equal to unity then the retarding force will be equal to the weight of the wagon. Also the deceleration equals the acceleration due to gravity. Then the braking efficiency is 100%. This is the theoretical limit for braking efficiency. Highly efficient brakes giving a large deceleration might injure the passengers due to sudden stopping of the train .More over this will cause the brake shoes to wear rapidly and their is always the risk of derailment. The braking efficiencies usually vary from 50% to 80%, which enables the train to stop safely within a reasonable distance.

COMPONENTS OF THE VACCUME BRAKE SYSTEM

This diagram shows the principal parts of the vacuum brake system as applied to an electric or diesel train. Click on the name to see a description of the part. The systems used on steam locomotives were somewhat different.



Block Diagram of Basic Vacuum Brake Equipment

3.1 DRIVER'S BRAKE VALVE

The means by which the driver controls the brake. The brake valve will have (at least) the following positions: "Release", "Running", "Lap" and "Brake On". There may also be a "Neutral" or "Shut Down" position, which locks the valve out of use. The "Release" position connects the exhauster to the brake pipe and switches the exhauster to full speed. This raises the vacuum in the brake pipe as quickly as possible to get a release.
In the "Running" position, the exhauster keeps running but at its slow speed. This ensures that the vacuum is maintained against any small leaks or losses in the brake pipe, connections and hoses."Lap" is used to shut off the connection between the exhauster and the brake pipe to close off the connection to atmosphere after a brake application has been made. It can be used to provide a partial release as well as a partial application, something not possible with the original forms of air brake.

"Brake On" closes off the connection to the exhauster and opens the brake pipe to atmosphere. The vacuum is reduced as air rushes in.Some brake valves were fitted with an "Emergency" position. Its operation was the same as the "Brake On" position, except that the opening to atmosphere was larger to give a quicker application.

3.2 EXHAUSTER

A two-speed rotary machine fitted to a train to evacuate the atmospheric pressure from the brake pipe, reservoirs and brake cylinders to effect a brake release. It is usually controlled from the driver's brake valve, being switched in at full speed to get a brake release or at slow speed to maintain the vacuum at its release level while the train is running. Exhausters are normally driven off an electric motor but they can be run directly from a diesel engine.

3.3 BRAKE PIPE

The vacuum-carrying pipe running the length of the train, which transmits the variations in pressure required to control the brake. It is connected between vehicles by flexible hoses, which can be uncoupled to allow vehicles to be separated. The use of the vacuum system makes the brake "fail safe", i.e. the loss of vacuum in the brake pipe will cause the brake to apply.

3.4 DUMMY COUPLING

At the ends of each vehicle, a dummy coupling point is provided to allow the ends of the brake pipe hoses to be sealed when the vehicle is uncoupled. The sealed dummy couplings prevent the vacuum being lost from the brake pipe.

3.5 COUPLED HOSES

The brake pipe is carried between adjacent vehicles through flexible hoses. The hoses can be sealed at the outer ends of the train by connecting them to dummy couplings.

3.6 BRAKE CYLINDER

Each vehicle has at least one brake cylinder. Sometimes two or more are provided. The movement of the piston contained inside the cylinder operates the brakes through links called "rigging". The rigging applies the blocks to the wheels. The piston inside the brake cylinder moves in accordance with the change in vacuum pressure in the brake pipe. Loss of vacuum applies the brakes, restoration of the vacuum releases the brakes.

3.7 VACUUM RESERVOIR

The operation of the vacuum brake relies on the difference in pressure between one side of the brake cylinder piston and the other. In order to ensure there is always a source of vacuum available to operate the brake, a vacuum reservoir is provided on, or connected to the upper side of the piston. In the simplest version of the brake, shown above, the brake cylinder is integral with the vacuum reservoir. Some versions of the brake have a separate reservoir and a piped connection to the upper side of the piston.

3.8 BRAKE BLOCK

This is the friction material which is pressed against the surface of the wheel tread by the upward movement of the brake cylinder piston. Often made of cast iron or some composition material, brake blocks are the main source of wear in the brake system and require regular inspection to see that they are changed when required.

3.9 BRAKE RIGGING

This is the system by which the movement of the brake cylinder piston transmits pressure to the brake blocks on each wheel. Rigging can often be complex, especially under a passenger car with two blocks to each wheel, making a total of sixteen. Rigging requires careful adjustment to ensure all the blocks operated from one cylinder provide an even rate of application to each wheel. If you change one block, you have to check and adjust all the blocks on that axle.

3.10 BALL VALVE

The ball valve is needed to ensure that the vacuum in the vacuum reservoir is maintained at the required level, i.e. the same as the brake pipe, during brake release but that the connection to the brake pipe is closed during a brake application. It is necessary to close the connection as soon as the brake pipe vacuum is reduced so that a difference in pressure is created between the upper and lower sides of the brake cylinder piston. See the next paragraph - Operation on Each Vehicle.

WORKING OF VACUUM BRAKE

4.1 BRAKE RELEASE

This diagram shows the condition of the brake cylinder, ball valve and vacuum reservoir in the release position. The piston is at the bottom of the brake cylinder, the brake cylinder is open at the top so that it is in direct connection with the vacuum reservoir.

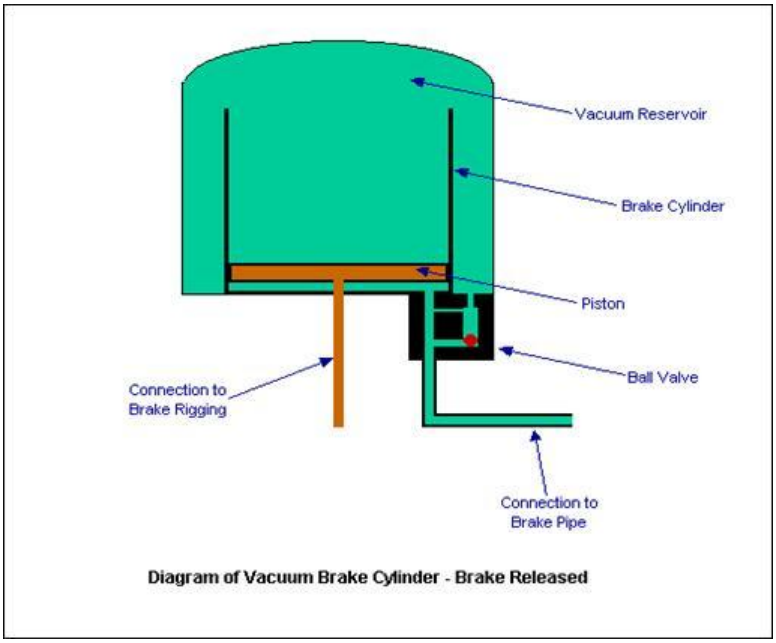


Diagram of Vacuum Brake Cylinder - Brake Released

A vacuum has been created in the brake pipe, the vacuum reservoir and underneath the piston in the brake cylinder. The removal of atmospheric pressure from the system has caused the ball valve to open the connection between the vacuum reservoir and the brake pipe. The fall of the piston to the bottom of the brake cylinder causes the brake blocks to be released from the wheels.

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A Simple Wooden Lamp with an Utterly Enchanting UI

Mr. AnandNaikwade (BE B), Mr. Sagar Mane (BE C)

MOST LIGHTS TURN on one of two ways: Flip a switch or turn a knob. If you're fancy, you might control your lights with a capacitive sensor, or even a smartphone app. Or, you know, a Clapper.

