Mechanica Association

MECH MAG

2021-22

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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 impart quality–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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06. Ocean CleaningTechnology

01

INTELLIGENT EXO-SKELETONS

NITHISH KUMAR G
20BME013

Intelligent exo-skeletons-helps kids with cerebral palsy walk upright. Cerebral palsy is the leading cause of childhood disability, affecting about 3.3 children per 1,000 births. It's a group of neurological movement disorders caused by brain malformation or injury before, during or shortly after birth. Children and adults with cerebral palsy may have limb weakness, overly tight muscles, tremors and lack of coordination.
One of the biggest issues for many people with cerebral palsy is known as "crouch gait," or walking while the knees are excessively bent. Children with cerebral palsy will often naturally walk in a crouch position because their muscles are too weak to hold them upright or too tight to let them fully extend their legs. But walking in this position uses up an immense amount of energy. And while it may be sustainable while a child is small and light, once they grow bigger and heavier it becomes increasingly difficult to move around in a crouch position.

"That results in a downward cycle where mobility—the ability to walk—deteriorates," Bulea says.

Since the early 2000s, researchers have been trying to develop lower-limb exoskeletons that augment human mobility by reducing the metabolic cost of walking and running versus without a device. In 2013, researchers finally broke this 'metabolic cost barrier'. We analyzed the literature through December 2019, and identified 23 studies that demonstrate exoskeleton designs that improved human walking and running economy beyond capable without a device.
Here, we reviewed these studies and highlighted key innovations and techniques that enabled these devices to surpass the metabolic cost barrier and steadily improve user walking and running economy from 2013 to nearly 2020. These studies include, physiologically-informed targeting of lower-limb joints; use of off-board actuators to rapidly prototype exoskeleton controllers; mechatronic designs of both active and

passive systems; and a renewed focus on human-exoskeleton interface design.
The Spanish National Research Council, known as the CISC, has introduced the world's first exoskeleton specifically targeting children's spinal muscular atrophy. The device, made out of aluminum and titanium, weighs 26 pounds.
It will allow children to walk with greater ease— and in some cases for the first time. The exoskeleton will also be used for training purposes and to ward off muscular atrophy from lack of use. "So an exoskeleton able to adapt to these changes autonomously is necessary. Our model includes intelligent joints that modify the stiffness automatically and adapt to the symptoms of each child at all times."
The exoskeleton has a robotic frame that attaches to the child's legs and torso and can target a variety of symptoms. It consists of five motors in each leg. The users have direct control over all five, which can detect the slightest intent of muscle movement and responds accordingly. The exoskeleton is flexible and can adjust to rapidly growing bodies, and is aimed at the ages of three through fourteen. The CISC's research arm has already patented the technology.
Exoskeletons have been having a moment in recent years. Researchers have developed robotic exoskeletons that let people with stroke or spinal cord injuries stand and walk, allow construction workers and soldiers to carry heavy items with less fatigue and risk of injury, and give people with paralysis the ability to move using their thoughts. But the exoskeletons have not done well transitioning from research lab to market. They're usually quite expensive, for one, ranging from between about $40,000 and $100,000. And experts say they are often still too bulky and complex to be especially useful in a home setting. Some even wonder if the emphasis on walking upright is a form of ableism that suggests walking is "more normal" than using a wheelchair, and that a better use of resources would be to make our cities more accessible to people who use mobility devices.

USE OF EXO-SKELETON IN MILITARY :

Developing a full-body suit that meets the needs of soldiers has proven challenging.

The Defense Advanced Research Projects Agency (DARPA) launched the Warrior Web program in September 2011 and has developed and funded several prototypes, including a "soft exosuit" developed by Harvard University's Wyss Institute. In the early 2000s, DARPA funded the first Sarcos full-body, powered exoskeleton prototype, which was hydraulically actuated and consumed 6,800 watts of power. By 2010, DARPA and Sarcos had more than halved that, to 3,000 watts, but still required the exoskeleton to be tethered to the power source. Nowadays, the Sarcos Guardian XO is powered by lithium ion batteries and is applicable for military logistics applications.
In 2019, the US Army's TALOS exoskeleton project was put on hold. A variety of "slimmed-down" exoskeletons have been developed for use on the battlefield, aimed at decreasing fatigue and increasing productivity. For example, Lockheed Martin's ONYX suit helps soliders to perform knee intense tasks.

