

Dear Industry Member,

This is a compilation of various activities and research interests of SSN Mech team, presented to you.

You are requested to identify areas of interest to you and consider interactions at various levels

- Internship for students
- Internship for faculty
- Sharing list of problems for students to take up as their project work
- Offering Student Innovation Competitions
- Offering research problem for PhD.Scholars

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AP1. Car bumper with Improved energy absorbing capacity

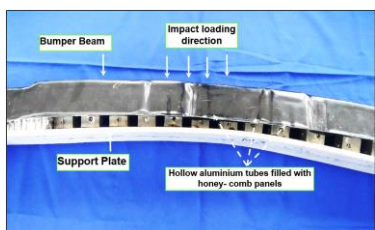
Automotive Products

Description of Technology : In this technology, the impact energy absorbing capacity of the car bumper beam has been increased by incorporating hollow aluminium tubes filled with Aluminium honey comb panels. Both lab scale and full scale testing (at ARAI-Pune) was carried out to develop the proof of concept.

Status of development : Developed the prototype and patent has been filed. Patent application no is **201841010364**. Can be developed further for customization.

Possible area of usage : The concept is suitable for all the existing cars which need additional impact energy absorbing capacity. In particular, the idea will be suitable for all brands of Light Commercial Vehicles.

Images with description: In general, bumper in automobiles is considered as the front-most and rear most part designed to withstand damage to the vehicle's safety systems. In this concept, impact energy absorbing capability of car "bumper beam" portion has been enhanced by incorporating "**hollow Aluminium tubes filled with aluminium cellular structure**". Number of hollow tubes were arranged along the bumper beam to improve their crash behaviour. Both lab scale and full scale testing of the bumper have been conducted.



(a) Bumper beam with hollow aluminium tube (b) Aluminium honey comb panel (c) full scale bumper testing facility

Fig. Concept of full scale bumper model with testing facility

In order to understand the service performance of the bumper, three bumper beam models were developed. Bumper beam model-1 was unfilled with other elements. In model-2, series of aluminium hollow tubes filled with aluminium cellular structures was implanted. The hollow aluminium tubes comprise of deformation triggering mechanism which will accelerate the plastic deformation within a short period of time. In model-3, only aluminium cellular structure was embedded. The models were tested at authorized test centers of automobiles ARAI for about 15 km/hr speed. The test details are tabulated.

Sl.No	Bumper Model	Crush time	Velocity	Peak acceleration	Energy absorbed
		milli-second	(m/s)	m/s ²	J
1	Model-1	36	-0.8	117.3	6595.0
2	Model-2	45	-1.6	118.0	12954.3
3	Model-3	43	-4.3	104.5	21080.5

It was observed that, by using aluminium cellular structure as filler material of bumper beam, **three times higher (3 times) impact energy can be absorbed** compared to unfilled model.

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AP2. Hybrid bumper system

Automotive Products

Description of Technology: A hybrid bumper system is proposed, comprising of a primary stage pneumatic spring loaded piston and a secondary stage hydraulic fluid loaded piston of varying cross sections built in a single cylinder acting as a unitary unit to absorb the energy from low and high speed impact collisions of any moving vehicle. The hybrid system used unitarily or in multiples, can be attached to the front, rear and sides or any part of a moving vehicle to provide all-round safety to the vehicle and its occupants by absorbing the impact from any direction.

Status of development : Patent filed - Patent ref Number- 6062 /CHE/2014

Possible area of usage: Can be fitted to automobiles along any direction, to strengthen their bumper systems , enhancing the capability to absorb more impact.

Images with description:

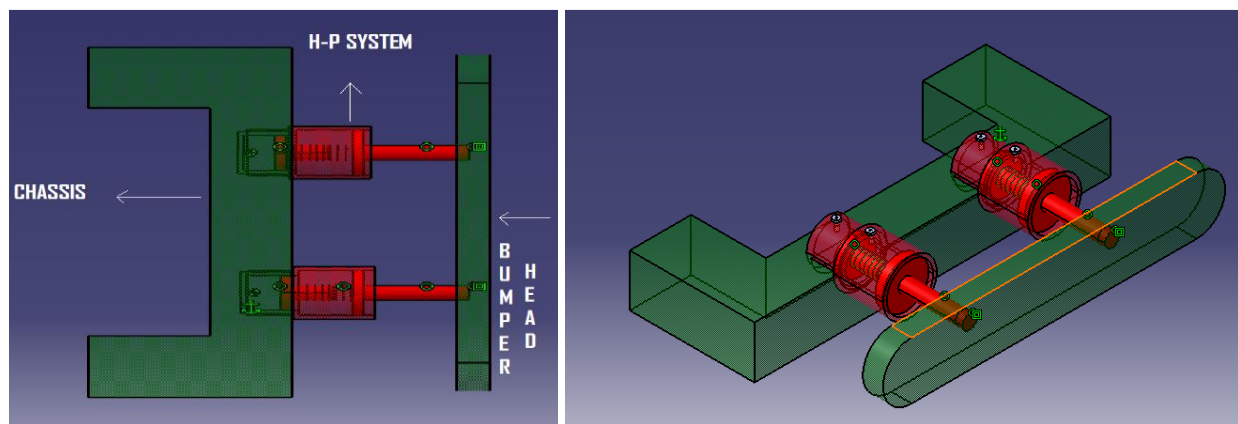
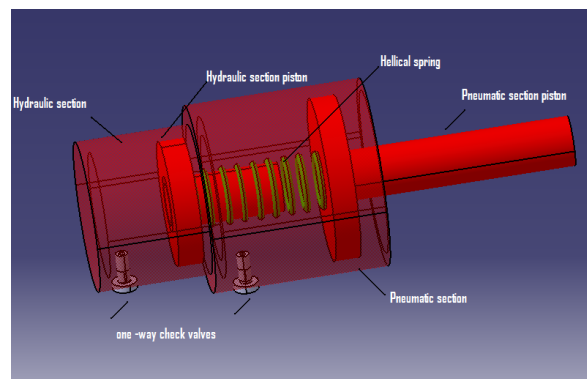


Figure 1(a) Top view of the bumper system

1(b) Front view of the bumper system



1(c) Detailed view of the single bumper system

Figures 1(a) shows the 3D model top view of the bumper system showing the method of fitting two bumper systems to the head bumper. Figure 1(b) shows the 3D model front view of the bumper system. Figure 1(c) shows the 3D model detailed view of a single bumper system with the pneumatic spring loaded part and the hydraulic fluid loaded part.

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AP3. Escape provision for car during drowning

Automotive Products

Description of Technology In this concept, a novel mechanism has been developed to enhance the escape-worthiness of car occupants.

Status of development: A patent has been filed for this concept. (Ref No. **201841030306**)

Possible area of usage: The concept can be implemented in all the existing cars with little modifications. Especially the idea is suitable for Light Commercial Vehicles.

Images with description :

In this innovation, an attempt has been made to improve the escape worthiness of car occupants when the car is under drowning condition. It has been achieved by a novel mechanism which will open the roof of the car, the moment the car starts to sink. Various possible car sinking mechanisms and flow behaviour were studied to optimize the design parameters of the mechanism. Both prototypes and full scale models were tested to validate the functioning of the present mechanism and it showed a good response even under critical orientation of car drowning. Care has been taken while designing a mechanism in such a way that, it should not function during normal raining condition, it could also be triggered manually, and it should not reduce the air-conditioning comfort of the passenger. Furthermore, the present innovation will help the occupants to escape from a car when the car doors get jammed due to road accidents. The Concept of the mechanism and full scale testing images are shown in figure.



(a) Concept of escape worthiness



(b) roof opening Mechanism



(c) Full scale testing of car –orientation1



(d) Full scale testing of car –orientation 2

Fig. Concept of escape-worthiness and full scale test facility

The main advantages are

1. The death toll of the occupants due to car drowning can be minimized to a greater extent
2. The mechanism is less in cost, easy to be incorporated and ensures maximum safety against critical situations such as sinking, fire accidents and jammed doors.

The innovation reduces the human (including kids) effort and injuries while escaping from a drowning vehicle.

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AP4. Seats with improved Thermal comfort

Automotive Products

Description of Technology: The thermal comfort of occupant in seats has become more important due to their increasing mobility, leading to more time spent by people over a particular position in seats.

Our project discusses the thermal comfort of human being when subjected to sitting in a chair/seat, for a prolonged period of time.

Seats, in general, hinder the heat and moisture transport from the human, back to the environment, bringing thermal discomfort for a seated person. So people may feel uncomfortable due to the heat buildup.

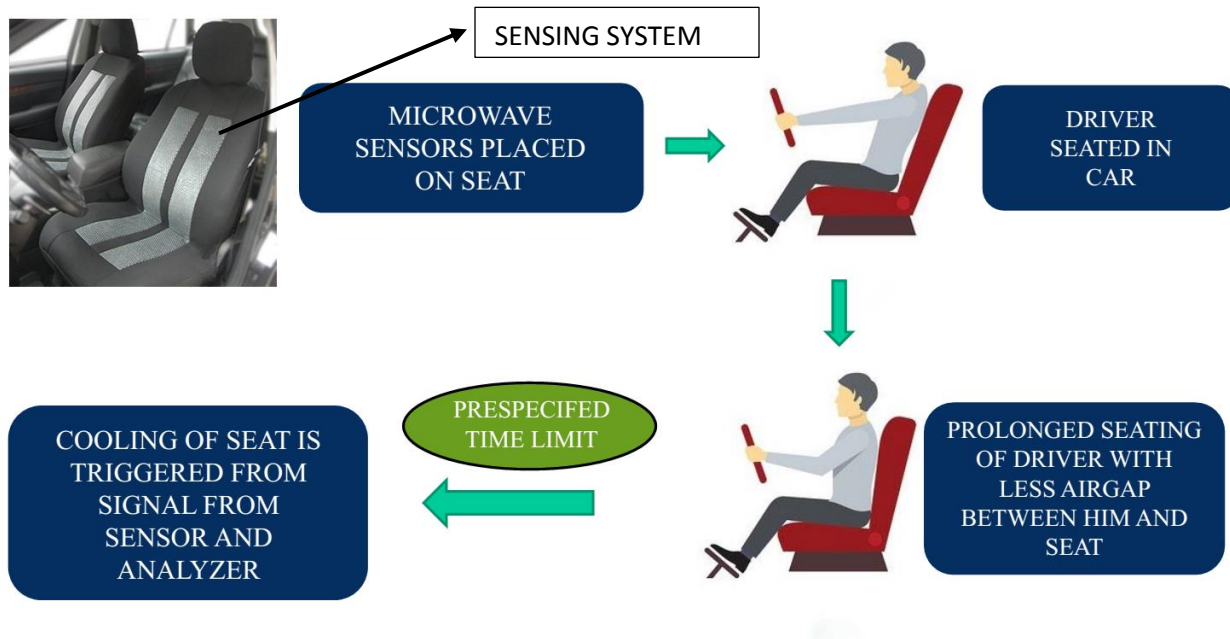
This heat will produce various ergonomics problem to a seated person. So evaluating the “thermal discomfort” of the seated person is very much important in order to prevent him/her from suffering ergonomics problem.

In this work, we developed a Sensing system integrated with Car Seat to trigger the Thermal Comfort System developed with Peltier module to create a cooling environment between the seated person and car seat.

Status of development: Prototype made; currently in the process of Optimizing the Algorithm's. Patent to be filed.

Possible area of usage: Automobile Sector - OEM Companies for Auto Sector

Images with description: photo or picture with salient features / parts marked.



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AP5. Fiber reinforced Plastic (FRP) connecting rod for IC Engine Automotive Products

Description of Product: A FRP engine connecting rod is a linking rod between the piston head and the crank shaft, transferring the engine power. This FRP connecting rod has high strength and reduction in weight up to 75% compared to the conventional metallic engine connecting rod. The fibers are aligned in such a way suitable to counter all possible forces acting on an engine connecting rod. By using FRP engine connecting rod, the heavy weight steel connecting rod can be replaced to achieve fuel economy.