The Heng Balance Lamp relies on none of these mechanisms. The lamp's construction is simple. It consists of a wooden frame; a strip of embedded lights; and two wooden balls, each attached to a string. Lift the bottom ball into close proximity with the upper ball to activate the lights. Once there, magnets inside the wooden spheres keep them in place. The interaction echoes an old-

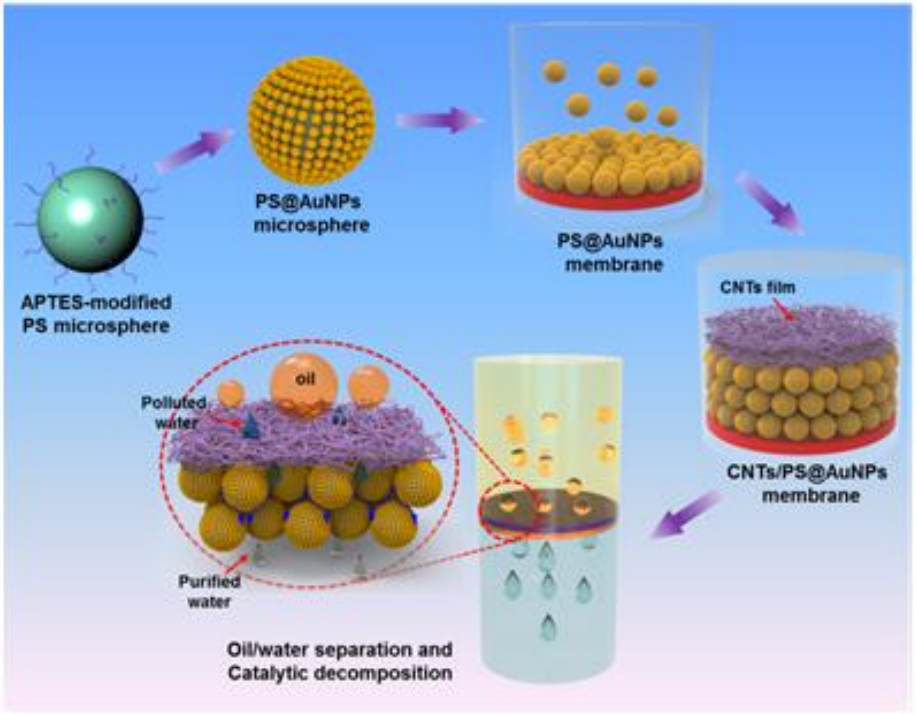
school pull chain, but the final effect feels more enchanting—like there's some unusual technology whirring below the surface.

There isn't. Chinese designer Li Zan Wen built Heng out of wood and magnets, mostly. There are no sensors hiding in its bent frame, and it requires a human hand to operate. These days—especially the days following CES—that kind of clever simplicity is a rare but refreshing sight.

Seeking a novel way to redesign a light switch while simultaneously retaining a functional and aesthetically pleasing object was the design challenge for Chinese designer Li Zan Wen. His solution was the Heng Balance Lamp, a fun desktop light that relies on a pair of magnets suspended on strings to pull an internal switch. The design concept won a Red Dot Design Award last year, and AllocacocDesignNest is now launching an edition of the lamp through Kick starter.

Composite material for water purification

Mr. Karan Desai (SE B), Mr. SammedBagane (SE B)



Fresh, clean water coming directly from the tap is a true luxury. In developing countries, people often have no choice but to use a contaminated river for drinking water. Water filters can help by quickly converting polluted surface or ground water into safe drinking water. In the journal AngewandteChemie, researchers have now introduced a novel multifunctional composite material that removes inorganic, organic, radioactive, and microbial impurities from water.

Usually, water purification involves a series of filters, each designed to remove a single type of impurity. In contrast, this new filter material is an all-rounder. Scientists from the Universities of Ulm (Germany) and Zaragoza (Spain) have now seized upon a relatively new approach for

designing materials, which allows molecular components to be assembled into multifunctional composites called SILP materials (supported ionic liquid phases). An ionic liquid is a salt that is melted at room temperature, making it liquid without being dissolved in a solvent. When such an ionic liquid is absorbed onto a solid substrate it forms a solid composite material with properties that can be selectively tuned through chemical modification.

The researchers led by Scott G. Mitchell and CarstenStreb have now produced the first SILPs based on polyoxometallates (POM). POMs are molecular transition metal-oxygen clusters in which the metal atoms are bridged by oxygen atoms to form a three-dimensional network. For the new filter materials, they selected polyoxotungstate anions. These anions have a binding site which can trap heavy metal ions. The counter ions they selected are voluminous tetraalkylammoniumcations known for their antimicrobial effect. The resulting ionic liquids are hydrophobic, immiscible with water, and form stable thin layers on surfaces. By using a porous silicon dioxide support, the researchers obtained dry, free-flowing powders that are easy to transport and handle.

In laboratory experiments, the anions of the new composites reliably removed lead, nickel, copper, chromium, and cobalt ions. Radioactive uranium in the form of UO (2)(2+) was trapped

directly by the silicon dioxide support. Similarly, the water-soluble blue trityl dye commonly used in the textile industry was also removed as a result of the lipophilic character of the ionic liquid. The antimicrobial captions effectively halt the growth of E. coli. Bacteria.

The researchers hope that their new "POM-SILP" filter materials will form the basis for the development of contaminant-specific chemically designed filter systems that can be used for the reliable purification of water in remote areas and developing nations, as well as after natural disasters and chemical accidents.

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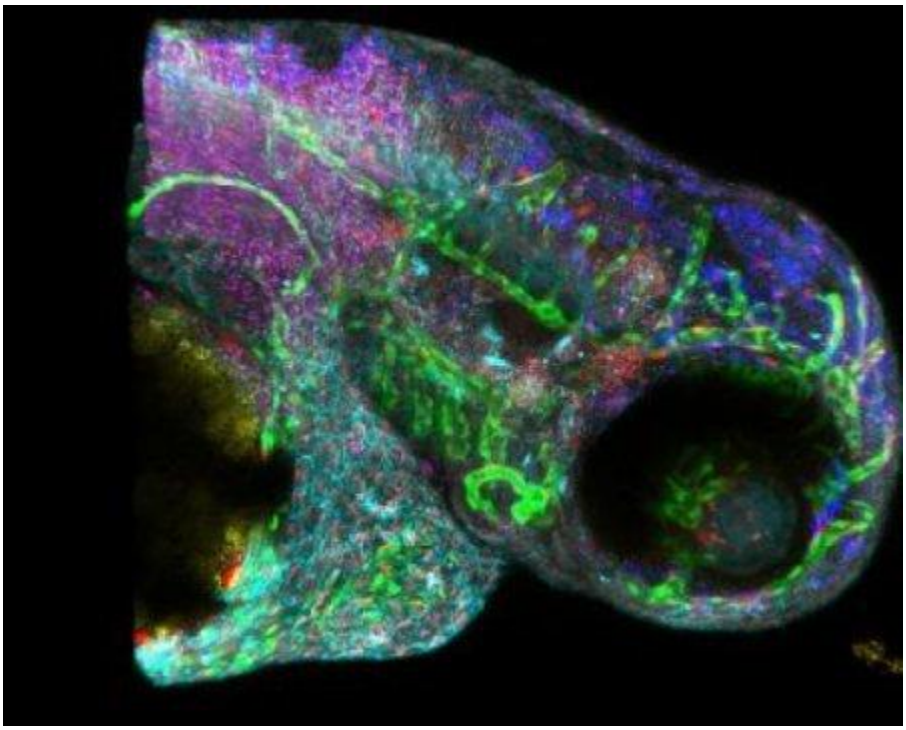
New technology enables 5-D imaging in live animals, humans

Mr.Rajratna Patil (SE B), Mr. Patil Shubham(SE B), Mr. RohitKore(SE B)



Novel image analysis technology enables new insights in complex systems biomolecules networks. By enhanced multi-color imaging scientists at USC's Translational Imaging Center access a new information dimension that reveals interactions between molecules. In the figure, a Zebrafish embryo with six different colors was analyzed by Francesco Cutrale and Scott E. Fraser at the University of Southern California's Translational Imaging Center.

A new image analysis technique makes it easier for scientists to quickly find and track important biological molecules including tell-tale signs of disease.Called"Hyper-Spectral Phasor" analysis, or HySP, it could even be useful for diagnosing and monitoring diseases by using cell phone

images. It is much faster and far less expensive than current techniques.Through the new imaging technology, researchers use fluorescent imaging to locate proteins and other molecules in cells and tissues. It works by tagging the molecules with dyes that glow under certain kinds of light the same principle behind so-called “black light” images.

Fluorescent imaging can help scientists understand which molecules are produced in large amounts in cancer or other diseases, information that may be useful in diagnosis or in identifying possible targets for therapeutic drugs.