02

SAND BATTERY

PRADEEP KUMAR R
21BME304

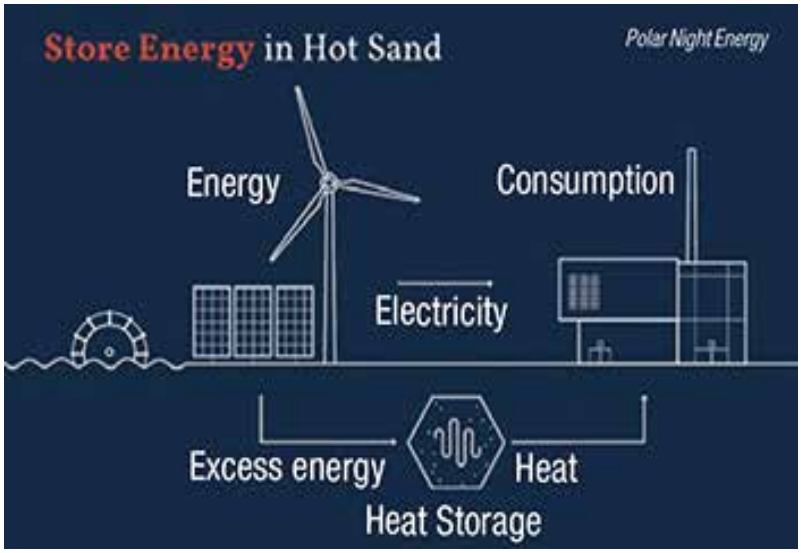
Finnish "sand battery" offers solution for renewable energy storage. Not every technology bettering our future has to be complicated, some are simple, yet extremely effective. One of these kind of technologies has come from some Finnish engineers who have found a way to turn sand into a giant battery.These engineers piled 100 tons of sand into a 4 x 7 metre steel container. All of this sand was then heated up using wind and solar energy.

This heat can then be distributed by a local energy company to provide warmth to buildings in nearby areas. Energy can be stored this way for long periods of time.
All of this occurs through a concept known as resistive heating. This is where a material is heated by the friction of electrical currents.
Sand and any other non-super conductor are warmed by the electricity passing through them generated heat than can be used for energy

Finnish companies Polar Night Energy and Vatajankoski have built the world's first operational "sand battery", which provides a low-cost and low-emissions way to store renewable energy.
The battery, which stores heat within a tank of sand, is installed at energy company Vatajankoski's power plant in the town of Kankaanpää, where it is plugged into the local district heating network, servicing around 10,000 people.

The company behind the technology, Polar Night Energy, says it helps to solve one of the key obstacles in the transition to full renewable energy: how to store it for use during times when the sun isn't shining or wind isn't blowing, and particularly for use in the wintertime when demand is high.
"Solar and wind power is basically already really competitive in terms of energy price per produced energy unit," Polar Night Energy co-founder and chief technology officer Markku Ylönen told Dezeen. "The only problem with them is that you can't really choose when it's produced."
He said that while lithium batteries are well suited for vehicles, "if we're talking about gigawatt hours or terawatt hours of excess electricity, it's not technically feasible to try to cover that with lithium batteries, and also the costs will be immense".
"Even even if we dug out all the lithium in the world, we couldn't build batteries big enough

to accommodate all the fluctuation in renewable energy production," Ylönen added.



The battery stores excess renewable energy as heat that can later be sent to homes and businesses. Polar Night Energy's sand battery stores heat for use weeks or even months later. It works by converting the captured renewable electricity into hot air by using an industrial version of a standard resistive heating element, then directing the hot air into the sand.

The heat transfers from the air to the sand, which ends up at temperatures of around 500 to 600 degrees Celsius and retains that heat well. To unlock it for use, the process is reversed and the hot air funnelled into a heating system used for homes or industry.

According to Ylönen, the process is low-cost sand is inexpensive so the main costs are related to equipment and construction of the steel storage tank. It is also low-impact, with the only substantial greenhouse gas emissions being embodied emissions from construction and the transport of sand, which should come from a location close to the battery site.

And although there is a sand shortage related to the material's use in concrete and glass, Ylönen says the battery does not require this kind of fine-grain, high-quality sand. Instead, they can use sand rejected by the construction , industry, or even alternative "sand-like materials", of which Polar Night Energy already has several contenders.
The battery can be made with any type of sand from any location.

The Kankaanpää battery is four metres in diameter, seven metres high and contains 100 tonnes of sand, but Polar Night Energy envisions future batteries being 20 metres across and 10 metres high. This should give the battery one gigawatt hour of storage capacity, which is equivalent to one million kilowatt hours (kWh). The average UK home uses 1,000 kWh of gas and 240 kWh of electricity per month.

