MECH MAG

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MECHANICA

2022-2023

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21BME348

VISION

To transform students from rural background into professional leaders of tomorrow in the field of Mechanical Engineering with a strong sense of social commitment

MISSION

To impartquality engineering education leading to specialization in the emerging areas of CAD/CAM/CAE, Energy Engineering and Materials Technology to provide continually updated and intellectually stimulating environment to pursue research and consultancy activities

Programme Educational Objectives (PEOs)

PEO1.**Technical Expertise**: Actively apply technical and professional skills in engineering practices towards the progress of the organization or the entrepreneurial venture in competitive and dynamic environment.

PEO2.**Lifelong Learning**: Own their professional and personal development by continuous learning and apply the learning at work to create new knowledge.

PEO3.**Ethical Knowledge**: Conduct themselves in a responsible, professional and ethical manner supporting sustainable economic development which enhances the quality of life

Programme Outcomes (PO)

On successful completion of B.E. Mechanical Engineering programme, graduating students/graduates will be able to:

PO1. Apply knowledge of basic sciences and engineering concepts to solve complex mechanical engineering problems.

PO2. Identify, formulate, and analyze engineering problems using scientific principles and concepts.

PO3. Design products, manufacturing processes and facilities that deliver the requirements of the target customers and desired quality functions.

PO4. Conduct experiments, analyze and interpret data to provide solutions for engineering problems.

PO5. Use appropriate tools and techniques to solve engineering problems.

PO6. Apply contextual knowledge to make informed decisions in societal, health, safety, legal, entrepreneurial and cultural issues.

PO7. Demonstrate the knowledge of need for sustainable development in providing engineering solutions in global, environmental and societal contexts.

PO8. Practice Ethical responsibility.

PO9. Work effectively in teams and build/manage interpersonal relationships.

PO10. Communicate effectively through oral, non-verbal and written means.

PO11. Apply management principles to manage individual and team work for executing projects in av multidisciplinary environment.

PO12. Articulate and engage in pursuit of career and life goals through continuous Learning.

Programme Specific Outcomes (PSOs)

PSO 1: Demonstrate functional competencies for roles in design, manufacturing and service by learning through centers of excellence and industrial exposure.

PSO 2: Demonstrate behavioral competencies required for roles in design, manufacturing and service by learning through structured professional skills training

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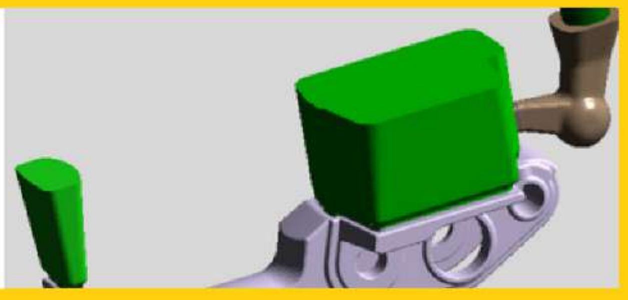