Looking at just one or two molecules in cell or tissue samples is fairly straightforward. Unfortunately, it doesn’t provide a clear picture of how those molecules are behaving in the real world. For that, scientists need to expand their view.“Biological research is moving toward complex systems that extend across multiple dimensions, the interaction of multiple elements over time,” said postdoctoral fellow Francesco Cutrale. He developed HySP with Scott Fraser, a USC Provost Professor of Biological Science who also holds the Elizabeth Garrett Chair in Convergent Bioscience.The work was conducted at USC’s Translational Imaging Center, a joint venture of USC Dornsife and USC Viterbi School of Engineering. It was published in the journal *Nature Methods* on Jan. 9.

“By looking at multiple targets, or watching targets move over time, we can get a much better view of what’s actually happening within complex living systems,”Cutrale said. Currently, researchers must look at different labels separately, then apply complicated techniques to layer them together and figure out how they relate to one another, a time-consuming and expensive process, Cutrale said. HySP can look at many different molecules in one pass.“Imagine looking

at 18 targets,"Cutrale said. "We can do that all at once, rather than having to perform 18 separate experiments and try to combine them later."

In addition, the algorithm effectively filters through interference to discern the true signal, even if that signal is extremely weak – very much like finding the proverbial needle in a haystack. Recent technology from NASA's Jet Propulsion Laboratory can also do this, but the equipment and process are both extremely expensive and time-consuming.

"HySP uses much less computing time, and we don't need the expensive imaging instrumentation," Fraser said.Cutrale and Fraser, along with researchers from Keck School of Medicine of USC, Caltech and the University of Cambridge in the United Kingdom, have used zebra fish to test and develop HySP. In this common laboratory model, the system works extremely well. But what about in people?

"In experimental models, we can use genetic manipulation to label molecules, but we can't do that with people," said Fraser. "In people, we have to use the intrinsic signals of those molecules."Those inherent signals, the natural fluorescence from biomolecules, normally gets in the way of imaging, Fraser said. However, using this new computer algorithm that can effectively find weak signals in a cluttered background, the team can pinpoint their targets in the body.

The scientists hope to test the process in the next couple of years with the help of soldiers whose lungs have been damaged by chemicals and irritants they may have encountered in combat.The researchers will extend a light-emitting probe into the soldiers' lungs that will record images of the fluorescence in the surrounding tissues. They will then use HySP to create what amounts to a fluorescent map and compare it with that of healthy lung tissue to see if they can discern the damage.

If they are successful, they hope to further develop the technology so it may one day help these soldiers and other lung patients receive more targeted treatment.It might also be possible one day for clinicians to use HySP to analyze cell phone pictures of skin lesions to determine if they are at risk of being cancerous, said Fraser and Cutrale."We could determine if the lesions have changed color or shape over time,"Cutrale said. Clinicians could then examine the patient further to be certain of a diagnosis and respond appropriately.Cutrale and Fraser see the technology as a

giant leap forward for both research and medicine."Both scientists at the bench and scientists at the clinic will be able to perform their work faster and with greater confidence in the results,"Cutrale said. "Better, faster, cheaper. That's the payoff here."

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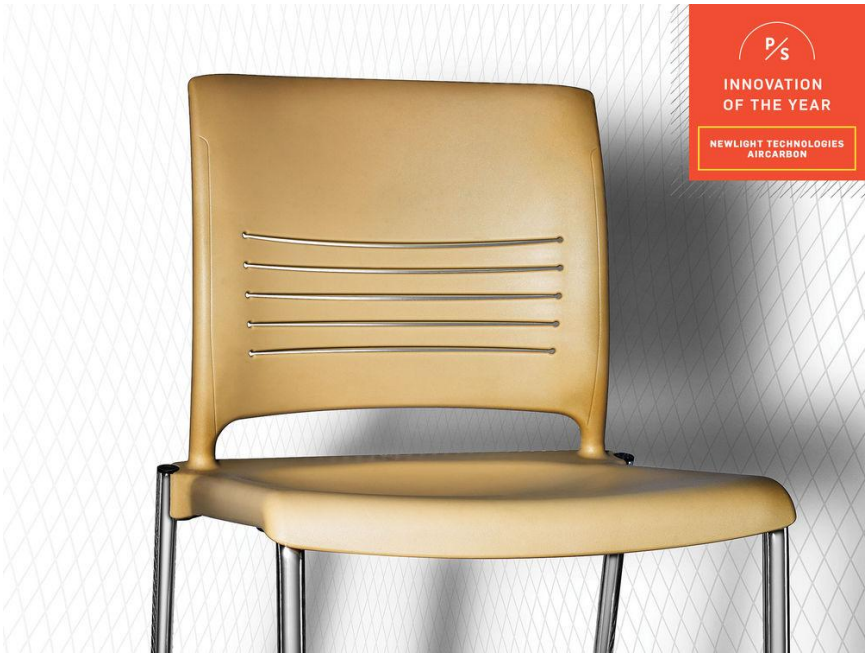
NEWLIGHT TECHNOLOGIES AIRCARBON

Miss. ShailajaHasure(SE A), Miss. AshwiniShendge(SE A)



Air Carbon is a material made by sequestering carbon emissions that would otherwise become part of the air.Sustainable. While almost all plastics today are made exclusively from oil or other fossil fuels, AirCarbon is different.AirCarbon is made by combining air with methane-based carbon emissions–carbon that would otherwise become part of the air we breathe–to produce a material that is approximately 40% oxygen from air and 60% carbon and hydrogen from captured methane emissions by weight. By replacing oil with Air Carbon, we transform the products we use everyday into materials that sequester more greenhouse gas than they emit and actually improve the world–displacing oil, reducing cost, and reducing the amount of carbon in the air.

High-Performance. Air Carbon is able to meet the performance requirements of a wide range of applications, including applications currently using fossil fuel-based polypropylene, polyethylene, ABS, polystyrene, and TPU. Air Carbon can be used in extrusion, blown film, cast film, thermoforming, fiber spinning, and injection molding applications. For more information about specific functional properties, please contact Newlight.

Carbon-Negative. Air Carbon has been independently-verified on a cradle-to-grave basis as a carbon-negative material, including all energy, materials, transportation, product use, and end-of-life/disposal associated with the material. Specifically, NSF commissioned Trucost to develop a cradle-to-grave greenhouse gas emissions footprint of AirCarbon, presenting the final results based on standardized cradle-to-grave boundaries determined by NSF, including carbon associated with all energy inputs used to carry out the AirCarbon manufacturing process, as well as material inputs, transportation, packaging, and product end-of-life. The conclusion, based on Newlight'sAirCarbon production process, which uses concentrated methane-based carbon emissions that would otherwise become part of air as a feedstock input: "AirCarbon is a carbon-negative material on a cradle-to-grave basis, as verified by independent third-party analysis performed by Trucost in cooperation with NSF Sustainability." **Please check labeling or packaging for grade-specific carbon footprint information.Change the World. Transform the products we use every day into products that reverse the flow of carbon.

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The Future of Wind Turbines? No Blades

Mr. Ajay Bhise (BE C), Mr. BhosaleUday (BE C)

It's no longer surprising to encounter 100-foot pinwheels spinning in the breeze as you drive down the highway. But don't get too comfortable with that view. A Spanish company called Vortex Bladeless is proposing a radical new way to generate wind energy that will once again upend what you see outside your car window.Their idea is the Vortex, a bladeless wind turbine that looks like a giant rolled joint shooting into the sky. The Vortex has the same goals as conventional wind turbines: To turn breezes into kinetic energy that can be used as electricity. But it goes about it in an entirely different way.Instead of capturing energy via the circular motion of a propeller, the Vortex takes advantage of what's known as vorticity, an aerodynamic effect that produces a pattern of spinning vortices. Vorticity has long been considered the enemy of architects and engineers, who actively try to design their way around these whirlpools of wind. And for good reason: With enough wind, vorticity can lead to an oscillating motion in structures, which, in some cases, like the Tacoma Narrows Bridge, can cause their eventual collapse.Where designers see danger, Vortex Bladeless's founders—David Suriol, David

Yáñez, and Raul Martín—sees opportunity. “We said, ‘Why don’t we try to use this energy, not avoid it,’” Suriolsays. The team started Vortex Bladeless in 2010 as a way to turn this vibrating energy into something productive. They just launched a crowd funding campaignto raise awareness of the technology.