Status of development: Prototype of the FRP engine connecting rod has been developed and a patent has been filed.

Possible area of usage: Can be used in a single cylinder IC engine as a connecting rod between piston head and the crank shaft.

Images with description:

Any automobile part manufactured at present needs to be weight saving for better fuel efficiency and economy. In this connection, it was planned to replace the engine connecting rod which are made of high strength steel by FRP engine connecting rod. FRP materials have very good strength and can withstand very high temperatures.



The FRP engine connecting rod at our institution was made using a simple hand layup arrangement incorporating the fibers in a desired fashion.

(Work done by mech students under the guidance of Professor of Civil Engg dept)

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AP6. Fiber reinforced Plastic (FRP) open coil springs

Automotive Products

Description of Product: A FRP open coil spring can be used in the place of steel open coil springs in automotive vehicle suspension system. This FRP open coil spring has low weight and high strength combined with anti-corrosiveness properties. FRP springs made of high strength fibers are aligned in such a way to counter the torsional force developed in an open coil spring.

Status of development: Different types of FRP open coil springs have been developed and a patent has been filed.

Globally research is being carried out to find a suitable material which has high strength and is light in weight, especially in moving parts of a machine where energy could be saved leading to fuel economy.

In the automotive sector the use of FRP has become inevitable to gain more mileage. In this relation, the weight of steel open coil suspension springs used in automobiles was planned to be reduced by replacing the steel springs by FRP open coil springs which weigh much lower.

The open coil springs which were developed at our institution were manufactured by using a semi mechanised method and was tested at our laboratory for its functionality and performance under test loading condition. This product developed can be directly used for field applications.

Possible area of usage: Can be used in automobile suspension system and other places where suspension effect is needed, coupled with weight reduction such as in the fields of aerospace, defense, biomedical etc.

Images with description:



(Work done by mech students under the guidance of Professor of Civil Engg dept)

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AP7. Slow release clutch mechanism

Automotive Products

Description of Technology: The present invention is related to a clutch manipulating mechanism in an automobile.

More specifically, it describes about the design of slow release clutch mechanism to assist the drivers in moving the vehicle from standstill without getting the engine-off by releasing the actuated clutch pedal gradually after the gear shift. This clutch operating assistance will find utility mostly for the learner drivers until they learn proper driving in an automobile.

Status of development: Patent Application number 201741034676 . Status -Published

Possible area of usage: For all automobile driving learners to practice driving.

Images with description:

An additional spring loaded gear moving on a guided circular rack ensures slow release of the clutch.

The mechanism is arranged such that it can be either engaged or disengaged when not required.



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AP8. Adjustable wheel wrench

Automotive Products

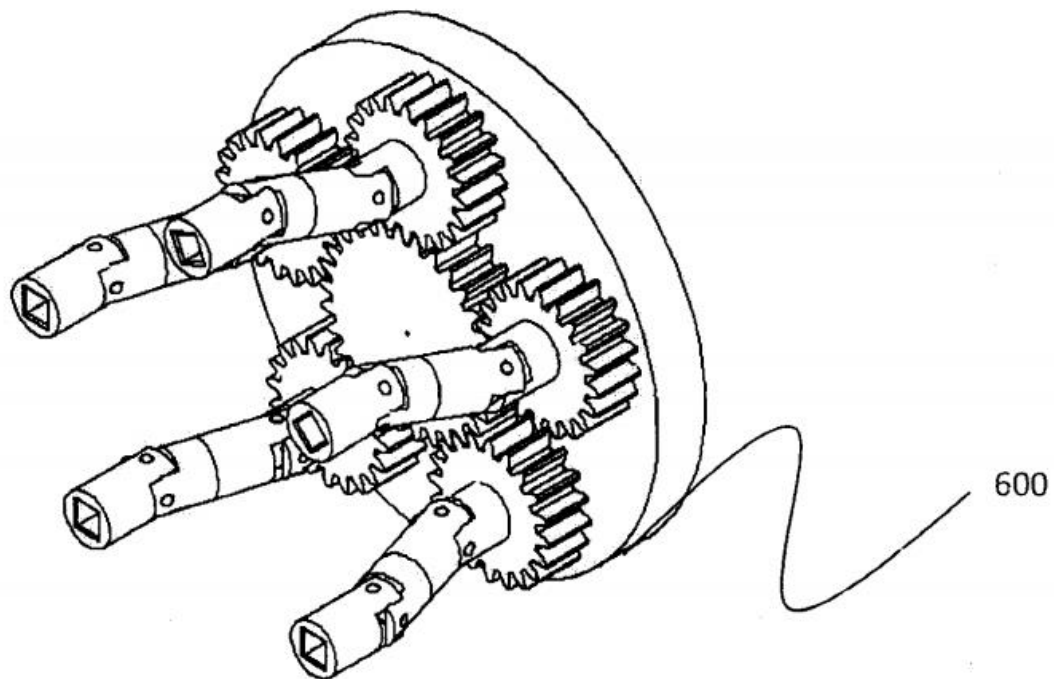
Description of equipment : A method of designing an adjustable wheel wrench that is capable of loosening and tightening of more than two lug nuts arranged in any pitch circle diameter of a light motor vehicle at the same time, comprising of

- 1) a double universal coupling to connect gears with lug nuts
- 2) the wrench which comprises of square shaped recess cut into the gear into which the double universal coupling can be inserted.
- 3) a spur gear train to transfer power from a central shaft to multiple parallel shafts.
- 4) a flexible shaft , keyed to the gears whereas this flexibility allows to adjust the shaft to match pitch circle diameters (PCD) of various wheels.
- 5) a double universal coupling that provides necessary degree of flexibility to remove wheels with 'n' number of nuts arranged in a square pattern.

Status of development: Equipment available. Patent applied . Patent number 201641009930

Possible area of usage: Can be used for wheel removal in light vehicles.

Images with description:



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AP9. Retractable wheels based Dynamic stabilizing attachment for Motor cycle

Description of Technology : The present invention relates to an attachment which will assist the rider to balance the two wheeler under life-threatening road environments.

Status of development : A patent has been filed for this concept. (Ref.No.: **201741003692**)

Possible area of usage : This concept can be implemented to all the two wheelers where the rider safety becomes most important. The idea can be best used for Motorbikes.

Images with description :

Motor cycle riding on city streets under dense traffic is becoming difficult and tedious. It is necessary for the rider to frequently stop and start, while balancing the bike with one foot on the ground.

This difficulty has become more pronounced as the weight of motor cycles has increased in recent years. Some of the larger bikes are very difficult to manage in crowded areas. In order to overcome this, a dynamic balancing attachment for a motorcycle is proposed.

Primarily, the attachment consists of a curved main arm in which the auxiliary wheels are mounted. The arm can be fixed to the central frame of the motorcycle (between the front and rear wheels) without causing any modifications in the motorcycle. The frame can be actuated by a motorized control which can be triggered by the rider.

The dynamic balancing apparatus assists the rider at the time of tricky situations caused at the road surfaces and small impact received from neighboring vehicles. In addition, the innovation reduces the effort required to balance the vehicle even under static condition of the motorcycle. Figure shows the top and side views of the proposed mechanism.

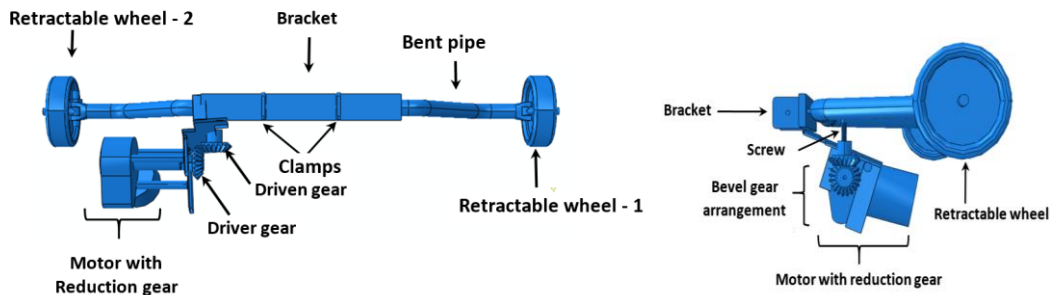


Fig. Concept of dynamic stabilizing mechanism for two wheeler rider

The following are the important advantages:

The proposed innovation completely replaces the center stand as the wheels can be locked to the floor. The present location of the mechanism will not affect the sitting comfort of rear passenger. The frequent activation and deactivation of the mechanism will not hurt the rear passenger. No major modifications of the motor cycle is required as the attachment is directly attached to the central frame.

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AW1. Aluminium / copper cold plate (Fabricated by Friction Stir Welding)

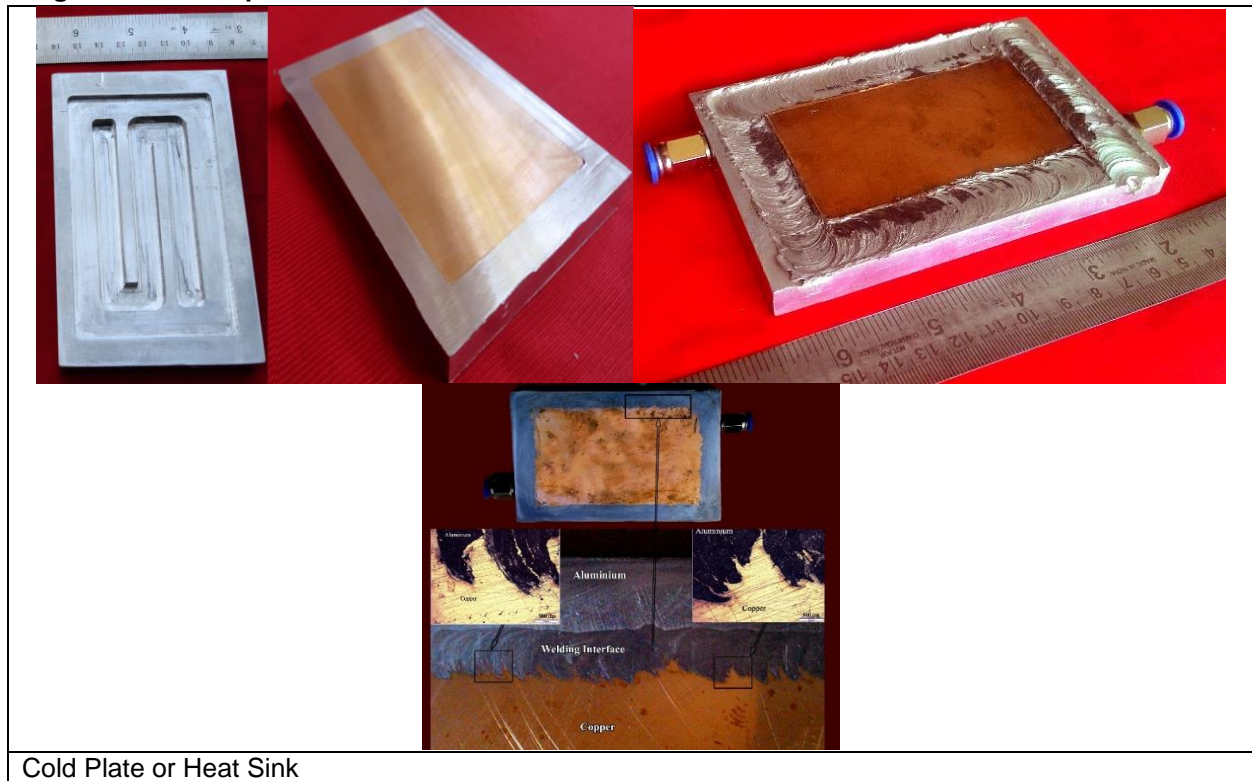
Description of process: An attempt is made to design and fabricate a cold plate with aluminum-copper dissimilar interface joined by friction stir welding. Optimum welding conditions for obtaining sound-quality corner and T joints with an aluminum-copper interface were established. Welded cross sections of the friction stir welded cold plate were analyzed to understand the bonding characteristics. Computational fluid dynamics (CFD) was used to evaluate the fluid-flow characteristics and thermal resistance of friction stir welded cold plate and the results are compared with the conventional bolted cold plate configuration. For CFD modeling of a cold plate with a dissimilar interface, a new methodology is proposed. From the CFD analysis and experimental results, it is observed that friction stir welded cold plate offered better thermal performance compared to the bolted cold plate and it is due to the metallurgical bonding at the aluminum-copper interface with the dispersion of copper particles.