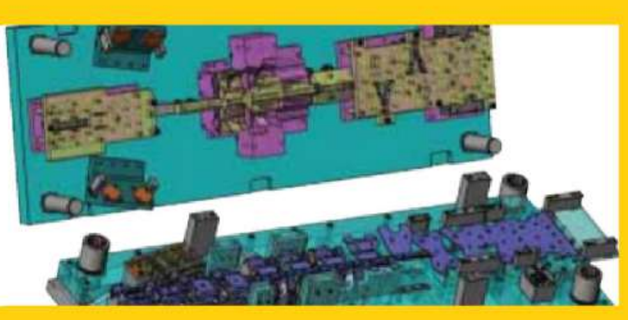

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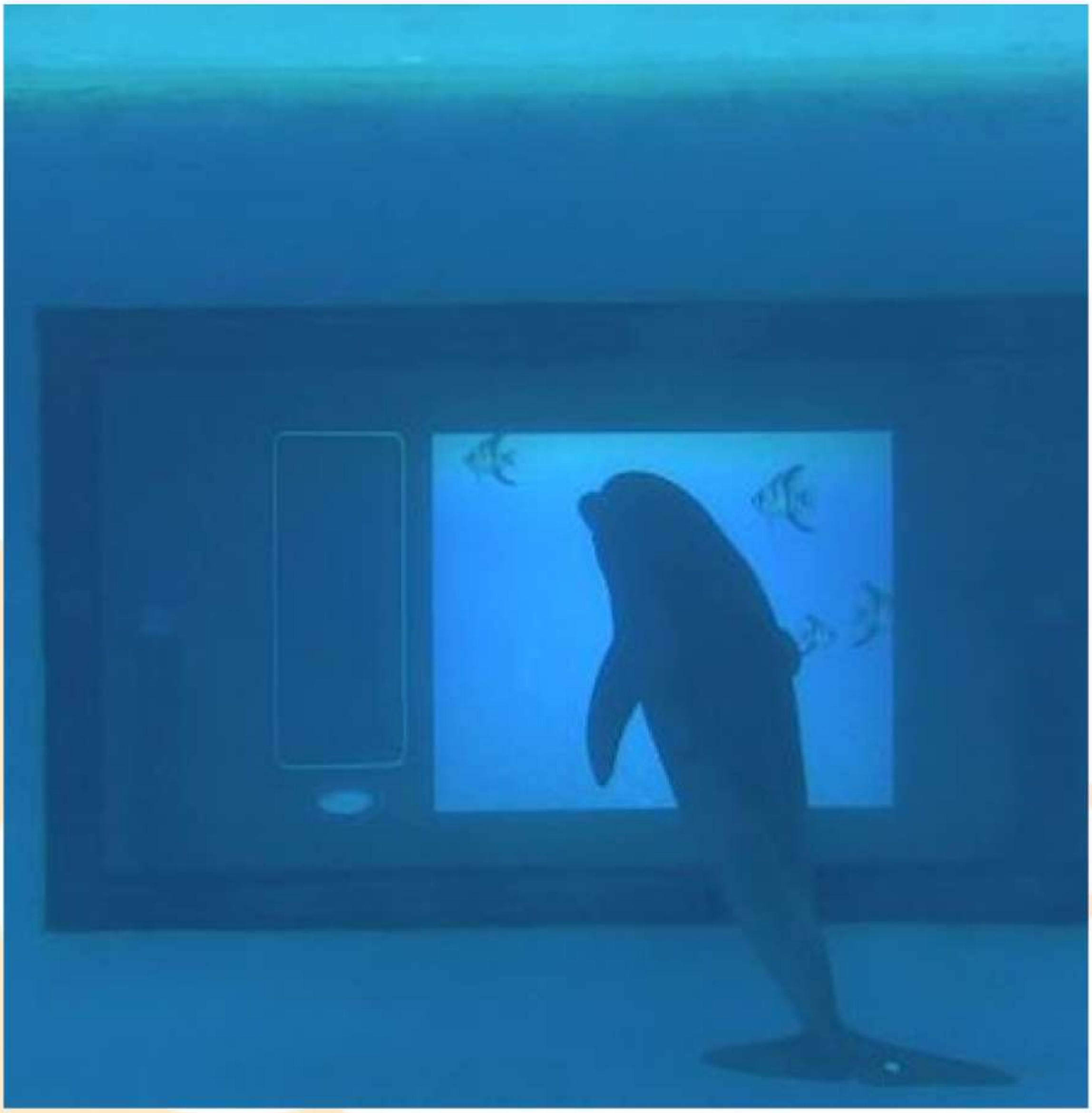
Nithish Kumar G
20BME013



Underwater computer touchscreen to assess dolphin intelligence

Using optical technology specifically developed for this project, dolphins at the National Aquarium in Baltimore, Maryland, are at the centre of research from an interdisciplinary team from Hunter College and Rockefeller University.

The system, the first of its kind, will be used to investigate dolphin intelligence and communication by providing them choice and control over a number of activities.

Researchers believe this technology will help extend the high-throughput revolution in biology that has brought us whole-genome sequencing and the BRAIN project, into the field of animal cognition.

The 2.4-metre underwater touchscreen features specialised dolphin-friendly apps and a symbolic keyboard to provide the dolphins – which are intelligent and highly social – with opportunities to interact with the system.

To make the system safe for the dolphins, the touchscreen has been installed outside an underwater viewing window, so that no parts of the device are in the pool: the animals' touch is detected purely optically.

While the research is still in its early stages, the team has embarked on studies aimed at understanding dolphin vocal learning and communication, their capacity for symbolic communication, and what patterns of behaviour may emerge when the animals have the ability to request items, videos, interactions and images.

"We hope this technologically-sophisticated touchscreen will be enriching for the dolphins and also enrich our science by opening a window into the dolphin mind," said Hunter College research scientist Diana Reiss. "Giving dolphins increased choice and control allows them to show us reflections of their way of thinking and may help us decode their vocal communication."