The Vortex’s shape was developed computationally to ensure the spinning wind (vortices) occurs synchronously along the entirety of the mast. “The swirls have to work together to achieve good performance,” Villarreal explains. In its current prototype, the elongated cone is made from a composite of fiberglass and carbon fiber, which allows the mast to vibrate as much as possible (an increase in mass reduces natural frequency). At the base of the cone are two rings of repelling magnets, which act as a sort of nonelectrical motor. When the cone oscillates one way, the repelling magnets pull it in the other direction, like a slight nudge to boost the mast’s movement regardless of wind speed. This kinetic energy is then converted into electricity via an alternator that multiplies the frequency of the mast’s oscillation to improve the energy-gathering efficiency.

Its makers boast the fact that there are no gears, bolts, or mechanically moving parts, which they say makes the Vortex cheaper to manufacture and maintain. The founders claim their Vortex Mini, which stands at around 41 feet tall, can capture up to 40 percent of the wind’s power during ideal conditions (this is when the wind is blowing at around 26 miles per hour). Based on field testing, the Mini ultimately captures 30 percent less than conventional wind turbines, but that shortcoming is compensated by the fact that you can put double the Vortex turbines into the same space as a propeller turbine.

The Vortex team says there are some clear advantages to their model: It's less expensive to manufacture, totally silent, and safer for birds since there are no blades to fly into. Vortex Bladeless says its turbine would cost around 51 percent less than a traditional turbine whose major costs come from the blades and support system. Plus, Suriol says, it's pretty cool-looking. "It looks like asparagus," he says. "It's much more natural."

The company has already raised $1 million from private capital and government funding in Spain, and they have plans to close a round in the United States soon. There's enough interest, Suriol says, that he fields upward of 200 emails a day from people inquiring about the turbine. Of course, the technology still has a ways to go. They're hoping to have their first product, a 9-foot, 100-watt turbine that will be used in developing countries, ready before the end of the year. The Mini, it's 41-foot counterpart, will be ready in a year.

For the time being, you'll continue seeing pinwheels dotting the landscape, which Suriol is actually happy about. "We can't say anything bad about conventional wind turbines; they're great machines," he says. "We're just proposing a new way, a different way."

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Volvo Drive-E Engine

Mr. AdarshKudalkar(BE C), Mr.AltafBadiwale (TE A)

Volvo has been known as leaders in vehicle safety. With safety, comes other reasons why Volvo has the enthusiast's following it does today. Performance is a quality Volvo takes seriously. Turbocharging has been a part of the company's heritage since 1981. The mighty 242 Turbo showed that Volvo could boost up the horsepower to make it a player in the performance stakes. Turbocharging became an integral part of many Volvo cars since. It is not enough to turbocharger a car anymore. They are no longer made for just performance. Today's engines are demanding. They need to be a combination of performance and economy. They may have to be boosted to gain more horsepower and torque. While they need to be superlative in performance, they also need to be balanced, quiet and flexible. Volvo came up with a solution that combines

all of these attributes into one new line of engines. They call it Drive-E. It begins with a four-cylinder engine with a 2.0liter displacement. Codenamed VEP4, it is part of a new Volvo Engine Architecture that was engineered from the ground up. The goal of this new family of engines is to balance efficiency and performance.

To achieve this further, turbocharging is added for the first layer of added performance. These will become the new T5 engines. However, to replace the more powerful engines in the current lineup, the T6 adds a supercharger on top of the turbocharger for added performance, while achieving new benchmarks in fuel consumption. Current Drive-E engines available are the T5 turbocharged version with 240 horsepower and the T6 turbocharged and supercharged version putting out 302 horsepower. In the upcoming 2016 XC90, the T6 engine will be uprated to 316 horsepower. As an example of the kind of fuel consumption figures the Drive-E engines achieve, the S60 T5 FWD and V60 T5 FWD models can get up to 37 MPG. Drive-E engines can also accommodate additional electric motors for even more performance and efficiency. The 2016 XC90 will come with a plug-in hybrid version of the Drive-E engine called the T8. There are other plans for hybrid Drive-E models for the future, including plug-in models.

To get the Drive-E lineup of engines, choose from the 2015.5 S60, S80 T5, V60, XC60, and XC70. These models offer the Drive-E engine with front-wheel drive at this time. When the 2016 XC90 arrives, the Drive-E engine will be available in all-wheel drive. The new Volvo engine may have a different approach these days, but it did start from somewhere. From that start, the future seems bright thanks to the new lineup of Drive-E engines.

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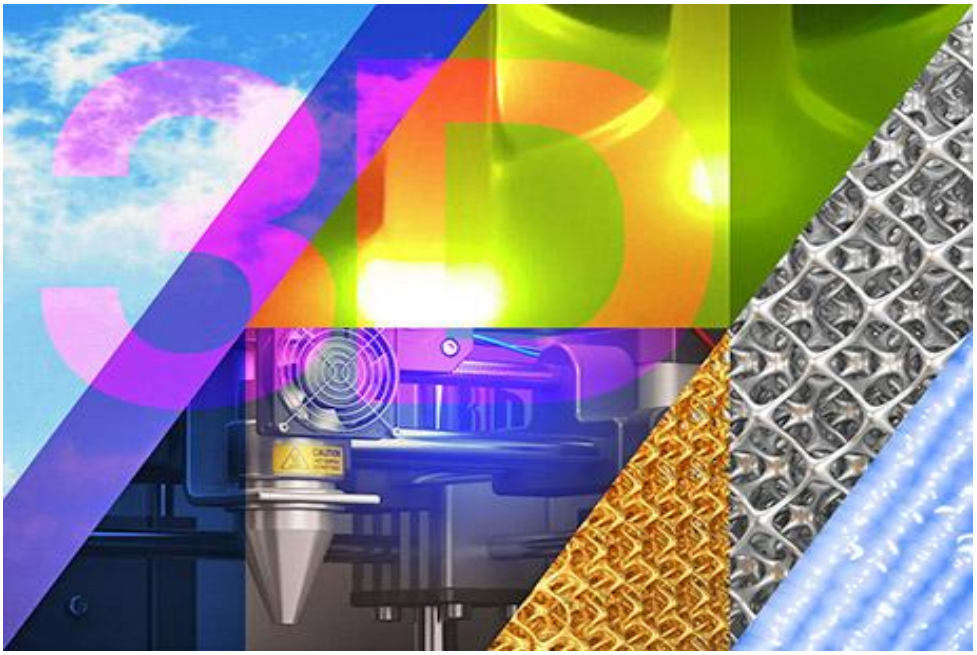
7 Startups Driving Innovation in 3D Printing

Mr. Pratik Patil (SE A), Mr. Pratik Mane (SE A)



The excitement of consumer 3D printing might be fizzling, but the excitement continues to build for industrial applications. It's a market still ripe for innovation and as expected there has been a surge of startup activity in the field of additive manufacturing. According to the Wohlers Report 2016, the AM industry surpassed $5 billion in 2015 and is expected to balloon to more than $26 billion by 2021. "The next frontier is to apply 3D printing to the production of parts for final products. This is where the largest opportunities lie and where most investments will be made in the future," wrote Terry Wohlers, president at Wohlers Associates Inc., in this article.In industrial engineering, 3D printing is being used to create jigs and fixtures, molds, or machine parts, thereby improving traditional manufacturing processes. The challenges of speed and scale still remain, presenting a fertile ground for innovative startups

to create new solutions. Below we round up seven startups that are developing novel technologies and aspiring to be the next big thing in 3D printing.

Parts produced by the RizeOne 3D printer. Image: Rize

1.RizeInc. Founded:2012Headquarters:Woburn,MA

Technology: RizeOne, an industrial grade 3D printer, which uses the company's augmented polymer deposition technology, promises zero post-processing of parts and no toxic fumes. It eliminates the task of refining so that parts can be released quickly from support structures without any filing or sanding. "Post-processing has been 3D printing's dirty little secret, as engineers and additive manufacturing lab managers wrestled with the reality that post-processing parts after 3D printing often doubled the total process time; added substantial costs; and prevented 3D printers from the desktop," said Frank Marangell, CEO of Rize. Rize One is designed to be used primarily by engineers and product designers for prototyping, end-use production parts and tooling, fixtures and jigs for manufacturing.