Welding without consumables, non polluting and non fuming. Metals are joined by Plastic deformation by a moving/ rotating tool, using frictional heat.

Status of development: Product developed and tested to be better than bolted cold plates. Can be scaled up, based on need.

Possible area of usage: Can be attempted as an environmentally friendly alternate to bolted cold plates of any configuration, with enhanced thermal performance.

Images with description:



Cold Plate or Heat Sink

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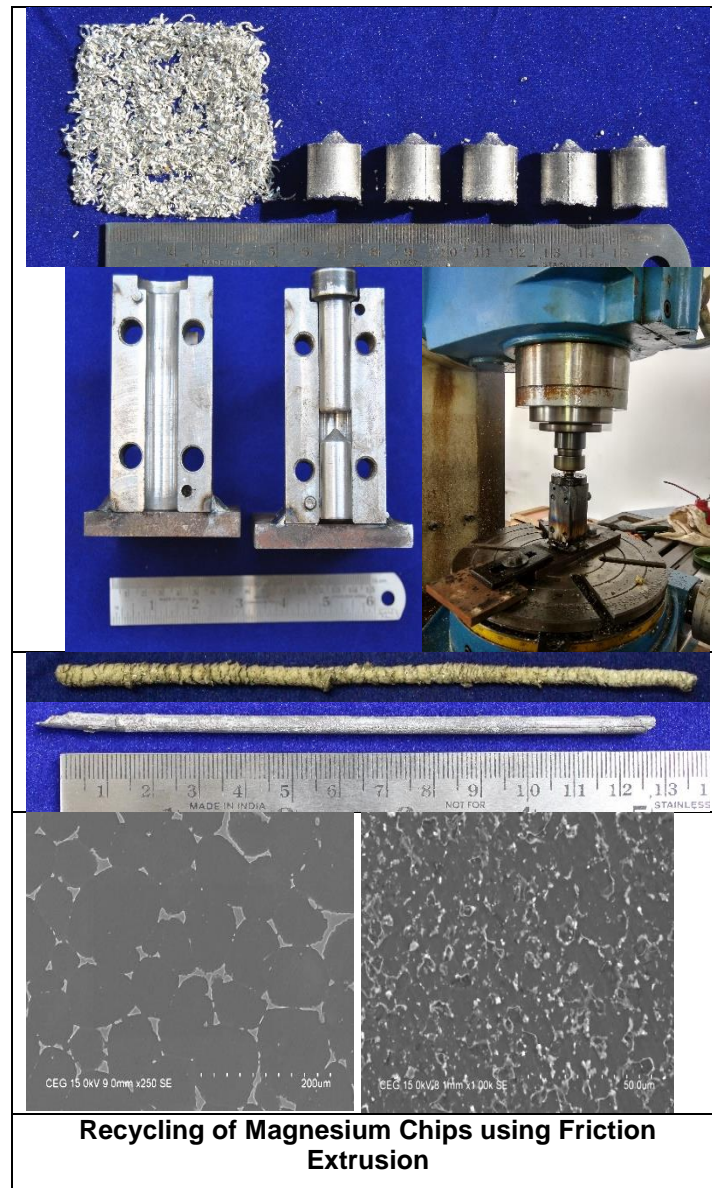
Advanced Welding related products / technologies

AW2. Recycling of Magnesium chips into tubes (by Friction Stir Extrusion)

Description of process: Friction stir back extrusion (FSBE) is a method of fabricating lightweight tubes with refined microstructure, based on the principle of Friction Stir Welding (FSW). Present process is to convert magnesium chips into tubes, by the novel process of FSBE. Machined chips are consolidated by Plastic deformation by a moving/ rotating tool, using frictional heat and extruded as a wire or tube.

Status of development: Process successfully developed for magnesium chips. Can be studied on other soft ductile material chips also.

Possible area of usage: Can be attempted to fabricate Magnesium wires from chips, which can be used for welding and repair work on magnesium alloy components, Mg wires for additive manufacturing, Mg tubes for biomedical applications.



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Advanced Welding related products / technologies

AW3. Micro tubes by friction stir back extrusion

Description of process: Friction stir back extrusion (FSBE) is a method of fabricating lightweight tubes with refined microstructure, based on the principle of FSW. This involves fabrication of Magnesium Wire and Tubes using solid state recycling of machined chips or rods. These are consolidated by Plastic deformation by a moving/ rotating tool, using frictional heat and extruded as a wire or tube.

Status of development: Process being researched for making micro tubes from rods.

Possible area of usage: Can be attempted to fabricate Magnesium pipes for structural applications, heat pipe fabrication and Magnesium tubes for biomedical applications.



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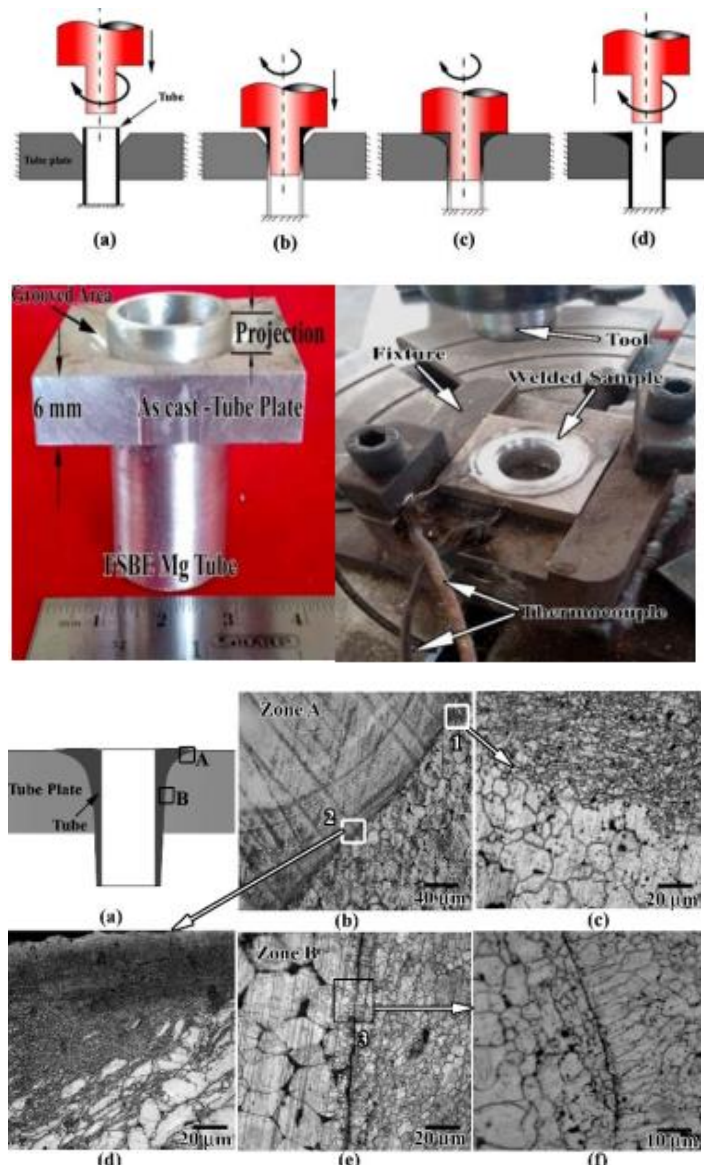
AW4. Tube to plate welding (by Friction Stir Welding)

Description of process: Welding tubes onto plates, without consumables, by a non-polluting and non-fuming process. Metals are joined by plastic deformation by a moving/ rotating tool, using frictional heat.

Status of development: Process established for aluminium , magnesium, copper and soft alloys . Process being researched for hard materials (steels).

Possible area of usage: Can be attempted as an environmentally friendly alternate to any welding process, in automotive industries. Process can be developed for any specific welding requirement.

Images with description:



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AW5. Rare Earth Metal Added welding rods

Description of Technology: Development of welding rods with rare earth metal addition. The new filler rods were used for welding Aluminium Alloy Plates to enhance the weld strength and thereby to reduce the Structural Dead-Weight and to increase the Payload Capacity.

Status of Development: Prototype made. Can be developed further for Customization.

The 5000 series aluminium alloy, AA5083-H111 was taken for Study and Tungsten Inert Gas Welding was performed to join the two plates with the help of the commercial filler rod ER5356. A cast filler rod was manufactured by adding Scandium with 5356 filler material using stir casting techniques.

The welded joints were subjected to Mechanical Characterization, such as, tensile testing and hardness measurement, using universal testing machine and vicker's hardness tester. It was found that the tensile strength of the scandium added filler rod used joints, produced better joint efficiency, than that of the commercial filler rod welded joint. The reason for the enhancement of tensile property may be due to addition of Scandium and the formation of Al_3Sc nano precipitates.

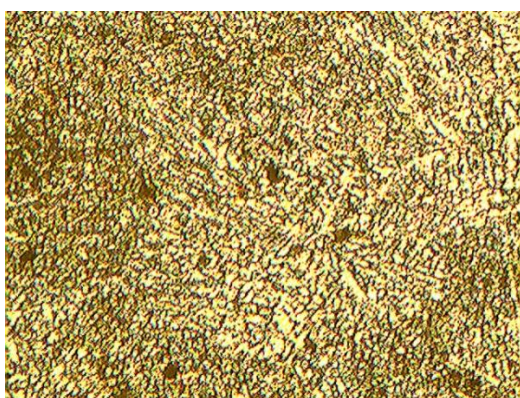
Table.Tensile properties of TIG welded joints of AA5083-H111 Aluminium Alloys with ER5356 Filler rod with and without scandium addition.

No.	Type of Joint	Tensile Strength, MPa	Elongation, %	Jt. Efficiency, %	Fracture Location
1	Scandium-Free	195.5	5.50	65.54	Weld
2	Scandium-Added	287.5	13.75	96.38	Weld
3	AA5083-H111Base Metal	298.3	31.1	-----	-----

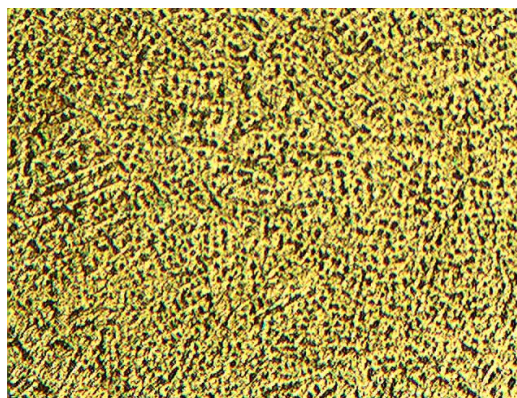
Scandium addition with ER5356 Filler Rod welded joints were better than that of the other joints made by ER5356 Filler Rod . An enhancement of 92MPa in tensile properties and 8.25% in ductility was observed.

Possible Area of Usage: will be useful, wherever weight reduction of the primary structures and increase in Payload is required.