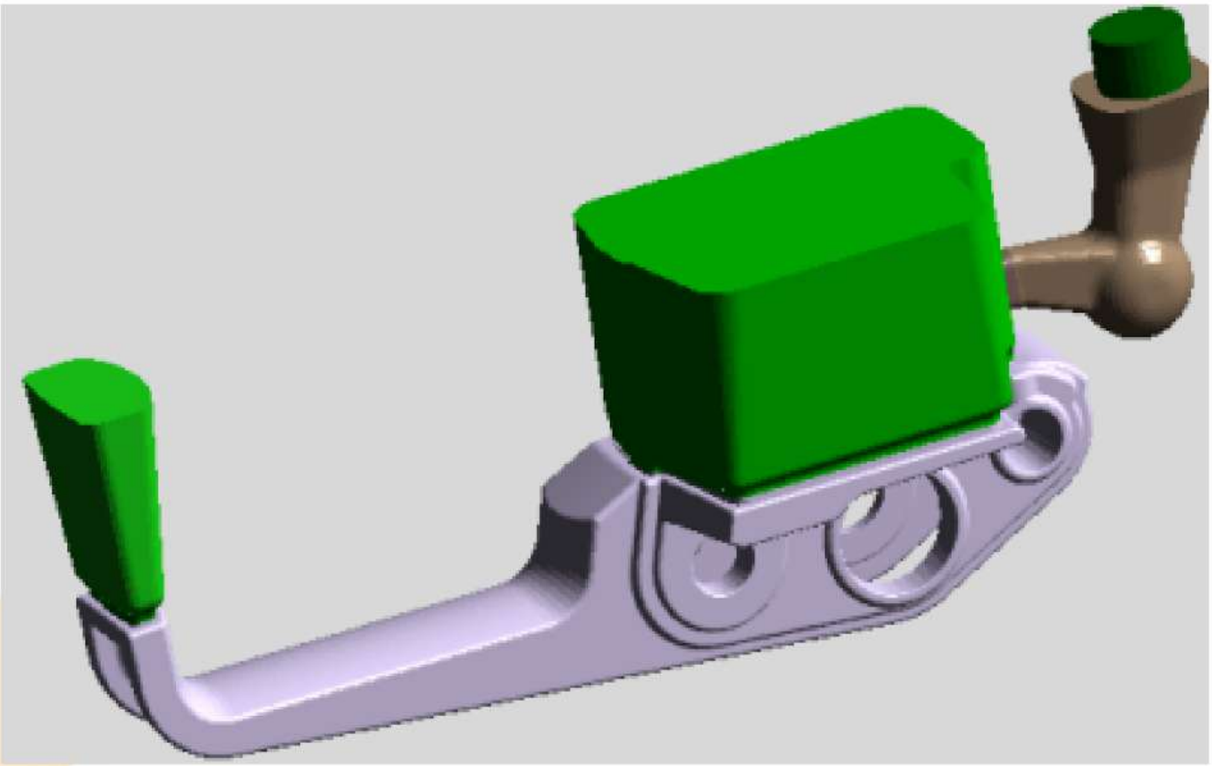
Biophysicist Marcelo Magnasco, integrative neuroscience professor at Rockefeller University said: "It was surprisingly difficult to find an elegant solution that was absolutely safe for the dolphins, but it has been incredibly rewarding to work with these amazing creatures and see their reactions to our system."

In addition to the touchscreen itself, the dolphin's habitat at the National Aquarium has been fitted with equipment to record their behaviour and vocalisations as they encounter and begin to use the technology.

Already, the scientists have begun to introduce the dolphins to some of the system's interactive apps, so the animals can explore on their own how touching the screen results in specific contingencies. "Without any explicit training or encouragement from us, one of the younger dolphins, Foster, spontaneously showed immediate interest and expertise in playing a dolphin version of Whack-a-Mole," Reiss says, "in which he tracks and touches moving fish on the touchscreen."

The research team hopes that the information gleaned from this research will also result in increased empathy toward dolphins and inspire global policies for their protection.

Vetrivel A
22BME350



Analysis and Simulation of Die Filling in Gravity Die Casting using MAGMA Software

Designing a new mould is often most expensive single investment in product development so we have to find out where the problems may arise before we manufacture the mould or die. For this we need a simulation software.

The primary purpose of the simulation software is to predict the various casting defects such as air entrapment, residual stresses, distortion, shrinkage porosity, etc. for a given die design. Then the casting simulation software can be used as a virtual shop floor of a casting plant to simulate various gating design options to optimize the design and to increase the yield and reduce rejections.

Computer simulation of casting is based on the concept of mathematical modeling of manufacturing processes. In any mathematical model, the physical reality is idealized and approximated. As a result, there will be certain deviations between practical/field/plant observations and modeling or simulation results. However, by having a proper understanding of modeling procedures, and the physical reality, this gap between physical reality and simulation results can be minimized

The casting simulation technology has sufficiently matured and has become an essential tool for casting defect troubleshooting and method optimization. It enables quality assurance as well as high yield without physical trials. Productivity is improved, higher value castings can be taken up, and internal knowledge can be preserved for future use and training new engineers.