2.Carbon: Founded:201Headquarters:RedwoodCity,CA

Technology: Carbon's continuous liquid interface production (CLIP) technology is a photochemical process that pulls a solid product from a melt of plastic material, with mechanical properties, resolution, and surface finishes that are very similar to injection-molded parts. Due to the continuous printing process, objects made with CLIP don't have the same microscopic holes seen in traditional 3D printed parts. The company's co-founder and CEO Joseph DeSimone unveiled CLIP at the 2015 TED conference. Its first 3D printer, the M1, was launched in April and the early customers include Ford and BMW.

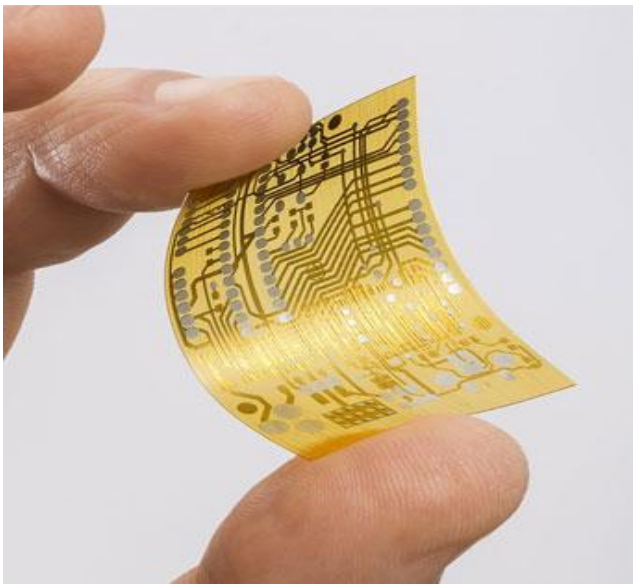
The Voxel8 3D electronics printer. Image: Voxel8

3.Voxel8: Founded:2014Headquarters:Somerville,MA

Technology: Leveraging over a decade of research from the materials science lab of Harvard Professor Jennifer A. Lewis, Voxel8 is looking to change the way the world creates 3D printed electronics. Its technology allows electronic devices to be printed in one piece, wires and all. The latest functional prototypes include a 3D printed digital watch, multiple 3D printed antenna designs, and 3D printed quadcopters. "We really believe to push the industry forward to creating finished parts. That's going to take the ability to co-print novel materials together," said Daniel Oliver, co-founder of Voxel8.

4.Markforged: Founded:2013Headquarters:Cambridge,MA

Technology: Another startup with its roots in Boston, Markforged, aims to bring high-strength 3D printing to everyday engineering. The company's Mark One 3D printer enables engineers to combine the design flexibility of 3D printing with the strength of carbon fiber, fiberglass, or Kevlar, creating fiber-reinforced plastic parts stronger than aluminum. Its newest 3D printer, Mark Two, can implement fiber reinforcement in features up to 15 times smaller than before, allowing for even smaller parts.



Close-up of a multilayer PCB printed by the DragonFly 2020 3D printer. Image: Nano Dimension

5.NanoDimension: Founded:2012:Headquarters:Israel

Technology: An Israel-based startup also trying to integrate electronics and 3D printing is Nano Dimension. Nano Dimension's technologies enable the use of nanoparticle conductive and dielectric inks for rapid prototyping of complex multilayer printed circuit boards (PCBs). Engineers can print either an entire board or just part of a circuit using the DragonFly 2020 3D Printer. PCB prototypes are a key component of the product development process for evaluating design before mass production and Nano Dimension wants to enable product development teams to develop, test, and iterate on the fly.

6.XJe: Founded:2005:Headquarters:Israel

Technology: Another Israeli startup Xjet aims to bring new levels of detail to the production of metal parts. Its patented Nano Metal Jetting technology uses nanoparticles instead of metal powder to create special liquid metals that can 3D print metal parts with better speed and surface finish. XJet's system print heads deposit an ultrafine layer of liquid droplets which contain metal-nanoparticles. This ink is delivered in sealed cartridges, achieving a new level in safety and simplicity, per the company web site.

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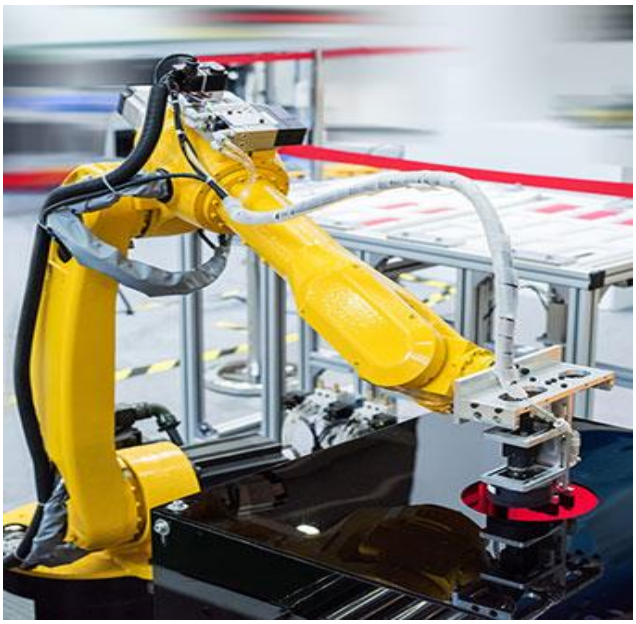
Robotic Self Starters

Mr.Omkar Patil (TE A), Mr. IjajMujawar (TE A)

Machine-intelligence startup Osaro of San Francisco aims to slash the time and skill needed to train industrial robots.

Manufacturers will use the in-house-developed operating system to teach robots how to take their own actions toward human-set goals. In other words, industrial robots learn from their human mentors, then keep learning on their own thanks to the software's algorithms. In a move that differs from the aim of other San Francisco startups (in late 2015, Osaro received $3.3 million in seed-rounding funding from some big names in computer software), the company plans to one day offer machine learning for industrial robots, which will allow manufacturers to perform more nimbly by reducing the time they spend training robots, says Derik Pridmore, Osaro's president The company plans to offer its artificial intelligence, machine learning operating system to industrial robot manufacturers and their customers in 2017. Why the focus on robotic training? Industrial robots aren't flexible. They need to be programmed, and then they

go on to perform programmed actions by rote. Imagine the cost and time savings that can come from industrial robots that teach themselves, he says. Osaro also wanted to put the operating system to work on a current problem, rather than within a developing robotics industry such as for drones or small robots that perform household duties.



Industrial manufacturing robots can now teach themselves how to perform according to human goals.

Robotic Training

Today, a skilled technician can spend weeks reprogramming an assembly-line robot, Pridmore says. His company's software should reduce that time to less than one week and help technicians program robotics that can cope on the fly with common manufacturing issues such as components that change shape and lines that change speeds. The technician trains the robot a few times on how to complete a task. The technician then scores the robot on success of failure at the task. Using those scores, the robot begins training itself, he says. Rather than a technician telling a robot what to do, it figures it out on its own. This type of machine learning is particularly useful in environments that change over time, such as a manufacturing plant, Pridmore adds.

The company's artificial intelligence operating system takes a deep learning approach that involves feeding the program large quantities of data to train it to make inferences based on new data. The system further blends deep learning with reinforcement learning, that is, teaching

machines how to carry out certain functions through trial and error, Pridmore says. Deep learning and deep reinforcement learning are two techniques that fall under the broad heading of machine learning, which is allowing algorithms to learn from data.

Quick Learner

Not only can robots powered by the Osaro operating system teach themselves, they are quick learners as well. The company's artificial intelligence system can pick up a game 100 times faster than Google DeepMind, Pridmore says. In December 2013, Google DeepMind showcased its artificial intelligence system that learns how to play video games similar to the way humans learn. The system mastered seven Atari 2600 games in a matter of hours and could outperform some of the best human players. In March 2016, AlphaGo, a Google DeepMind program that learns to play the game Go, won in four to one rounds against Lee Se-dol, the world's second-ranked professional Go player. With that kind of speed, the Osaro operating system's training process should be straightforward and effortless, Pridmore says. In the future, manufacturers will be able to show a robot a few parts, a finished product, and tell them to get to work on part assembly, he says. The Osara machine learning system is certainly a step beyond robotic arms like that from Universal Robot, of Denmark, which is itself a move beyond the type of commonly programmed industrial robots mostly seen today. In contrast to traditional industrial robots, the Universal Robots stay hardwired inside safety enclosures. As they run on electricity, they can be moved from site to site within a factory and can be reprogrammed, often by the person who had been doing the job the robot is set to take over, within minutes, says Scott Mabie, general manager of Universal Robots' Americas Division. A plant employee can quickly program the arm to perform a relatively simple, repetitive task, Mabie says.