Images with description: Same as normal welding filler rods for Aluminium Alloy plate Joining.



Microstructure of Sc free weld



Microstructure of Sc containing weld

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EP1. Air-inlet mechanism for compressed air driven engines

Description of Technology: Mechanism to admit compressed air to run a piston-cylinder arrangement.

Status of development: Prototype made. Patent filed. Patent ref Number- 4646/CHE/2012

Possible area of usage: To run any existing or new two stroke or four stroke engine

Images with description:

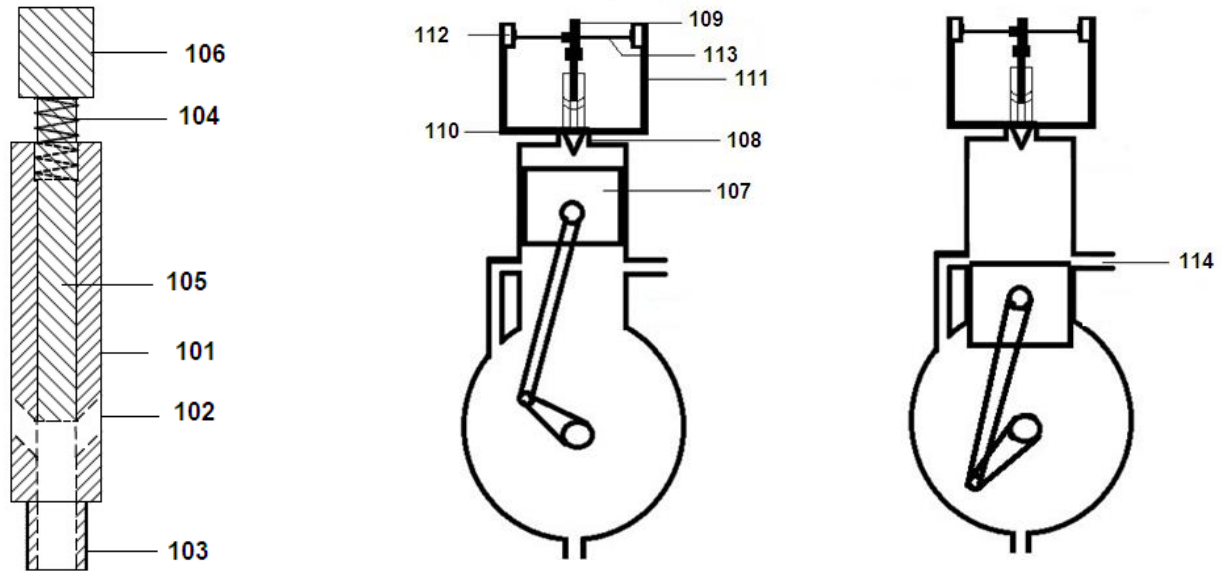


Figure shows the inlet mechanism is a hollow cylindrical piece (101) with angular inlet nozzles for compressed air, in which the plunger (105) reciprocates. Angular drills (102) are provided for the arms to direct the flow of compressed air into the engine. The spark plug used in the engine is replaced by the threaded head (103) of the inlet. The engine head has a threaded internal bore (108), to accommodate the spark plug, which has now been replaced by the inlet mechanism. A spring (104), is used to enable return motion of the plunger. The inlet mechanism has a plunger (105) which reciprocates in the bore (108), to control the flow of air into the cylinder. The plunger (105) is actuated by a cam (109). The cam (109) is designed such that inlet of compressed air is allowed into the cylinder only when the piston (107) is near the top dead center. When the exhaust port (114) begins to open, the plunger (105) shuts off the supply of compressed air into the cylinder. Spring force is used to push the plunger (105) back to continue the cycle. The feed for the cam (109) shaft is obtained from the crank shaft itself, by means of a chain drive.

Figure 2 shows the inlet support mechanism which is fitted to the top of the engine head. It consists of a base plate (110), which is attached to the engine head to support the inlet mechanism. Two vertical plates (111) are welded to a base plate (110) in order to accommodate the bearings (112) which are used to support the cam shaft (113) which is coupled to the crank shaft by means of a chain drive.

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Energy Related Products and Technologies

EP2. Vortex tube cooler

Description of equipment : It is a mechanical device that separates compressed gas into cold and hot streams. It can find its applications in the cooling of machine tools. The cold end of the vortex tube shall be kept in the coolant tank and cold air shall be bubbled through the liquid coolant. Due to this arrangement, the coolant is cooled by sensible cooling due to cold air from vortex tube as well as evaporative cooling due to mixing of cold air with coolant.

Benefits: Flexible, can be easily moved from one machine to another machine, Compact size, No moving parts, low cost, maintenance free, will improve tool life and the overall production.

Status of development: Equipment is available. Process is established. Can be offered for customer requirements based on specific applications.

Possible area of usage: Can be used to i) cool grinding wheels in grinding machines, ii) cool cutting tools in lathes, milling machines and CNC machines during machining operations.

This cooler was tested in an industry manufacturing grinding wheels. 10 litres of coolant (which is used for grinding application), was cooled from 33°C to 25°C (8°C reduction in temperature) in 1 hour.

Images with description: This concept was presented at IMTEX 2017 (Indian Metal cutting Machine Tool Exhibition), Bangalore as part of the exhibition of academia projects during January 26 – February 1, 2017 and was awarded second prize with cash of Rs. 12,500/-.



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General Implements

GP1. Automatic table loom

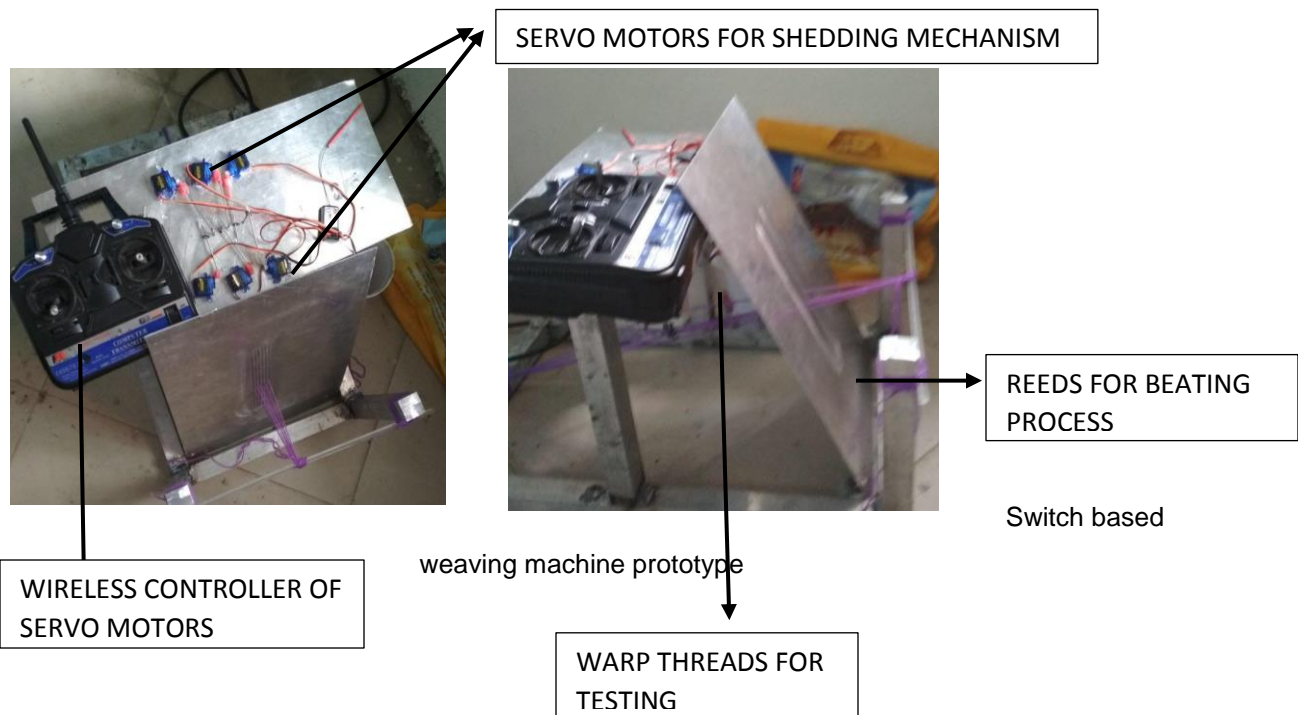
Description of Technology: A loom is a device used to weave cloth and tapestry. The basic purpose of any loom is to hold the warp threads under uniform tension, and to lift the warp threads in a designated sequence of order to allow the passage of the weft threads which will be inserted sideways with the help of a shuttle. Though the precise shape and size of the looms may vary, the basic function of a loom remains, more or less, the same.

The main objective of our project is to automate the process of weaving by using servo motors and remote control, to reduce considerably, the time taken and the manual work input required by the traditional looms, and to reduce significantly the production cost of the woven fabric. While doing so, we are also aware that electronic power looms are in fact used by industries to produce bulk material, which are very expensive. We intend to improve the efficiency, only of the domestic weaving machines and the quality of the output cloth at an affordable cost.

Status of development: Prototype made; currently in the Process of Upgrading it to Full Scale Weaving Machine.

Possible area of usage: Weaving Sector; Ministry of handlooms and textiles

Images with description :



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General Implements

GP2.Stretchable Wheelchair

Description of Technology: Newly designed structure functions as bed, stretcher and wheelchair.

Status of development: Prototype made. Can be developed further for customization.

Possible area of usage: Will be useful as an aid for people who are admitted in the hospitals.

Images with description:



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General Implements

GP3. Air conditioner cum auxiliary cooler with evaporative condenser

Description of Technology: An improved air conditioning system that utilizes the condensate water from evaporator to enhance the cooling of the condenser coils, thereby increasing the cooling effect. It integrates conventional air conditioning unit and a condenser cooling mechanism along with an auxiliary cooling set up that provides natural evaporative cooling to a small storage space.

Status of development: Prototype made and tested.

Possible area of usage:

An integrated AC cum vegetable/fruit storage unit.

Will be useful to meet domestic cooling requirements

Images with description:



Evaporator side of the unit



Condenser side of the unit with condensate water spray arrangement

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Manufacturing Support systems

MS1. CAD / CAM / 3D Printing facility

Name of the Equipment:

3D Printer - 500 x 500 x 500 mm printing range with PLA, ABS, Composites.

Software capability : CREO / SOLID WORKS/ ANSYS/CATIA/MATLAB/ABAQUS

Description of the capabilities:

2D and 3D Designs of structures/ automobile parts/ can be developed and optimized using CREO ,SOLID WORKS and CATIA Software.

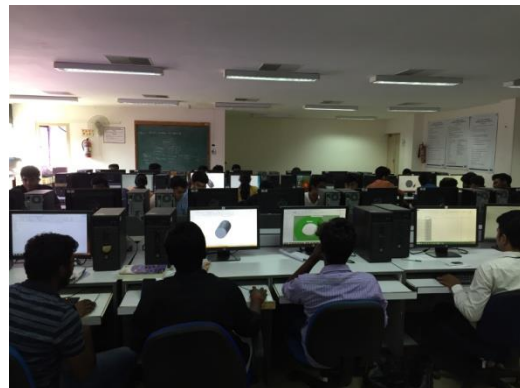
Structural/ Thermal / Vibration simulation and analysis of the components and systems can be performed using ANSYS /ABAQUS, thus helping in design validation, before the prototype can be produced. Prototypes made of PLA/ABS/composites can be printed. MATLAB tools can be used for design optimization.

Possible area of usage: Automobile , Aerospace, consumer based industries and those who extensively work on product development, prototyping and design validation can benefit from the facilities and expertise available at the centre.

Images with description:



3D Printer



CAD/CAM/CAE Lab

Contact person mail id: vijaysekarks@ssn.edu.in

Manufacturing Support systems

MS2. Ultrasonic assisted stir casting setup (for fabricating Al and Mg based Nanocomposites).