Therefore the MAGMA software is used for simulation of the filling in of the gravity die casting and various parameters are calculated in this process. Proper analysis of these parameters helps us to find out the defects in the die design and make changes in the design accordingly.

In this paper, analysis of steps 4 to 8 have been carried out using MAGMA software. Firstly, the design of the component of which the castings are to be made is given to the die or mould design department. This design is in the form of a CAD model. With the help of this model, the designers design the die which would be used in the production of the castings.

They make necessary changes a in the die based upon the design of the component. In Gravity die casting process gate is made for pouring the molten metal into the die and risers are also provided in the die. The blue part which is shown the figure is the required component and the rest of the parts which are generated due to gate and riser systems can be removed in the machining process.

Pre-processing: It is a general terminology used for all simulation model setup related activities. In this stage the physical reality is translated to computer simulation model. This is a key stage and has many steps:

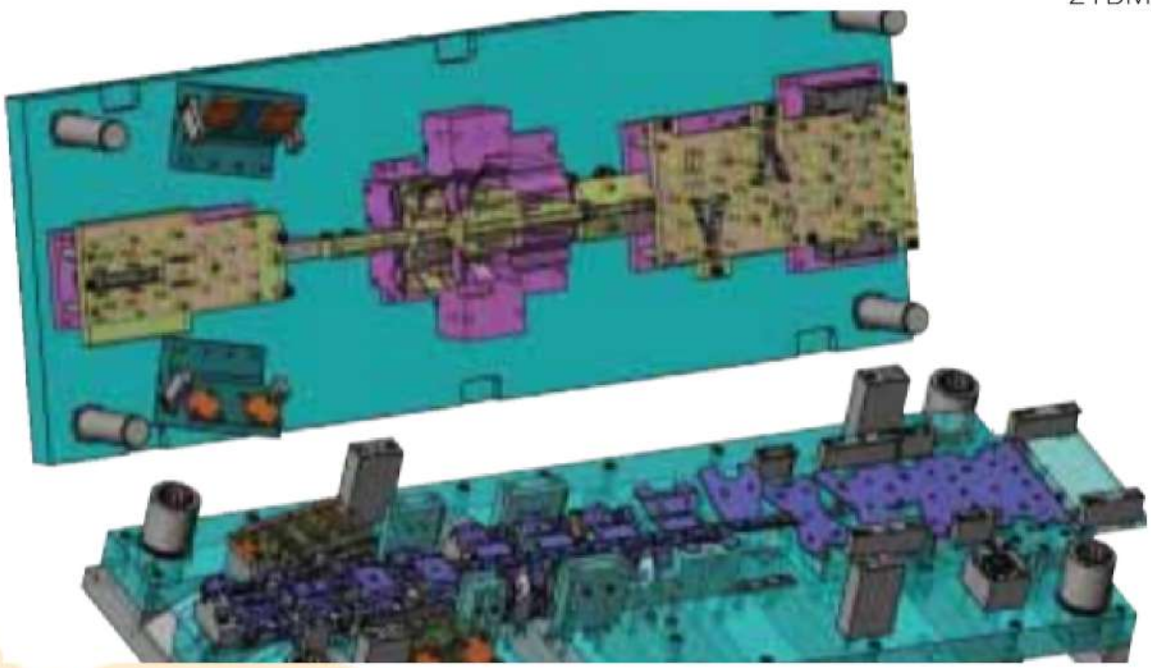
- Meshing
- Material properties
- Process definition
- Boundary conditions

Post processing: In this stage, the results of simulation are visualized. Casting simulation is a transient analysis process. This means, the solution results are available from the beginning of melt flow to the end till full solidification. These results have to be captured over specific number of time steps. This has to be properly set in the beginning of model set up. Typically 10-20 and in some cases even 100 steps are saved to get more detailed reports.

CONCLUSION

It can be concluded that the casting simulation has become a powerful tool to predict the location of defects and eliminate them by visualizing mould filling, solidification and cooling. It can be used to trouble shoot the existing castings or to develop a new castings without shop-floor trails by using fewer resources which reduces cost and time to market.