With robots like these in the pipeline, Pridmore and Mabie expect manufacturers to slash set-up and production times, decrease downtime, and increase their bottom lines in the process.

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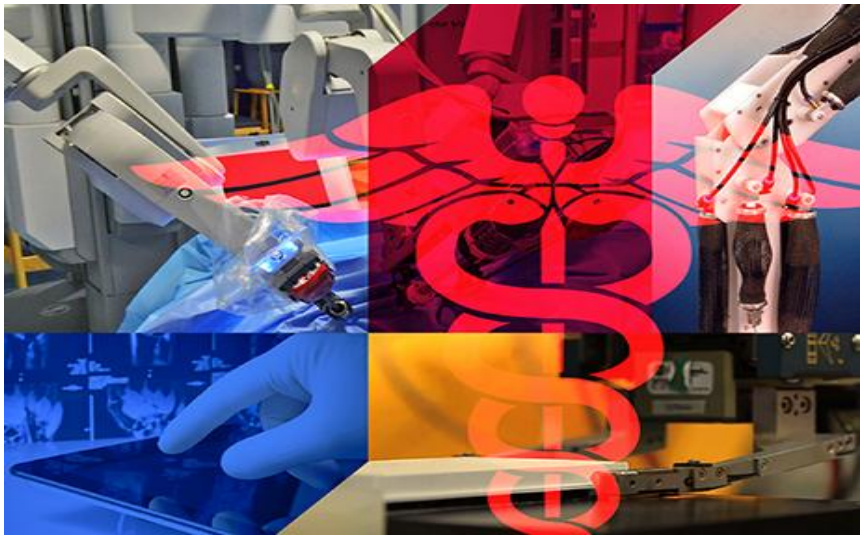
Top 6 Robotic Applications in Medicine

Mr. Sameer Giribuwa(BE C), Mr. Mahesh Gurav (BE C)



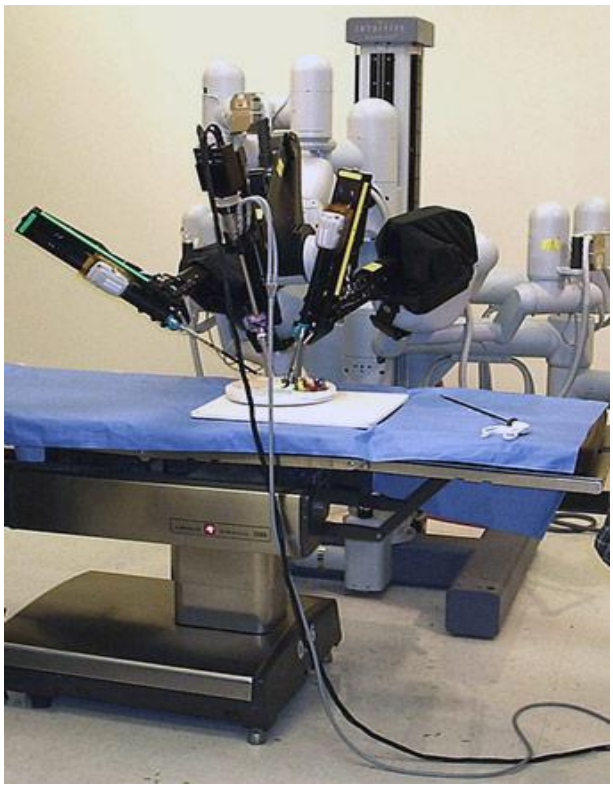
According to a recent report by Credence Research, the global medical robotics market was valued at $7.24 billion in 2015 and is expected to grow to $20 billion by 2023. A key driver for this growth is demand for using robots in minimally invasive surgeries, especially for neurologic, orthopedic, and laparoscopic procedures.

As a result, a wide range of robots is being developed to serve in a variety of roles within the medical environment. Robots specializing in human treatment include surgical robots and rehabilitation robots. The field of assistive and therapeutic robotic devices is also expanding rapidly. These include robots that help patients rehabilitate from serious conditions like strokes, empathic robots that assist in the care of older or physically/mentally challenged individuals, and industrial robots that take on a variety of routine tasks, such as sterilizing rooms and delivering medical supplies and equipment, including medications.Below are six top uses for robots in the field of medicine today.

1.Telepresence

Physicians use robots to help them examine and treat patients in rural or remote locations, giving them a "telepresence" in the room. "Specialists can be on call, via the robot, to

answer questions and guide therapy from remote locations," writes Dr. **Bernadette Keefe, a Chapel Hill, NC-based** healthcare and medicine consultant. **"**The key features of these robotic devices include navigation capability within the ER, and sophisticated cameras for the physical examination."



A robotic surgical system controlled by a surgeon from a console. Image: Wikimedia Commons

2.SurgicalAssistants

These remote-controlled robots assist surgeons with performing operations, typically minimally invasive procedures. "The ability to manipulate a highly sophisticated robotic arm by operating controls, seated at a workstation out of the operating room, is the hallmark of surgical robots," says Keefe. Additional applications for these surgical-assistant robots are continually being developed, as more advanced 3DHD technology gives surgeons the spatial references needed for highly complex surgery, including more enhanced natural stereo visualization, combined with augmented reality.

3.RehabilitationRobots

These play a crucial role in the recovery of people with disabilities, including improved mobility, strength, coordination, and quality of life. These robots can be programmed to adapt to the condition of each patient as they recover from strokes, traumatic brain or spinal cord injuries, or neurobehavioral or neuromuscular diseases such as multiple sclerosis. Virtual reality integrated with rehabilitation robots can also improve balance, walking, and other motor functions.

4.MedicalTransportationRobots

Supplies, medications, and meals are delivered to patients and staff by these robots, thereby optimizing communication between doctors, hospital staff members, and patients. “Most of these machines have highly dedicated capabilities for self-navigation throughout the facility,” states ManojSahi, a research analyst with Tractica, a market intelligence firm that specializes in technology. “There is, however, a need for highly advanced and cost-effective indoor navigation systems based on sensor fusion location technology in order to make the navigational capabilities of transportation robots more robust.”

Upper limb rehabilitation. Image: Center for Applied Biomechanics and Rehabilitation Research, National Rehabilitation Hospital, Washington DC

5. Sanitation and Disinfection Robots

With the increase in antibiotic-resistant bacteria and outbreaks of deadly infections like Ebola, more healthcare facilities are using robots to clean and disinfect surfaces. “Currently, the primary methods used for disinfection are UV light and hydrogen peroxide vapors,” says Sahi. “These robots can disinfect a room of any bacteria and viruses within minutes.”

6. Robotic Prescription Dispensing Systems

The biggest advantages of robots are speed and accuracy, two features that are very important to pharmacies. “Automated dispensing systems have advanced to the point where robots can now handle powder, liquids, and highly viscous materials, with much higher speed and accuracy than before,” says Sahi.

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Investigation of Solar Dryer with Thermal Energy Storage by PCM

Mr. Sunil Pujari (BE B), Mr. Sagar Mane (BE B)

Introduction

Food is a basic need for all human beings along with air and water. Food problem arises in most developing countries mainly due to the inability to preserve food surpluses rather than due to low production. Agricultural yields are usually more than the immediate consumption needs, resulting in wastage of food surpluses during the short harvest periods and scarcity during post-harvest period. Hence, a reduction in the post-harvest losses of food products should have considerable effect on the economy of these countries. More than 80% of food is being produced by small farmers in developing countries. Fruits and vegetables constitute a major part of the food crops in developing countries. From the limited data available on post-harvest losses in fruits and vegetables, it is understood that the actual losses are much higher. The minimum reported loss is 21%, while some references indicate estimates of above 40–50%. The most notable feature is that many varieties of fruits are seasonal and many of them are consumed in their dried form to a large extent which has been made possible by the process of drying. Preservation of fruits, vegetables, and food are essential for keeping them for a long time without further deterioration in the quality of the product.