Description of Equipment: This setup uses hybrid concept (combination of mechanical stirring and ultrasonic assisted stirring) to cast Al and Mg based nanocomposites.

Status of development: Machine installation is over. Sample castings have been made using Al alloy and hBN nanoparticles. Ready to use for any desired combination of metal and particulate materials.

Possible area of usage: This setup is better alternative than mechanical stirring to disperse nanoparticles in Al/Mg metal matrices.

Images with description:



Contact person mail id: poovazhaganl@ssn.edu.in

MS3. Wire cut EDM facility

Description of Equipment: Unconventional machining equipment that can create various profiles.

Status of development: Machine installed. Trials conducted and ready for use.

Possible area of usage: This setup is better alternative for

- profile cutting , especially for tensile specimen,
- taper cutting,
- tool and die cutting and
- cutting complex profiles.

Images with description:



Components produced in WEDM

contact person mail id : selvakumarg@ssn.edu.in

Manufacturing Support systems

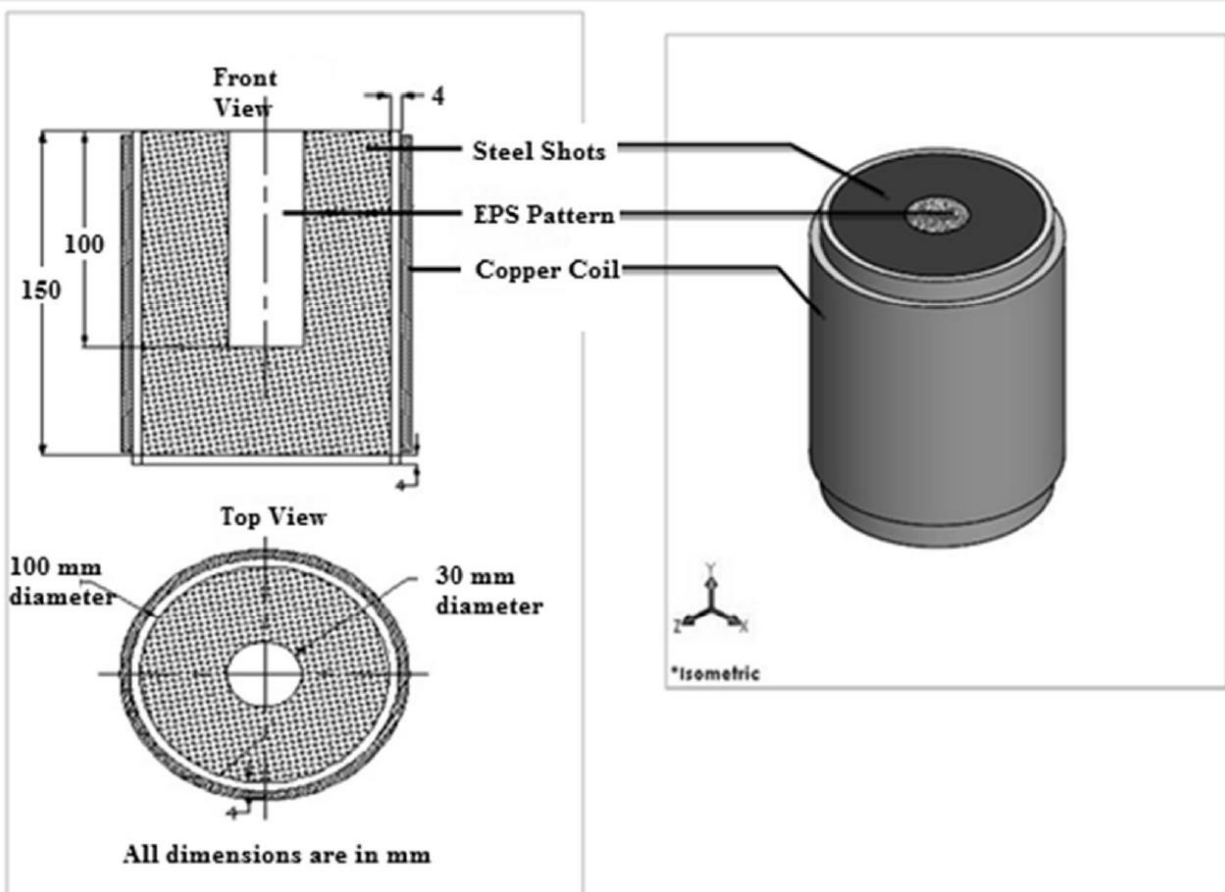
MS4. Magnetic Moulding

Description of process: Moulding sand replaced with steel shots (Small size steel balls). No pollution due to binders. High production rate due to less solidification time. Mould material can be re-used any number of times.

Status of development: Process established for Aluminium cylindrical composites. Process being researched for complex shapes.

Possible area of usage: Can be used for casting of components of small dimensions. (Size of the moulding cylinder – Diameter 100 mm and height 150 mm). Process can be developed for any casting requirement.

Images with description:



Contact person mail id: anandronaldb@ssn.edu.in ; arunprakashc@ssn.edu.in

Manufacturing Support systems

MS5. Coated Abrasive Disc Manufacturing Unit

Description of equipment : Resin coating head, electrical grain propulsion unit, flexing unit, curing ovens and performance evaluation machine.

Status of development: Equipment commissioned. Process established. Can be offered for customer requirements.

Possible area of usage: Any abrasive manufacturer can use this facility for trying out small quantities of new product formulations in Coated abrasive discs.

Images with description:



Contact person mail id: annamalaive@ssn.edu.in

Manufacturing Support systems

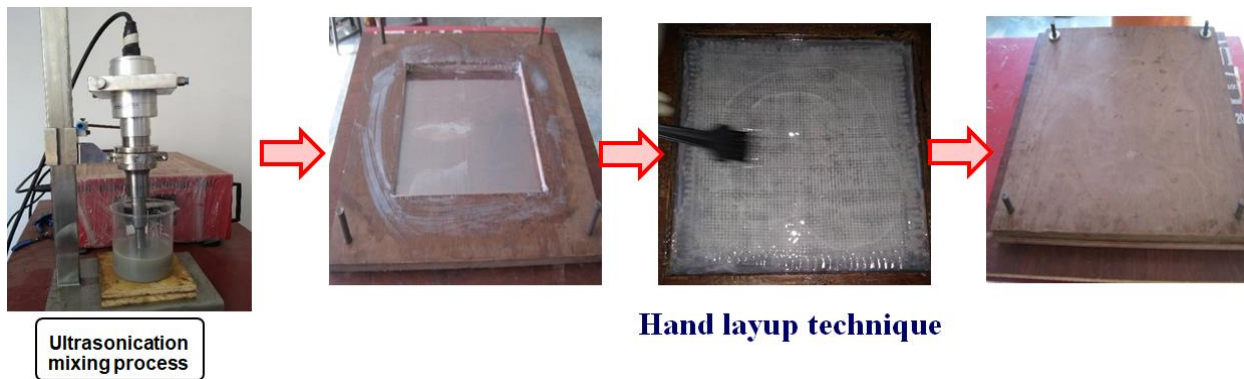
MS6. Polymer composite fabrication facility

Description of equipment: Equipment for manufacturing composites by Hand layup technique. Process comprises of stacking alternative layer of fibers , sprayed with resin, one over the other and subjecting to consolidation. A compression load of 5 kN is used for the composite fabrication.

Status of development: Process established. Can be offered for customer requirements on laminate basis. 300 mm x 300 mm size , thickness 4 to 6 mm

Possible area of usage: Can be used to prepare hybrid and natural polymer composite samples in polymer matrix like-epoxy, vinyl ester and polyester. This technology is very useful for the development of new polymeric materials by using natural fibers and fillers as reinforcement materials.

Images with description:



Methodology for composite fabrication



Composite slabs

Contact person mail id: rajkumark@ssn.edu.in

PS1. Cryogenic cooling unit – for hard to cut materials

Description of process: The liquid nitrogen jet has been used mainly to target the heat generation zones and to protect the wear of the cutting tool which enable better tool life and quality surface.

Status of development: Process established for machining of hard-to-cut materials.

Possible area of usage: Cryogenic cooling with its excellent cooling abilities and environment friendliness is used to reduce cutting zone temperature in machining of hard-to-cut materials and thereby improve the machinability characteristics. Can be attempted for machining of any difficult to machine materials.

Images with description:



Contact person mail id: ghananchezianm@ssn.edu.in

PS2. Thermal Energy Storage Unit

Description of equipment: It is a mechanical device that stores solar thermal energy in the storage medium. Thermal energy storage (TES) is temporary storage of heat for later use. The stored heat is released / retrieved by solidifying the PCM in the case of latent heat storage or lowering the liquid / solid material temperature in the case of sensible heat storage.

Status of development: Equipment is available. Process is established.

Can be offered for customer requirements based on specific applications to store & utilize heat energy.

Benefits - Can be used for either storing solar energy or heat energy from industrial waste heat.

Flexible, can be easily moved from one place to another place, compact size and low cost.

Possible area of usage: Can be used to i) store and utilize the solar energy, ii) store and utilize the waste heat from Industry processes for heating applications. This storage unit was tested for storing and utilizing (i) heat from solar energy via solar collectors and (ii) heat from constant heat source (temperature bath). 70 liters of hot water at an average temperature of 50°C can be obtained from the storage unit for direct use.

The results obtained from the experimentation have been presented in International conferences held in India and abroad and also published in International journals.

Images with description:



Photographic view of TES tank integrated with Temperature bath



Photographic view of TES tank integrated with solar flat plate collector

A = Flow Meter; B = TES Tank; C = Pump; D = Temperature Indicator; E = Electric Heaters
F = Temperature Bath; G = Solar Collector

Contact person mail ID: nallusamyn@ssn.edu.in

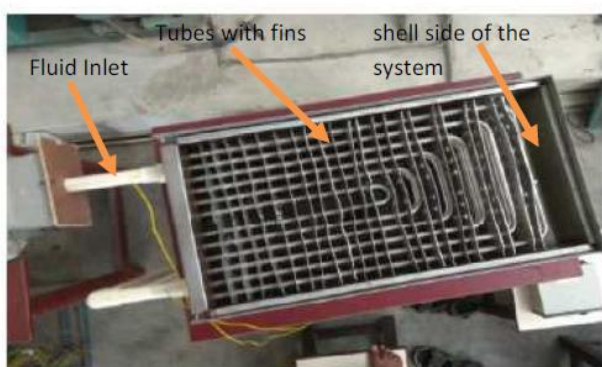
PS3. Thermal Storage Employing Phase Change Materials

Description of Technology: The system developed is basically a heat exchanger capable of storing heat or cold energy through the cyclic melting/freezing of materials called Phase Change Materials (PCMs). PCMs are available at different melting temperatures. Hence, the system can be customized to operate under any required temperature in the range minus 40 to 800 deg C. Ice, Water, Inorganic salts, Organics like paraffins, eutectic mixtures and fatty acids are best examples of PCMs.

Status of development: Three prototypes have been built and tested successfully in the department for thermal storage. The potential to scale up for real time industrial applications is high.

Possible area of usage: Can be deployed as Waste heat recovery systems in industries, process heating, thermal management in utilities, electronic cooling, building cooling, energy storage, cold storage in Refrigeration and Air conditioning applications, etc.

Images with description:



Heat Exchanger Unit before Filling with PCM



Insulated assembled unit after filling with PCM

Contact person mail id: lakshminarasimhann@ssn.edu.in

PS4. Quenching in Carbonaceous Medium (CNT/Graphene Nanofluids)

Description of process: Quenching is done using nanofluids (fluids suspended with nanoparticles at very low concentration). This leads to enhanced heat transfer rates.