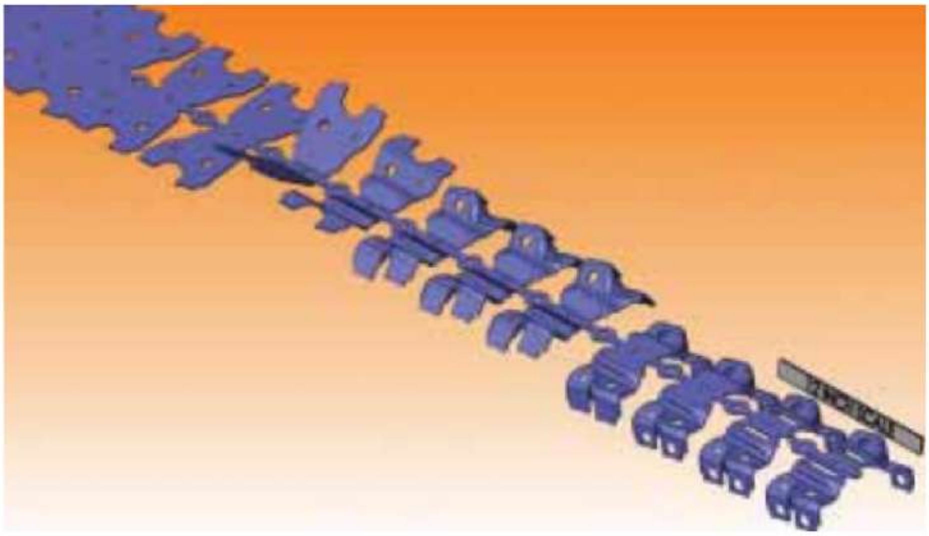
Selva Natheya R
21BME027



Die Design Goes Full Bore into Another Dimension.

3D die-design software hit the market a few years ago with relatively little fanfare. Why? It was new, expensive, difficult to use and designed only for very expensive CAD systems. Now, while still more expensive than its 2D cousin, 3D die design is within reach of even the smallest companies.

2D to 3D—What to Expect Some people say that designing is faster in 3D than in 2D. I have heard that it cuts design time in half. That has not been proven to me, but I'm not going to say it's not possible, especially if the dies to be designed are similar or have consistent and similar features. Speed depends on a number of factors. Here's one: Do the parts resulting from these die designs have 2D linear bends, i.e bent parts, or are they stamped parts that require 3D machining of die components? For bent parts, 3D design is quicker and that gap is widening due to progressive-die-design packages that automate strip creation to a high degree. These packages also simplify the process of making changes to the strip. Another benefit: a designer working with a fully parametric system such as Soli works can create drawings easily, and the drawings update as the model changes. With stamped parts, speed depends on additional facts. The vast majority of people that I ask say that 3D design of a stamped part, when compared to 2D design, takes a bit longer, but that this time is well spent. Two-dimensional design invites many more mistakes that can cost time and money during die tryout and debugging. That burns up much more time and money than Die Design Goes Full Bore into Another Dimension Raymond J. Proeber is president of Accurate Die Design.



Here's a strip assembly as captured in 3D progressive-die-design software. In preparing the tool design for Reich's customer, Accurate Die Design had to incorporate a number of changes to the strip assembly in less than a day. One change called for rotating the part 10 deg. in the strip from its original orientation. Making the changes took a few hours, longer than might be the case with 2D design, but that time is made up down the line when a more accurate die design is delivered, simplifying the tool-building and die-tryout portions of the project.

Simplified CAD Sharing When designing in 3D, you can create 2D views and section views quickly and then send them to your customer via e-mail. Greatly simplifying the process is eDrawings, a free viewer and markup tool from SolidWorks, available for download at www.solidworks.com. eDrawings files supply accurate representations of 3D models and 2D drawings created with the most widely used CAD systems on the market. The product offers capabilities such as point-and-click animations that make it simple for anyone with a PC, even those who don't own a CAD program, to interpret and understand 2D and 3D design data. To protect against information theft, eDrawings hides proprietary data while retaining external graphical details as well as dimensions and mass properties of the CAD model. It can be sent with a built-in viewer in a self-extracting e-mail. To view, the receiver needs only to double-click on the attachment. It allows users to add markups to a model and send it back and forth with each party continuing the threaded markup just as might occur in a regular e-mail.

PRAKASINI S.V
21BME037

Digital Twins

In industry and the mechanical engineering sector – where it isn't uncommon to work on a project in various locations simultaneously – 3D objects are quite often part of the design and development phase. However, coordinating with others involved in the project via a standard 2D screen has its limitations. A digital twin – the digital representation of an object – plays a valuable role in overcoming these challenges. Digital twins can represent actual objects or simulate a project that is still under development.

Adding virtual or augmented reality gives users a perfect combination of representation and reproduction. The August-Wilhelm Scheer Institute (AWS) for digital products and processes carries out intensive research into digital twins – both for actual objects and for projects that are still under development. The non-profit institute was founded in 2014 by Professor August-Wilhelm Scheer. It is located on the campus of Saarland University and works with numerous industry partners.