Renewable sources of energy have emerged as a crucial option, on account of the greater energy demand, price volatility of fossil fuels, climate mitigation and energy crisis due to the increasing depletion of fossil fuels. However, the unpredictability of the output of renewable energy conversion systems demands robust, reliable and efficient technologies. Such systems can produce savings by reducing the energy use and displacing fossil fuel expenditures. The United Nations general assembly in December 2010 designated 2012 as the international year of sustainable energy for all, aimed at ensuring universal access to modern energy services, doubling the rate of improvement in energy efficiency, and doubling the share of renewable energy in the global energy mix by 2030, thereby achieving economic and environmental goals.

Accelerated renewable energy development can contribute significantly to a country's energy security, besides creating new jobs in rural areas and facilitating rural development. The renewable energy share of global energy consumption in 2010 are shown in *Fig.1.1*

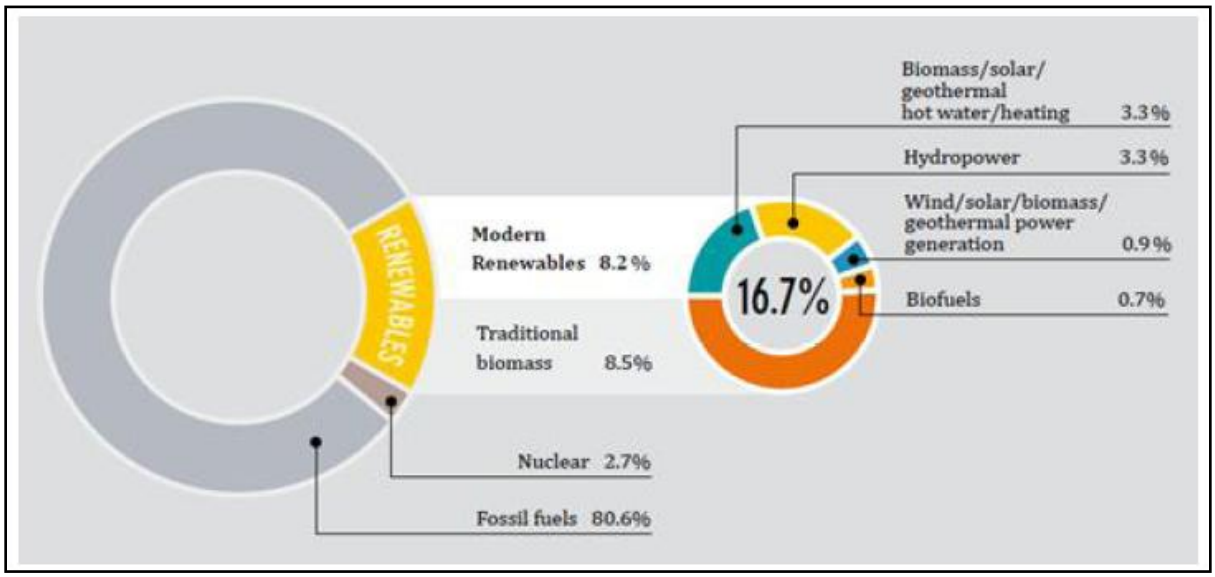

Fig.1.1 Renewable energy share of global energy consumption Source : REN 21 global status report in 2013

Solar energy is the one most abundant renewable energy source and emits energy at a rate of 3.8×10^{23} kW, of which, approximately 1.8×10^{14} kW is intercepted by the earth. The primary forms of solar energy are heat and light. Sunlight and heat are transformed and absorbed by the environment in a multitude of ways.Solar thermal energy is the cheapest and widely available renewable energy that often replaces fossil-fuelled or electrical water heating, reducing utility bills and greenhouse gas emissions. All the developed nations are in the process of promoting the use of solar energy for various applications.India is endowed with a high solar energy potential. India is actively pursuing the development of renewable energy technologies, especially solar based technologies, as high solar radiation is present in major regions, with a majority of days of clear sun.

1.1. Solar dryers:- Classification& Applications

Drying equipment may be classified in several ways. The two most useful classifications are based on (1) the method of transferring heat to the wet solids or (2) the handling characteristics

and physical properties of the wet material [6]. The first method of classification reveals differences in dryer design and operation, while the second method is most useful in the selection of a group of dryers for preliminary consideration in a given drying problem. A classification chart of drying equipment on the basis of heat transfer is shown in Fig. 1.8. This chart classifies dryers as direct or indirect, with subclasses of continuous or batch wise operation. Solar drying systems are classified primarily according to their heating modes and the manner in which solar heat is utilized. In broad terms they can be classified in to two major groups namely

- **Passive solar energy drying systems** (Conventionally termed natural circulation solar dryer systems) and
- **Active solar energy drying systems** (Most type of which are often termed as hybrid solar dryer)

Solar drying methods are usually classified to four categories according to the mechanism by which the energy, used to remove moisture, is transferred to the product:

1. **Sun or natural dryers:** The material to be dried is placed directlyunder hostile climate conditions like solar radiation, ambientair temperature, relative humidity and wind speed to achievedrying.
2. **Direct solar dryers:** In these dryers, the material to be dried isplaced in an enclosure, with transparent covers or side panels.Heat is generated by absorption of solar radiation on the productitself as well as the internal surfaces of the drying chamber.This heat evaporates the moisture from the drying product andpromotes the natural circulation of drying air.
3. **Indirect solar dryers:** In these dryers, air is first heated in a solarair heater and then ducted to the drying chamber.
4. **Mixed-type solar dryers:** The combined action of the solar radiationincident directly on the material to be dried and the airpre-heated in the solar air heater furnishes the energy requiredfor the drying process.

1.2 Introduction of PCM for Drying application

Drying is one of the most energy-intensive processes in agro-products industry. For this reason, using solar energy appears as an attractive not polluting alternative to be used in drying

processes. However, the daily and seasonal fluctuations in the radiation level require using energy accumulators with phase change materials (paraffin wax), to have continuous drying processes. The dryer includes paraffin wax as phase change material. The input variables were ambient temperature and solar radiation, both not controllable. Optimizing the use of solar energy. The idea to use phase change materials (PCM) for the purpose of storing thermal energy is to make use of the latent heat of a phase change, usually between the solid and the liquid state. Since a phase change involves a large amount of latent energy at small temperature changes, PCMs are used for temperature stabilization and for storing heat with large energy densities in combination with rather small temperature changes.

Figure.*Paraffin Wax*

The successful usage of PCMs is on one hand a question of a high energy storage density, but on the other hand it is very important to be able to charge and discharge the energy storage with a thermal power, that is suitable for the desired application. One major drawback of latent thermal energy storage is the low thermal conductivity of the materials used as PCMs, which limits the power that can be extracted from the thermal energy storage. As one of the goals of latent energy storage is to achieve a high storage density in a relatively small volume, PCMs should have a high melting enthalpy [kJ/kg] and a high density [kg/m^3], i.e. a high volumetric melting enthalpy [kJ/m^3]. Paraffins have an excellent stability concerning the thermal cycling,

i.e. a very high number of phase changes can be performed without a change of the material's characteristics.