- Higher hardness can be achieved.
- Quenched parts get thin coating (few microns) of carbon.
- Better wear properties can be expected.

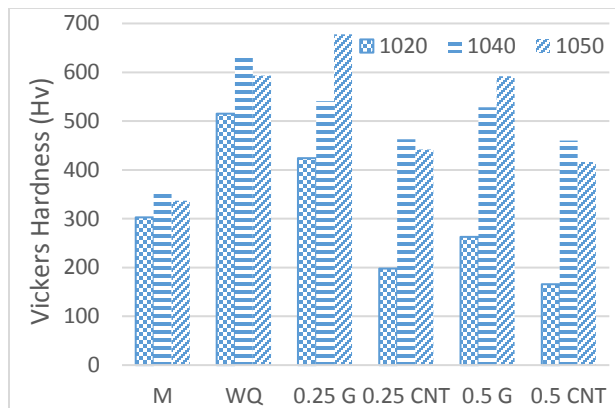
Status of development: Heat transfer rates with nano fluids can be estimated for any given product – heat treatment cycle. Heat transfer rates during quenching in CNT and Graphene nanofluids have been estimated through inverse heat conduction method with the experimentally measured time-temperature data as input.

The highest peak heat flux values observed for 0.25wt% Graphene nanofluid is 5.89 MW/m².

This is 83% higher than that in 0.5wt% CNT nanofluid and 126% higher than that in water.

Possible area of usage: Manufacturing industries involved in production of Gears, Sprockets and other such power transmission parts, can re-set their quenching process by attempting CNT nanofluids.

Images with description:



M – as machined

0.25 G – 0.25wt% Graphene Nanofluid

0.5 G – 0.5wt% Graphene Nanofluid

WQ – Water Quenched

0.25 CNT - 0.25wt% CNT Nanofluid

0.5 CNT - 0.5wt% CNT Nanofluid

As compared with WQ, the hardness of 1020 steel decreased in case of 0.25G followed by 0.5G.

Similar trend can be seen in cases of 0.25 CNT followed by 0.5 CNT.

Compared to CNT cases, quenching cases of G are better, but still lower than water quenching.

But with AISI 1040 steel, the hardness values of 0.25G or 0.5G are slightly lower than that of WQ.

The hardness values of 0.25CNT or 0.5CNT are much lower than that of WQ or G cases of quenching.

However, there is an increase in the hardness of 1050 quenched in 0.25G or 0.5G cases as compared to WQ

Contact person mail id: babuk@ssn.edu.in

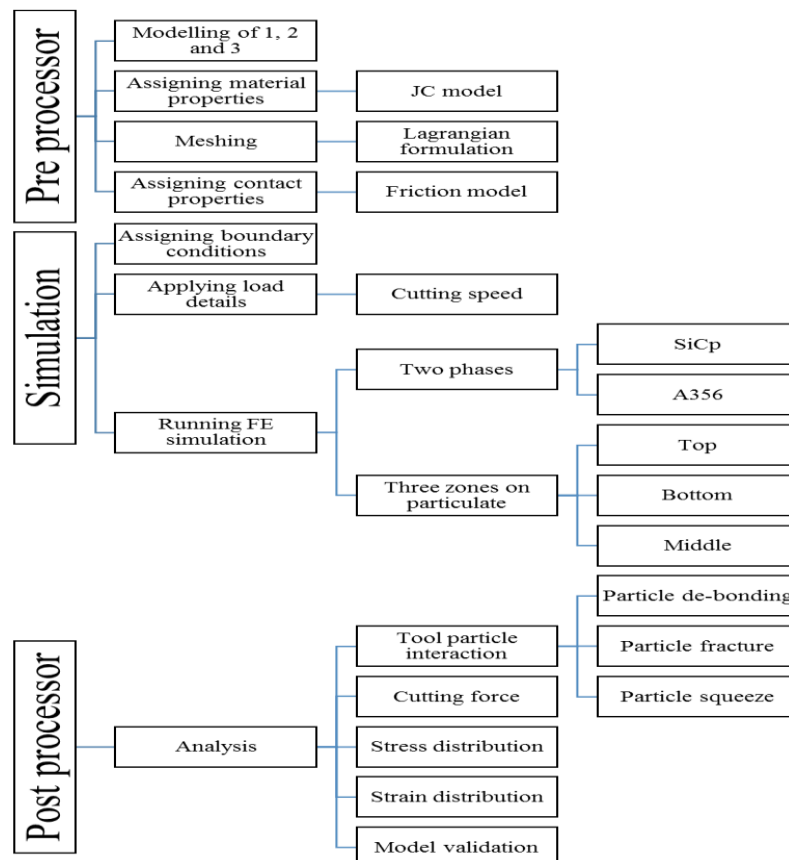
PS5.Finite Element Analysis of the Machining of Metals, Alloys and Composites

Description of process: In depth finite element analysis of turning, drilling and milling process with metals, alloys and composites can be done.

Status of development: Process well established for studying the machinability, cutting forces, tool wear, friction and flow stress in the turning, drilling and milling of AISI 1045, AA6082 - T6, Ti6Al4V, AISI 316 L, Inconel 718, Al 2024 T 351, hastelloy, A356/SiCp, A359/SiCp, GFRP, CFRP. Studies ongoing in Titanium and Magnesium based Metal Matrix Composites. Both experimental as well as finite element analysis have been well established and several finite element models have been optimized for the analysis. The developed Finite element model doubles up as an excellent prediction tool for advanced cutting conditions.

Possible area of usage: Finite element analysis is a cost friendly and time effective process that Industries can leverage to analyze the machining characteristics of a wide range of material groups for a wide range of cutting conditions. This robust tool reduces the design cycle time and manufacturing lead time, thereby bringing the product to market faster.

Methodology:



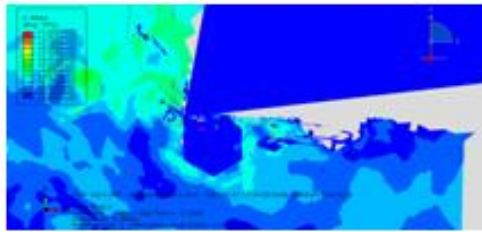
Some Finite element models developed so far:

Stress during orthogonal cutting, Tool particle interaction, Deformation plot during turning for metals

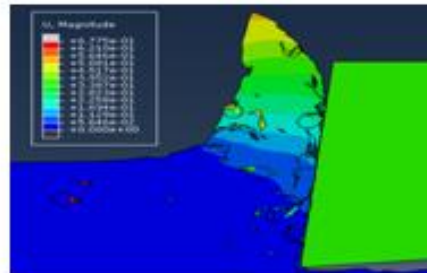
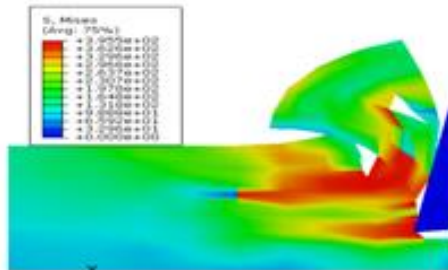
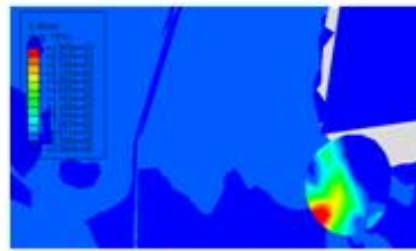
Stress plots during milling / drilling of Glass fibre reinforced plastics

Processing Support

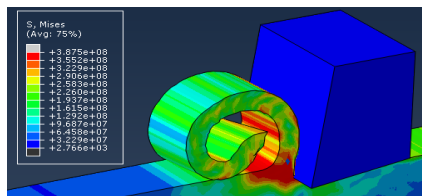
Stress plot of Hexagonal shape SiC_p



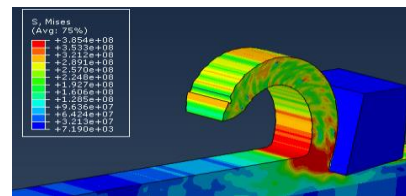
Tool particle interaction at top of SiC_p



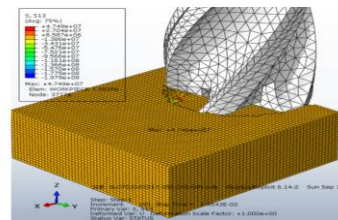
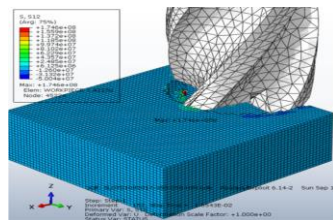
Stress during orthogonal turning of A356



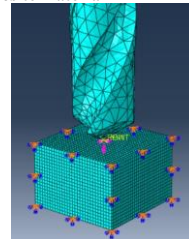
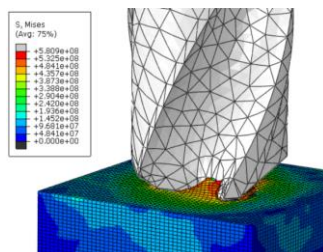
Deformation plot of turning of A359/ SiC_p



3D FE Stress distribution with turning of A356 alloy



3D FE stress plots - Slot milling of glass fiber composite material



3D FE stress plots - Drilling of glass fiber composite material

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PS6. Reclamation of abrasive grains from spent grinding wheels

Description of process: One third of the grinding wheel which is used for clamping, is wasted as scrap. Due to exposure to high temperature during grinding wheel manufacture, these grains get toughened and hence can be used as value added material in Resinoid and Coated applications, in place of BFRPL (Blue fired grains). Centre for Product Development at SSN College of Engineering has developed technology to optimize grain regeneration and to use it beneficially in Coated / Resinoid products.

Status of development: Process established. Grains recovered and used successfully in Coated and resinoid grinding wheel products as value added product.

Possible area of usage: Any user industry can consider generating abrasive grains from their used grinding wheels. It is possible to develop applications for internal consumption of these recycled grains.

Images with description: The process is as below:

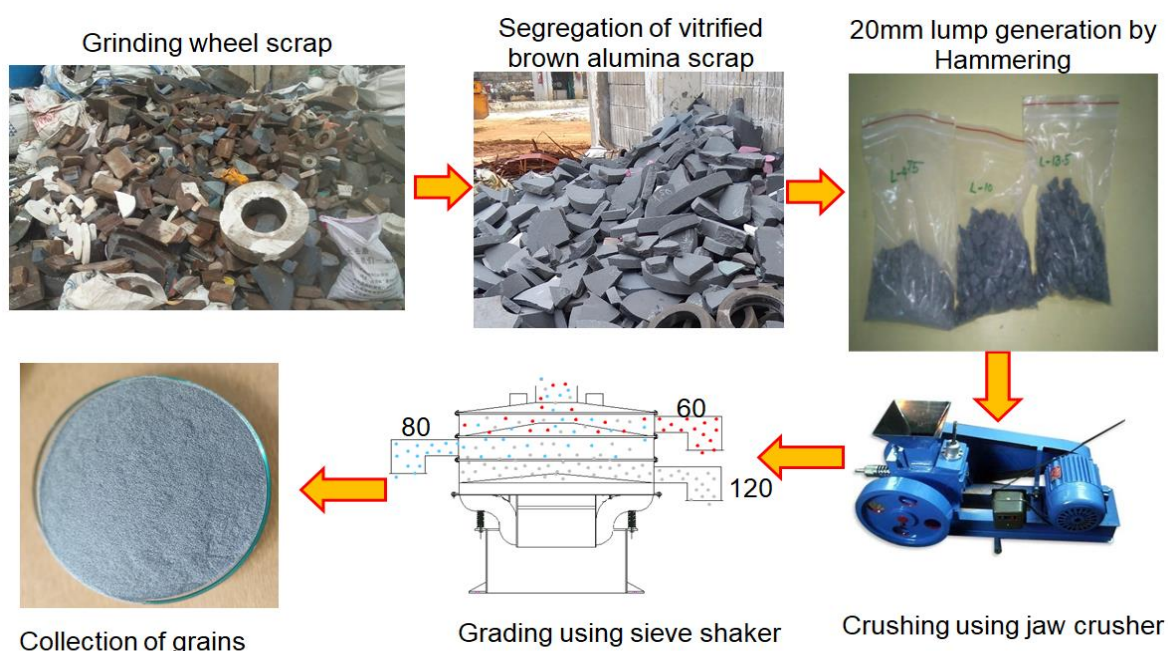


Figure showing the grain recovery process

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Processing Support

PS7. Size conversion of used coated abrasive discs.