The Holosim research project, which is funded by the German Federal Ministry of Education and Research (BMBF), focuses on optimizing virtual collaboration. One organization taking part, the M.TEC engineering company, is faced with a two-fold challenge when it comes to flow simulation (= CFD simulation; CFD = Computational Fluid Dynamics). It needs to depict the simulated flow behavior of components under development. However, conventional reproduction in 2D format is not suitable for three-dimensional simulation. The fact that the development team is spread across multiple sites is a further obstacle. .

This is where the AWS Institute comes in, linking a digital twin in the form of a 3D hologram to a virtual office to serve as an example: "We make meetings in three-dimensional spaces possible and combine everything with a digital twin. During the planning, drafting and design phase for new products, a planned object can be brought into the three-dimensional space to enable teams that are not based at a single location to analyse and work on it," explains Simon Bender, Head of Digital Realities Innovation Lab at the AWS Institute.

Exemplary efficiency for analysing condition data thanks to digital twin
Another project from the AWS Institute provides a perfect example of the digital twin principle. Here, the user touches a system's sensors to create a virtual representation. The visualized condition data of individual components can thus be experienced first-hand through natural interaction via VR glasses, as Bender points out: "I simply approach the digital twin, i.e. the virtual representation of the component. The object's performance data is then displayed for me on a clearly arranged dashboard." As a result, maintenance procedures and troubleshooting can be carried out directly in the virtual space.

Remote maintenance using a digital twin is not just a promising option in the coronavirus pandemic, but also in view of the travel costs eliminated and the protection of the environment.

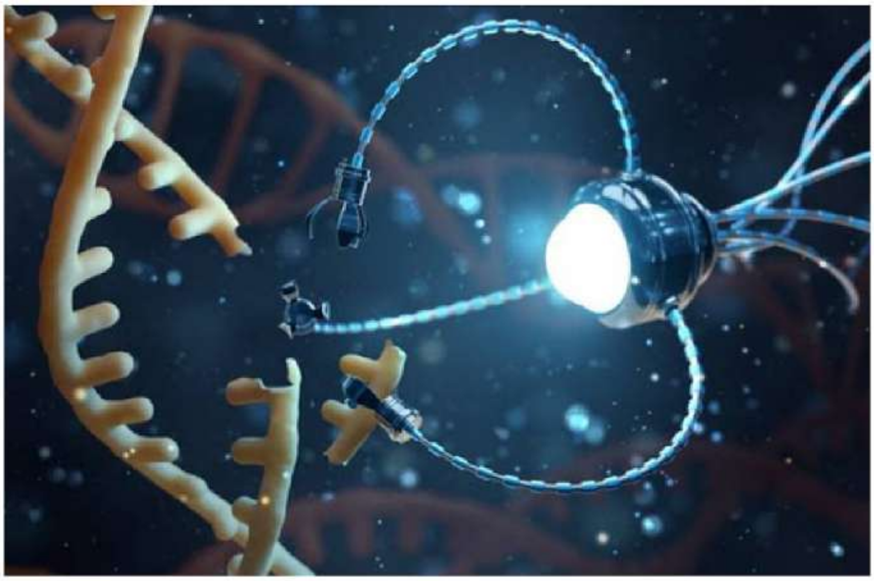
DIGITAL TWINS VS. SIMULATIONS

Although simulations and digital twins both utilize digital models to replicate a system's various processes, a digital twin is actually a virtual environment, which makes it considerably richer for study. The difference between digital twin and simulation is largely a matter of scale: While a simulation typically studies one particular process, a digital twin can itself run any number of useful simulations in order to study multiple processes.

The differences don't end there. For example, simulations usually don't benefit from having real-time data. But digital twins are designed around a two-way flow of information that first occurs when object sensors provide relevant data to the system processor and then happens again when insights created by the processor are shared back with the original source object.

By having better and constantly updated data related to a wide range of areas, combined with the added computing power that accompanies a virtual environment, digital twins are able to study more issues from far more vantage points than standard simulations can — with greater ultimate potential to improve products and processes.

Lal Nivedh S
21BME029



Nanoparticles

Nanoparticles are increasingly being explored for boosting crops and nutrition, but doubts remain over their long-term safety, writes Mićo Tatalović.

Proponents of nanotechnology say it will revolutionise farming and global food systems, with applications being explored that could cut waste, make food safer and help create 'super crops' that escape the controversial label of genetically modified organisms (GMOs).

If successful, it could help to overcome poor yields, malnutrition and opposition to GMOs – all of which are still large challenges in the global South.