The sand battery would most likely only be used to provide heat and not electricity due to the inefficiency of the conversion process, but according to Ylönen, the world's heating needs are great enough to justify having separate storage systems.

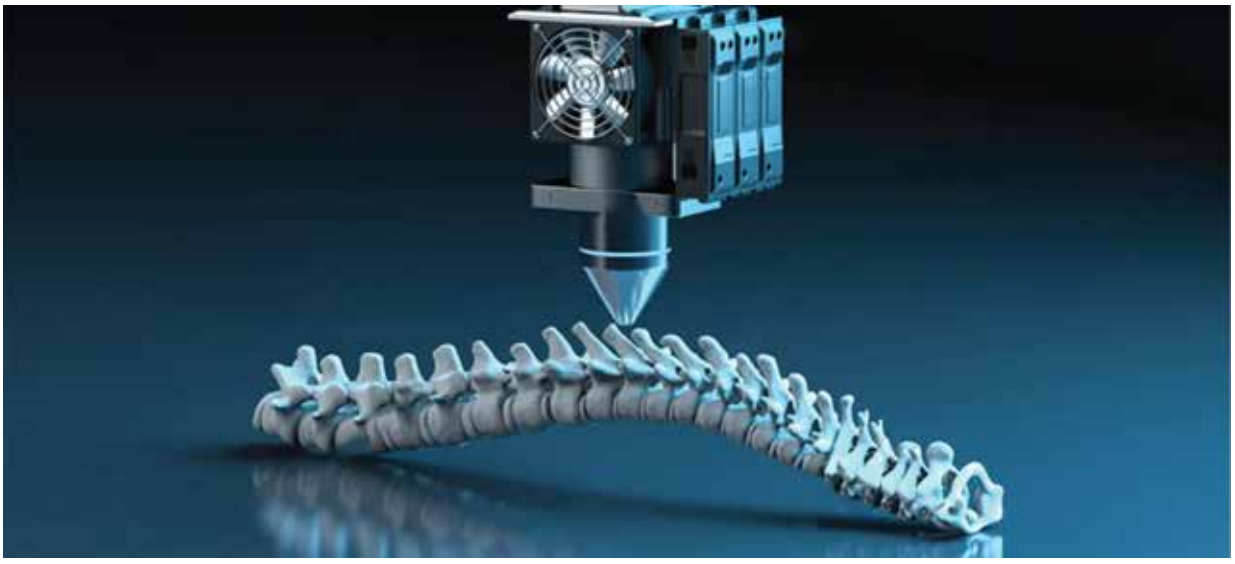
The urgency of transitioning to renewable energy has increased with the Ukraine war, which has led to spiralling energy costs and has revealed Europe's dependence on Russian oil and gas.

03 3D PRINTEDBONES

PRAKASINI S.V
21BME037

A Northwestern University research team has developed 3D printable ink that produces a synthetic bone implant that rapidly induces bone regeneration and growth. This hyper-elastic bone material is easily customizable to different shapes and could one day be especially useful in the treatment of bone defects in children. Bone implantation surgery is never an easy process, but it is particularly painful and complicated for children.

With both adults and children, bone is often harvested from elsewhere in the body to replace the missing bone, which can lead to other complications and pain. Metallic implants are sometimes used, but this is not a permanent fix for growing children.
“Adults have more options when it comes to implants,” said Ramille Shah, PhD, an assistant professor of Surgery in the Division of Organ Transplantation at Northwestern University Feinberg School of Medicine.



If you give them a permanent implant, you have to do more surgeries in the future as they grow. They might face years of difficulty.”
Shah and her team aim to change the nature of bone implants, and they particularly want to help pediatric patients. Adam Jakus, PhD, a postdoctoral fellow in Shah’s laboratory, is the first author of the study, which evaluated the material with human stem cells and within animal models.

.Shah’s 3-D printed biomaterial is a mix of hydroxyapatite (a calcium mineral found naturally in human bone) and a biocompatible, biodegradable polymer. The material is majority hydroxyapatite, yet it is hyper-elastic, robust and porous at the nano, micro and macro levels. These unique properties have contributed to the printed structure’s great promise in in vivo animal models.
“Porosity is huge when it comes to tissue regeneration, because you want cells and blood vessels to infiltrate the scaffold,” Shah said.