Description of process: Coated Abrasive discs of fibre backing are mostly used at the edges. The discs are disposed of, even if the inner portion has fresh unused grains. The fibre backing is vulcanized and hence creates pollution issues. By trimming the used disc and removing the outer used edge, the remaining disc of lesser diameter (next usable diameter) can be generated. This will solve pollution problem by extended life of disc. It also saves cost by enabling using the unused grains of the inner portion of the disc. Because of the size and the presence of abrasives, normal punching does not work effectively. The new developed process ensures proper cutting without edge fraying.

Status of development: Centre for Product Development at SSN College of Engineering has developed technology and a simple machine that can be used for size conversion of used discs. Any number of used discs can be converted to next usable diameter.

Possible area of usage: User industries can get their used discs converted to next usable diameter and save cost / reduce pollution.

Images with description: The used disc, the relieved portion and the next usable diameter disc.



Figure showing original disc, recovered disc and trimmed edge

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CS1. C-RING TYPE STRESS CORROSION CRACKING SETUP

Description of equipment: It consists of

- Proof Ring made up of EN-24 material hardened to 40 RC values. (range 1 ton)
- Load Cell (range 1 ton)
- Displacement transducer (range 0-10 mm)
- Digital Load and LVDT indicator (range 1 ton) and
- Corrodant container made of Perspex.

The container has holes at the bottom surface of the container for the entry of specimen grippers. 'O' ring is provided for water sealing. The specimen is fitted inside the container. The specimen holder passes from the bottom of the container. Two No's of 3/8 inches brass nipples plated is provided for circulation of Corrodant solution.

Status of development : Equipment established and ready to use.

Possible area of usage: Can be used to study the stress corrosion cracking behavior of metals.

To quantify the conditions under which environmentally assisted crack extension can occur in terms of the threshold stress intensity for SCC, KISCC and Kinetics of crack growth.

The experimental data obtained can be used for design of life prediction purposes in order to ensure either that the stress within large structures are insufficient to promote the initiation of SCC at whatever pre-existing defects that may be present or the amount of crack growth which would occur within the design life or inspection periods can be tolerated without risk of unstable failure.

Images with description:



Contact person mail id: damodaramr@ssn.edu.in

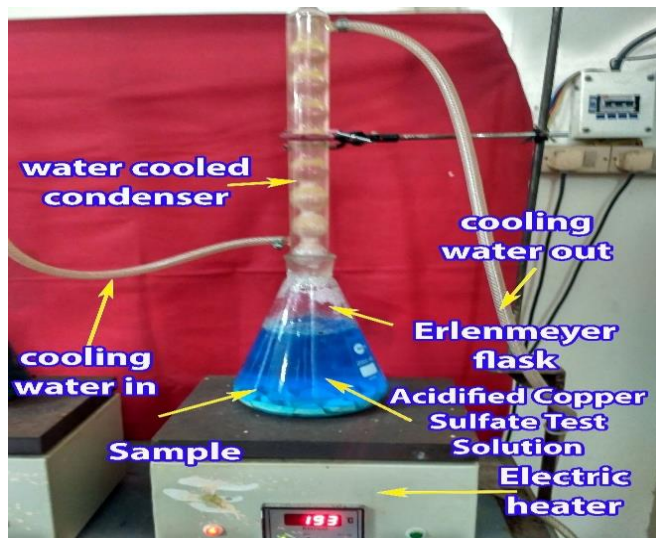
CS2. Intergranular corrosion test rig

Description of equipment : In accordance with ASTM standards of corrosion testing.

Status of development: Equipment available. Process established. Can be offered for customer requirements on need basis.

Possible area of usage: Can be used to carry out intergranular corrosion tests in dissimilar and similar GTAW,GMAW and solid state weldments.

Images with description: photo or picture with salient features / parts marked.



Experimental setup for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

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Characterisation Support

CS3.Noise and Vibration testing

Description of equipment Equipment consists of Triaxial Accelerometer, Vibration Analyser with DAQ, Vibration exciter, Noise Measurement and force transducer. The sensors can be mounted on the desired testing place. Noise , Vibration and Harshness levels and characteristics can be analysed.

Status of development: Equipment available. Process established. Can be offered for customer requirements on need basis.

Possible area of usage: Can be used in Static and Dynamic systems to identify Natural frequency, Mode Frequency, Damping, force exerted and noise level . Suitable for Automotive industry, Power plant , rotary and dynamic applications, for understanding and minimizing vibrations.

Images with description:



Mixer being tested for vibration

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Characterisation Support

CS4. Ballistic impact testing set up

Description of Technology: The equipment can be used to measure the impact energy absorbing capability of thin plates (metal sheets and composite targets)

Status of development: Both inlet and exit velocity of the projectile can be measured. The exit velocity of the projectile will be measured by using “Caldwell Ballistic Precision Chronograph”.

Possible area of usage : The facility can be used by all Auto Manufacturers to measure the low velocity ballistic impact of car floor and glass materials.

Images with description

The gas gun set up shown in fig 1(a&b) consists of air compressor, gun barrel, target holder and a velocity measurement system. The compressed air is used to trigger the projectile. The projectile penetrates the target and the exit velocity of the projectile is measured. In addition depth of penetration of the projectile on to the target can also be measured. Metal and composite samples of thickness less than 3 mm can be tested up to a projectile speed of 100m/s. The exit velocity of the projectile can be measured using ballistic chronograph device as shown in fig.1c.

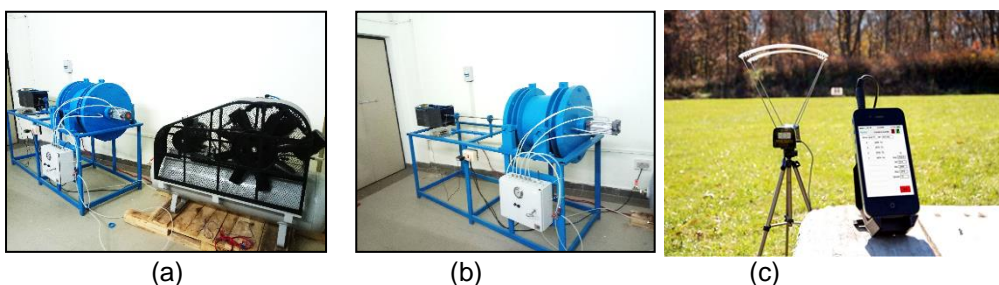
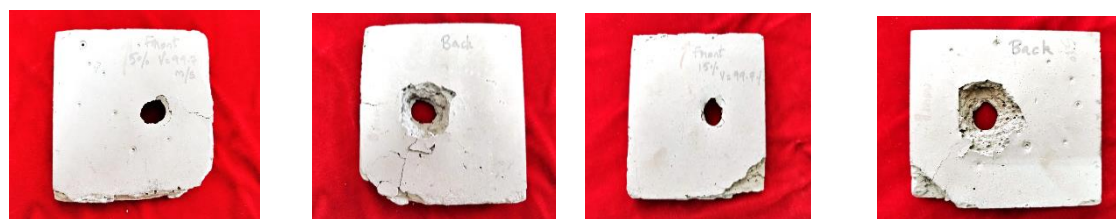


Fig.1 Gas gun set up (low velocity)

Using the set up, several attempts have been made to determine the ballistic impact behaviour of Aluminium metal foam targets. The variation of inlet and exit velocity of the projectile provides the ballistic performance of the targets. The tested samples are shown in fig.2.



5 % porosity :front face 5 % porosity : front face 15 % porosity :front face 15 % porosity :rear face

Fig.2 Ballistic performance of Aluminium metal foam target

The set up can also be used to determine the ballistic performance of light weight composite materials which are being used car bodies and floors. In addition, the set up can also be used to determine the ballistic performance of light weight body armours. Using this facility several research works are being carried out to determine the ballistic performance of nano powder (CNT and Graphene) intruded composite targets.

Contact person mail id sureshkumars@ssn.edu.in

Characterisation Support

CS5. Crack initiation and growth analysis of mechanical components using Extended Finite Element Method (XFEM)

Description of Technology: In this concept, crack initiation and propagation phenomenon can be predicted using A standard Finite element method code **Abaqus**.

Status of development : The concept of XFEM is ready to be used. Already the concept has been verified in a turbine blade analysis.

Possible area of usage : The concept of XFEM can be used to predict the residual life of the turbine blade in any existing designs. In addition the concept can also be used in automotive industries to predict the residual life of automotive components.

Images with description:

In general extended finite element method (XFEM) is a numerical method that enables a local enrichment of approximation spaces. The enrichment is realized through the partition of unity concept. The method is useful for the approximation of solutions with pronounced non-smooth characteristics in small parts of the computational domain, for example near discontinuities and singularities. In these cases, standard numerical methods such as the FEM or FVM often exhibit poor accuracy.

The XFEM offers significant advantages by enabling optimal convergence rates for these applications. In the present concept, XFEM has been used to predict the crack initiation and propagation life of the turbine blade has been carried out. The modeling and meshed images of the turbine blade are shown in the following figures. The major steps in XFEM crack analysis are specification of crack domain, crack propagation initial crack location, definition of enrichment radius, contact interaction property, damage initiation and analysis procedure.

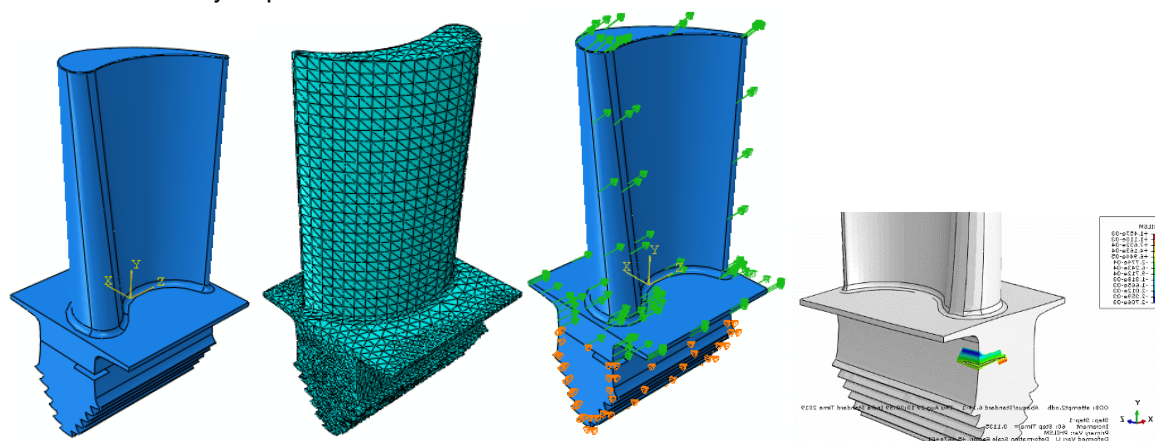


Fig.5 XFEM Crack initiation and propagation studies on Gas turbine blade model

In addition, the concept can also be used to determine the number of defects in a structure when subjected to static and dynamic loading. Based on the defects, the residual life of the components can be determined. The other approaches to predict the fracture behaviour are contour integral approach and Elastic Plastic Fracture Mechanics approach.