1.3 Classification of PCM

PCMs can be broadly classified as

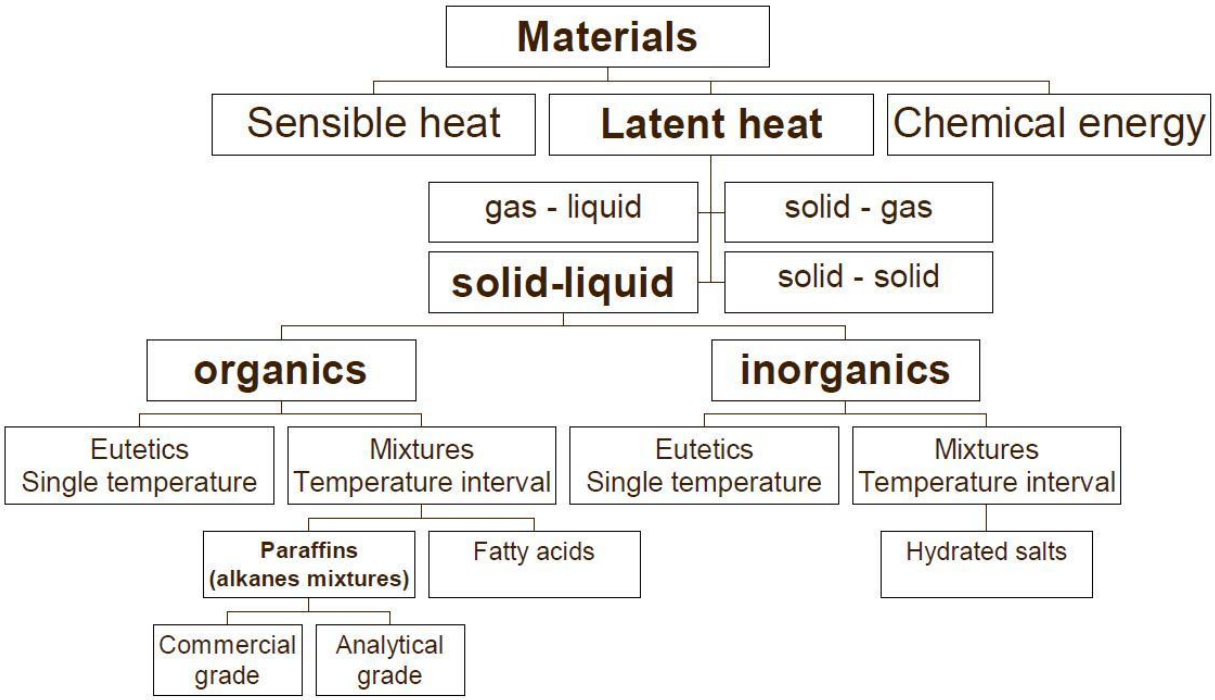

Figure.Classification of phase change material

Selection criteria and Properties of P.C.M. for drying application

Thermal properties:

1. Suitable phase-transition temperature.
2. High latent heat of transition.
3. Good heat transfer.

Chemical properties:

1. Long term chemical stability.
2. Compatibility with material of construction.
3. No toxicity.
4. No fire hazard.

Physical properties:

1. Favorable phase equilibrium.
2. High density.
3. Small volume change.
4. Low vapor pressure.

❖ **The advantages of using paraffin wax:**

1) It freezes without much super cooling.
2) It has ability to melt congruently.
3) It has self nucleating properties.
4) It is chemically stable.
5) It has high heat of fusion.
6) It is safe and non reactive.
7) It can be recycled easily

1.4 Solar Applications of PCM

1. Domestic or industrial solar water heaters

2. Space heating

3. Drying processes: Removing moisture from a dissolved solids/liquid mixture, paper, spools of dyed thread, hanks of yarn, fresh cut lumber, and countless other industrial products can be achieved through various thermal methods (cans, ovens, rotary, flash, dehumidification and spray dryers), for which solar thermal energy can be used. One typical drying process is crop drying, which usually occurs between 30 and 80^{o}C. The system can also be used for production of coffee, tea, maize and tobacco drying.

4. Fruits and Vegetable drying: drying of coconut is one of the applications in which PCMs can be used for drying purpose. It is done for extraction of oil used for domestic purposes. Drying of vegitables is done using solar energy. But the process of drying works effectively during the daytime and during night the process stops completely. The process can be made effective during night using thermal energy storage mediums.

5. Solar cooking

6. Washing processes: Typical applications for solar thermal washing systems are feed water for bottle washing and washing processes in textile industry and transport sector.

1.5 Selection of Phase Change Material for Drying Applications

The selection of the PCM for drying systems depends on the operating temperature range of the HTF which in turn is based on the application. A variety of PCMs exist, the temperature obtained by the HTF in flat plate collectors, and the desirable PCM properties, are the decisive factors in selecting the PCM. The test facility was meant for an application that demands hot air in a medium temperature range in between 50^0C to $60\ ^0$C.

The need to maximize the efficiency of the solar system restrains the selection of high melting temperatures of the PCM though higher storage temperatures could be advantageous for several applications. In such cases, the maximum heat gain can be obtained from the solar system and the fraction of high temperature energy requirement can be made available from other sources. The commercial phase change material (PCM), HS 58, which has a melting temperature of 57-58^o C was chosen considering the above factors The disadvantages of the PCMs are their cost and degradation of properties when subjected to high thermal cycling at high temperatures in long term TES applications.

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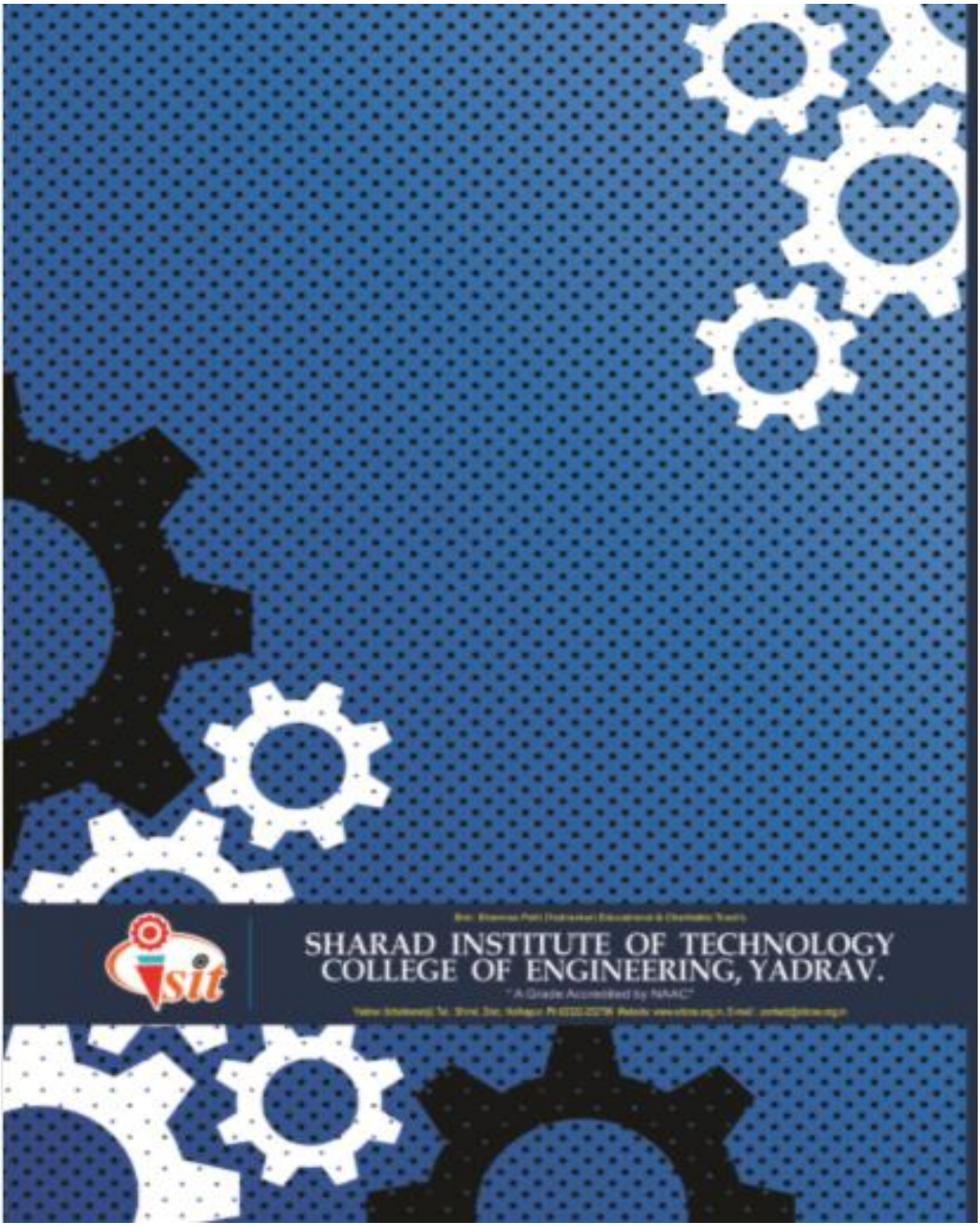
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