The science of nanotech is cutting-edge but simple enough to be affordable globally. And the development prospect is huge. So it's no surprise that many developing countries have already embarked on commercialising the technology.

But the blossoming of this relatively new technology also raises concerns about its long-term safety to human health and the environment, with many scientists calling for better and more internationally coordinated regulation and oversight of the proliferating uses of nanoparticles.

Scientists are even investigating use of nanomaterials to improve delivery of fertilisers and pesticides, and to create transgenic crops that would not be considered GM. Sonia Trigueros, a researcher at Britain's University of Oxford believes its "applications are limitless".

Landry's team is exploring the use of carbon nanotubes — long, narrow, stiff tubes of carbon — to alter plant genes without foreign DNA being inserted into the plant genome itself, which would lead to gene-edited crops that would not be considered genetically modified. Given the large and ongoing public opposition to genetically modified crops in developing nations, this approach could be a more palatable way to deliver benefits such as drought or flood resistance.

But against this march of technology, some people have been increasingly worried about the lack of long-term studies on the impact of nanomaterials on human health — and the environment.

"The transparency and vigilance against the risk are too limited," says Mathilde Detcheverry, head of information at Avicenn, a French NGO campaigning for open information on nanotechnology.

Some scientists say the community is rising up to face the challenges around nanotechnology and getting policymakers on board for a smart, nuanced approach to regulation.

"I'm confident that we are on the right path, but we still have a lot work to do," says Trigueros. "It's a very young technology, so we need to have a positive view."

The first and most significant advantage of nanotechnology applications is the ability to create lighter and stronger materials. The fuel consumption of automobiles could be drastically reduced as a result of weight reduction.

The reduction of pollutants emissions from engines has recently become the most highlighted concern in the transportation industry for environmentally friendly technology. To do this, a coating of aluminium nanoparticles could be applied to the cylinder walls to reduce friction.

Touchscreens are useful, but touch less displays would be far better. That's because, while touchscreens have aided the smartphone's advancement into our life and are required for us to use cash registers and ticket machines, they do have certain drawbacks.

In the Mechanical Engineering Department we have a strong emphasis on Nanoscale Engineering with faculty researching how nanoscale materials can be used for a wide variety of applications. This includes fundamental studies focused on manipulating light, heat and fluids as well as more applied work such as developing more efficient energy storage/conversion devices and controlling interactions with biological systems such as cells. Ultimately, Nanoscale Engineering is an inherently interdisciplinary area of research that is at the cutting edge of technology, and Vanderbilt is a significant contributor to the state-of-the-art.

Harini M
21BME018

Robot Turns Artist's Commands to Graffiti Print

Gerry Chen has focused on getting robots to do some of the most challenging human tasks. From that perspective, the doctoral candidate at Georgia Institute of Technology believes artistic endeavors, with their complex hand and arm movements, are an obvious target for robots to tackle.

Chen is one of a team of researchers at the school who has developed GTGraffiti, a cable-driven robot system that translates human motions while drawing to reproduce graffiti as an art form.

The bubble letters that form graffiti are a good starting point for robots to mimic because, unlike complex paintings, there are only a finite number of shapes (26) that the robot needs to learn to reproduce.

"A mural might be made of a thousand different unique strokes," Chen said, "If you're painting a portrait there might be shading and other advanced techniques involved, so it gets complicated quickly."

Bubble letters for alphabet graffiti on the other hand, need only to draw the outlines and the solid-colored insides can be painted in any pattern.

Translating Motions at Scale

The first go-around of the robot involved asynchronous mimicry between the painter and the robot. Data generated from two artists painted the alphabet in graffiti style were analyzed for speed, size, and direction. The researchers converted this data into electrical signals and created a library for each letter.

Depending on the word the team needs to be painted, the necessary configurations can be executed and translated into executable motor commands.

The newest version of GTGraffiti is more synchronous with an artist: An artist draws the graffiti letters on an iPad, which the robot reproduces in (near) real-time. Such a process is challenging, Chen says, because a human artist can traverse the entire length of the mobile device very quickly but the robot cannot.

“The artist gets confused because he makes a circle and then it might take the robot five seconds to catch up,” Chen said.

Scale is also a problem when translating art from a mobile device. “Because the iPad is small and the cable robot is big, you have to scale everything by [a factor of] fifty,” Chen said, “but if you scale the length you’re also scaling the velocity so you have to do something to slow it down.”

The stylus on the mobile device can also yield jitters which have to be filtered out. An additional challenge: The cable robot has four cables but only two degrees of freedom leading to over-actuation. “So if we just command the cable lengths or the motor positions then they might pull against each other and tear each other apart,” Chen said. The problem is resolved with high-frequency force control.