"Our 3-D structure has different levels of porosity that work to the advantage of its physical and biological properties."
While hydroxyapatite has been proven to induce bone regeneration, it is also notoriously tricky to work with. Clinical products that use hydroxyapatite or other calcium phosphate ceramics are hard and brittle. To compensate for that, previous researchers created structures composed mostly of polymers, but this shields the activity of the bioceramic. Shah's bone biomaterial, however, is 90 percent by weight hydroxyapatite and just 10 percent by weight polymer, and it still maintains its elasticity because of the way its structure is designed and printed. The high concentration of hydroxyapatite creates an environment that induces rapid bone Vregeneration.

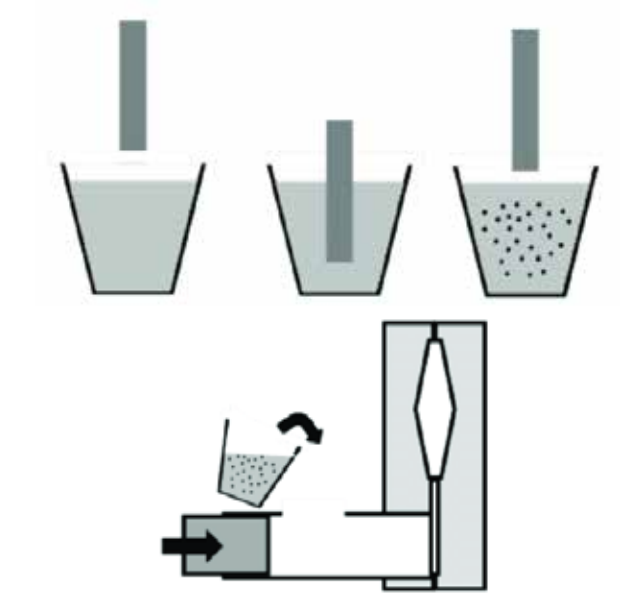
"Cells can sense the hydroxyapatite and respond to its bioactivity," Shah said. "When you put stem cells on our scaffolds, they turn into bone cells and start to up-regulate their expression of bone-specific genes. This is in the absence of any other osteoinducing substances. It's just the interaction between the cells and the material itself."

That's not to say that other substances couldn't be combined into the ink. Because the 3-D printing process is performed at room temperature, Shah's team was able to incorporate other elements, such as antibiotics, into the ink. "We can incorporate antibiotics to reduce the possibility of infection after surgery," Shah said. "We also can combine the ink with different types of growth factors, if needed, to further enhance regeneration. It's really a multi-functional material".
One of the biggest advantages, however, is that the end product can be customized to the patient. In traditional bone transplant surgeries, the bone — after it's taken from another part of the body has to be shaped and molded to exactly fit the area where it is needed. Using Shah's synthetic material, physicians would be able to scan the patient's body and 3-D print a personalized product. Alternatively, due to its mechanical properties, the biomaterial also can be easily trimmed and cut to size and shape during a procedure. Not only is this faster, but also less painful compared to using autograft material.
Shah imagines that hospitals may one day have 3-D printers, where customized implants can be printed while the patient waits.
"The turnaround time for an implant that's specialized for a customer could be within 24 hours," Shah said. "That could change the world of craniofacial and orthopaedic surgery, and, I hope, will improve patient outcomes."

04 GISS TECHNOLOGY

VETRIVEL A
22BME350

GISS TECHNOLOGY - Gas Indused semisolid technology helps die casters reduce porosity rejects and production costs at the same time.
GISS Technology The World's Latest Breakthrough in the Metal Casting IndustryThe GISS technology improves casting quality while reducing production cost at the same time.



The technology applies the Superheated Slurry Casting Process, the world's latest metal casting innovation. The GISS Technology is a quick solution technology for aluminum die casters who have porosity defect problems resulting in high reject rates. It is different from other solutions such as vacuum assist and squeeze pins because GISS Technology also reduces production costs while reducing the reject rates. Our customers are benefiting significant cost reduction applying the GISS Technology