This XFEM approach of defect initiation and propagation can be used in a better way for automobile components and aero engine components.

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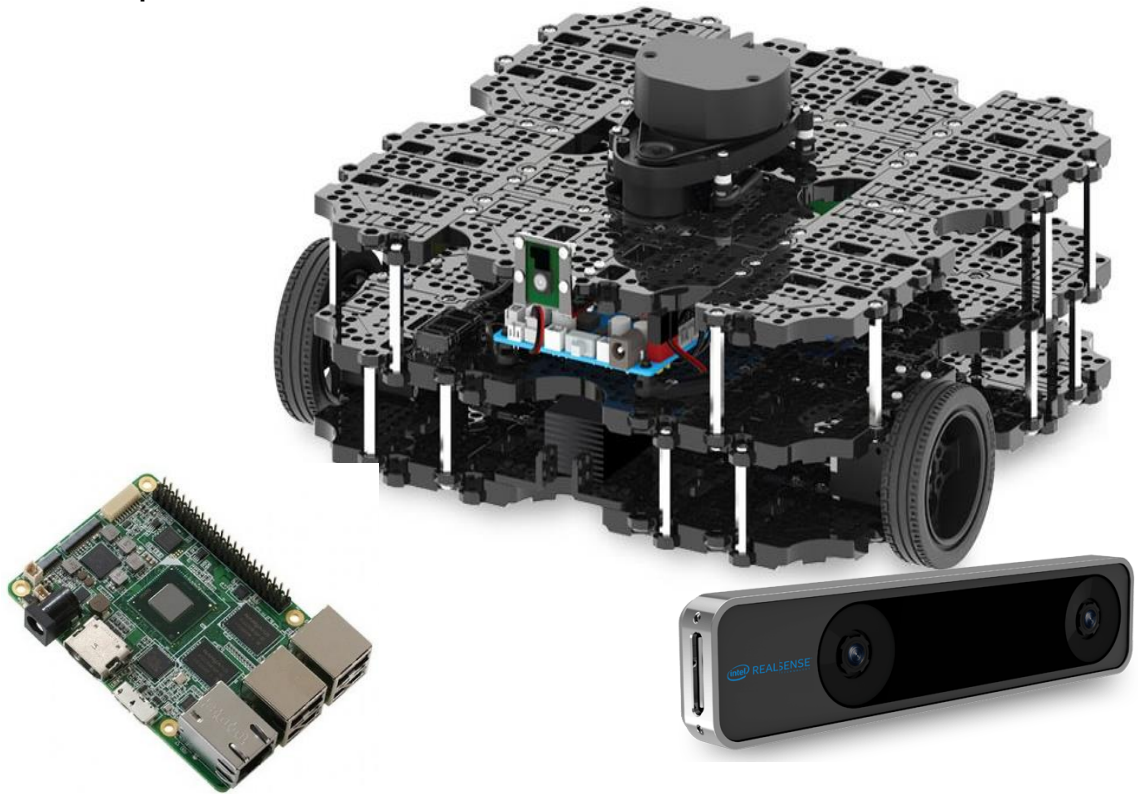
RS1. TurtleBot3 Waffle Pi with Intel AAEON UP Board & Real sense tracking camera T265

Description of equipment: Sturdy despite its small size, TurtleBot3 Waffle differs from its Turtlebot3 “Burger” cousin in its flattened format making it look like a waffle, as its name indicates. You can upgrade it with just about everything you can imagine: a robotic arm, servos, an embedded computer. The TurtleBot3 Waffle can move a payload of up to 30 kg (versus 15 kg for the Burger version) at a slightly faster translational velocity. Above all, it is equipped with the 3D Intel® Realsense™ R200 camera module, on top of all the items already found in the TurtleBot3 Burger

Status of development: Equipment available and could be offered for customer requirements on hourly basis.

Possible area of usage: mobile robotics, navigation, path planning, obstacle avoidance, SLAM

Images with description:



Contact person mail id: satheeshkumarg@ssn.edu.in

RS2. TurtleBot3 Burger with RM-X52-TNM & Real sense depth camera D435i

Description of equipment: The TurtleBot3 platform is modular, compact, open-source and completely customizable developed in collaboration with OpenRobotics and Intel. RM-X52-TNM is a compact version of OpenManipulator based on ROS. It has a high payload as DYNAMIXEL XM-430 model is applied. Easy to use with PC or mobile platform such as TurtleBot3 Burger/Waffle-Pi with provided source code and development environment. You can freely select and use either a PC or Controller e.g. OpenCR

Status of development: Equipment available and could be offered for customer requirements on hourly basis.

Possible area of usage: mobile robotics, navigation, path planning, obstacle avoidance, SLAM

Images with description:



Contact person mail id: satheeshkumarg@ssn.edu.in

RS3. e-puck v2.0

Description of equipment: e-puck2 is the latest mini mobile robot developed in 2018. This is an evolution of the successful e-puck robot used in many research and educational institutes. Now with WiFi and USB link & charge. e-puck2 is compatible with its predecessor but is powered by an STM32F4 microcontroller and features a larger number of sensors: IR proximity, sound I/O, 9x IMU, ToF distance sensor, camera, USD storage. The robot is a full system with USB hub, debugger/programmer, WiFi module.

Status of development: Equipment available and could be offered for customer requirements on hourly basis.

Possible area of usage: mobile robotics, navigation, path planning, obstacle avoidance, SLAM

Images with description:



Contact person mail id: satheeshkumarg@ssn.edu.in

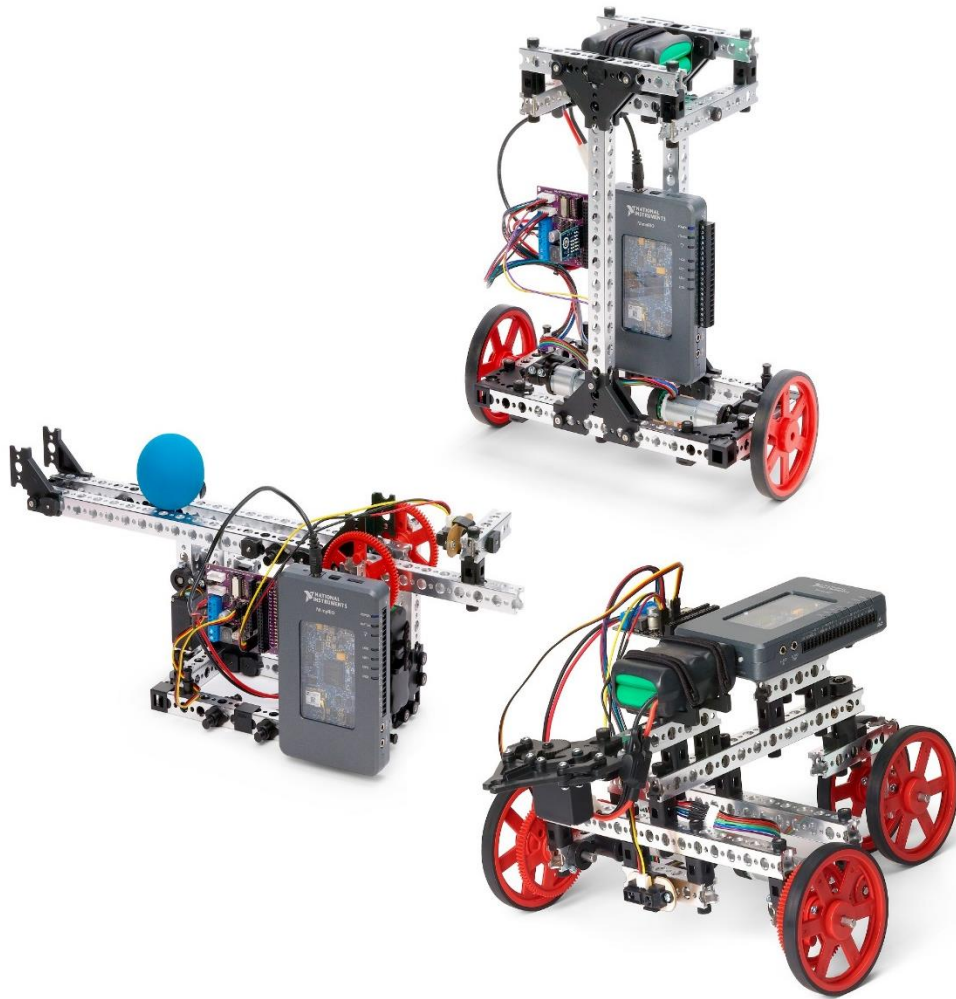
RS4.NI myRIO with Pitsco TETRIX PRIME bundle

Description of equipment: NI myRIO robotics bundle with battery, charger & USB Camera for performing experiments on mobile robots of various configurations.

Status of development: Equipment available and could be offered for customer requirements on hourly basis.

Possible area of usage: mobile robotics, navigation, path planning, obstacle avoidance, SLAM

Images with description:



Contact person mail id: satheeshkumarg@ssn.edu.in

Human Resource Support

Experienced Faculty and necessary facility available in Mechanical Engineering dept, for

1.Product Design

- Designing and developing robots for specific applications. (Dr.G.Satheeshkumar)
- Analysing the vibration in equipment and enabling redesign for ergonomcy. (Dr.M.S.Alphin)
- Analysing forces on digital models of material handling structures. (Dr.S.Sureshkumar)
- Machining of complex shapes by wire cut EDM (Dr.G.Selvakumar)

2.Energy

- Identifying energy saving opportunities in industrial processes. (Dr.N.Lakshmi Narasimhan)
- Designing , selecting and developing cooling systems based on specific requirements of air conditioning /cold storage. (Dr.M.Suresh)
- Checking engine performance at various load conditions . (Dr.S.Rajkumar)
- Evaluating fuel blends / developing alternate fuels for use in engines. (Dr.N.Nallusamy)

3.Process Improvements

- Studying any industrial welding process for improvement / defect reduction, optimization / conversion to non-polluting Friction Stir Welding. (Dr.S.Koteswara Rao)
- Evaluating materials for their corrosion properties. (Dr.A.K.Lakshminarayanan)
- Developing composites suitable for specific applications.(Dr.K.Rajkumar)
- Investigations on Machining of Composite Materials using FEM (Dr.K.S.Vijaysekar)
- Estimating the crack initiation propagation behavior in materials and components (Dr.S.Sureshkumar)
- Scientific analysis of waste and identifying opportunities for recycling / value addition (Dr.V.E.Annamalai)

Faculty with Industry experience

1. Dr.M.Suresh – around 7 years in refrigeration and air conditioning industry. Awarded Diploma in Carrier System Design Course for Packaged Air conditioning Equipment by United Technologies, Carrier-Asia Pacific Operations. Worked in various positions as R&D manager, lead engineer and job engineer in the following projects executed by ELGI, John Brown, Dalal and IDEA:

- Design, Development of oil free air screw compressors at ELGI equipment Ltd., Coimbatore
- Additional Compressor Module at HRC process platform, Mumbai
- BHN process platform revamp project, Mumbai
- Diesel hydro 45esulphurization project (DHDS), Vizag.
- Offsite and utilities plant, Dubai
- Water treatment chemical plant, Bangalore
- Maleic anhydride plant, Malaysia
- Neemazal plant, Cuddalore
- 12.8 MW WHR power plant, Durg, Madya Pradesh
- PE II Plant, Hazira

2. Dr.V.E.Annamalai- 16.5 years as Head - R&D in Murugappa Group (VP Technology). Was in charge of product development, quality and process improvements. Has an overall picture of approaching process improvements in industry. Experienced in Waste Reduction / Waste Management Strategies.

For any of the above requirements, please contact annamalaive@ssn.edu.in or call 98403 59093