Pradeep R
21BME304

Blockchain

Blockchain is a distributed database or ledger shared among a computer network's nodes. They are best known for their crucial role in cryptocurrency systems for maintaining a secure and decentralized record of transactions, but they are not limited to cryptocurrency uses. Blockchains can be used to make data in any industry immutable—the term used to describe the inability to be altered.

Because there is no way to change a block, the only trust needed is at the point where a user or program enters data. This aspect reduces the need for trusted third parties, which are usually auditors or other humans that add costs and make mistakes.

Since Bitcoin's introduction in 2009, blockchain uses have exploded via the creation of various cryptocurrencies, decentralized finance (DeFi) applications, non-fungible tokens (NFTs), and smart contracts.

- Blockchain is a type of shared database that differs from a typical database in the way it stores information; blockchains store data in blocks linked together via cryptography.
- Different types of information can be stored on a blockchain, but the most common use for transactions has been as a ledger.
- In Bitcoin's case, blockchain is decentralized so that no single person or group has control—instead, all users collectively retain control.
- Decentralized blockchains are immutable, which means that the data entered is irreversible. For Bitcoin, transactions are permanently recorded and viewable to anyone.

Blockchain consists of programs called scripts that conduct the tasks you usually would in a database: Entering and accessing information and saving and storing it somewhere. A blockchain is distributed, which means multiple copies are saved on many machines, and they must all match for it to be valid.

The blockchain collects transaction information and enters it into a block, like a cell in a spreadsheet containing information. Once it is full, the information is run through an encryption algorithm, which creates a hexadecimal number called the hash.

Every miner starts with a nonce of zero, which is appended to their randomly-generated hash. If that number isn't equal to or less than the target hash, a value of one is added to the nonce, and a new block hash is generated. This continues until a miner generates a valid hash, winning the race and receiving the reward.

A blockchain allows the data in a database to be spread out among several network nodes computers or devices running software for the blockchain at various locations.

This not only creates redundancy but maintains the fidelity of the data. For example, if someone tries to alter a record at one instance of the database, the other nodes would prevent it from happening. This way, no single node within the network can alter information held within it.

Sabari Iyyappan S
21BME343

Green Engineering

Environmental concerns may cause some companies to identify greener, or environmentally safer, manufacturing, shipping and design options.

Green engineering is a concept that focuses on minimizing a company's environmental impact and streamlining its operations.

Understanding green engineering may help you or your employer decide to use this design method for your needs. In this article, we define green engineering, discuss its core principles, provide some green engineering benefits and include several examples discussing green engineering in the workplace.

Green engineering utilizes engineering processes and methods that minimize pollution, improve a business' sustainability and decrease the potential for health issues caused by unsafe manufacturing and design methods.

Engineers may achieve this goal without affecting a company's economic success or efficiency by using and improving existing processes. Successful green engineering examines sustainability issues, such as fossil fuel use, measures a product or service's life cycle, identifies potential waste concerns and decreases the likelihood of these problems occurring with innovative concepts.

Engineers may use many processes when green engineering, including:

WASTE REDUCTION

Many commercial processes, such as manufacturing and shipping products, may waste energy through inefficient manufacturing and delivery methods. Green engineering seeks ways to minimize this waste, including finding new fuel methods and minimizing unnecessary production steps that needlessly use energy.

MATERIALS MANAGEMENT

Materials management entails finding better and safer materials for diverse engineering purposes, particularly in product design and manufacturing. Engineers may identify new and safer materials or invent options to integrate into their plans and find better and more efficient production methods.

POLLUTION PREVENTION

Pollution prevention focuses on identifying a company's pollution sources and minimizing their waste. Engineers may identify why pollution occurs, find processing methods that decrease its spread, integrate newer and cleaner techniques and enhance manufacturing and delivery cleanliness.

PRODUCT ENHANCEMENT

Green engineers seek to improve the products or services they're engineering while making them safer for the environment. This process may include finding alternate energy sources that work better than traditional options or identifying greener and more efficient manufacturing materials and methods.

Green engineers may work in many fields, including manufacturing, product design, architectural planning, land-use plotting, product distribution, supply chain management and city planning. Skilled engineering can not only decrease a company's pollution and waste but also minimize unnecessary spending.

BENEFITS OF GREEN ENGINEERING

- Enhances business practices
- Improves a company's reputation
- Minimizes energy or production waste
- Provides tax incentives
- Helps the global environment

CONCLUSIONS

As such, green engineering is an effective approach, which offers guidance and support towards the direction of sustainable processes, products and systems, whilst reducing the risks to humans and the environment.