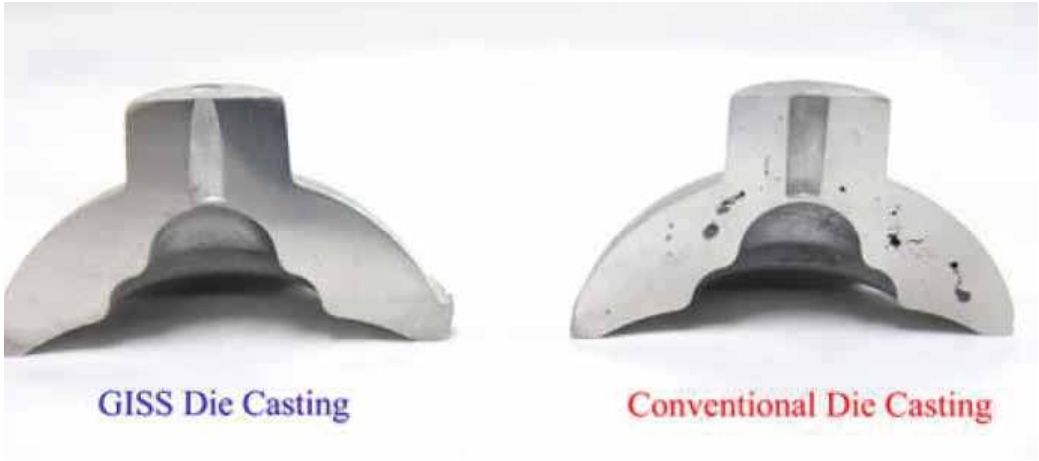
Besides improving quality and reducing cost, the GISS technology also enables die casting of wrought aluminum alloys such as 6061, 6063, and 7075 alloys, which can be anodized. This breakthrough will open up several opportunities in the die casting industry.

GISS PROCESS

The GISS Technology applies the Superheat Slurry Casting process, the world's latest metal casting innovation*. Instead of casting very hot liquid metal, the GISS Technology converts liquid metal into superheated slurry. Since the slurry is still superheated, it can effectively fill the die cavity. However, the slurry has significantly lower heat content than the liquid metal, so it gives several cost benefits such as die life extension and reduced cycle time.

The fraction of solid, which can be controlled using the GISS unit, allows the control of flow pattern into the die cavity. As a result, gas porosity can be effectively controlled. Furthermore, the presence of pre-existing solid particles in the slurry changes the solidification mode of the metal in the die cavity such that shrinkage porosity is greatly reduced.
The GISS Technology creates the superheated slurry by using a special probe to inject micro-size inert gas bubbles in the liquid metal at the suitable conditions.`

Slurry with controlled fraction of solid is then ready for the casting process. We, GISSCO, help our customers solve their problems by applying the GISS Units to the current production using existing die casting machines and dies, and provide full technical support to our customers. Customers can use the existing die designs without any modifciations to achieve the benefits of slurry casting process. We will provide technical support on the die casting parameter optimization to customers. We can understand from the below image that component produced from GISS die casting no pores, blow holes and slag inclusion.



KEY BENEFITS

Because we are injecting slurry with lower heat content, controlled viscosity, and some initial nuclei, we can achieve cost benefits immediately using the GISS Technology. Some of the key benefits are as follows:

1. Reject reduction due to gas porosity and shrinkage porosity from 10 – 50% to 1– 5%*, Production cost reduction by 10 – 15%*, Cycle time reduction reduced by 15–25%*, Increased die life to 2 – 4 times*, Melting energy reduction, lubricant usage reduction, water treatment reduction by 15 – 30%*

2. Gas porosity is reduced in the GISS casting process because the controlled solid fraction in the slurry yields less turbulent flow compared with conventional high-pressure die casting.

3. Shrinkage porosity is reduced in the GISS casting process because the initial solid particles present in the slurry act as nucleation sites in liquid metal so that different mode of solidification is achieved with less shrinkage amount also.

4. Slurries entered the die with significantly reduced heat content, resulting in shorter cycle time and longer die life.

5. Solid particles in the slurries are ultra-fine, yielding easy flow into the ultra-thin sections and uniform microstructure.

05

CATAPULTING SATELLITES INTO SPACE

SELVA NATHEYA R
21BME027

Spin Launch, the company designing a catapult-like device to launch rockets into space without propellant, just signed a Space Act Agreement with NASA.Spin Launch "will develop, integrate, and fly a NASA payload on the company's Suborbital Accelerator Launch System to provide valuable information to NASA for potential future commercial launch opportunities," a press statement reveals. Though it's in the early testing phase, the system could instigate a seismic shift in the space industry, massively reducing the cost and environmental impact of small satellite launches.

NASA's Space Act Agreement is part of its ongoing initiative to help the private sector build new space innovations that the agency could use in its pursuit of furthering science, exploring the cosmos, and establishing a network of future space colonies.

"SpinLaunch is offering a unique suborbital flight and high-speed testing service, and the recent launch agreement with NASA marks a key inflection point as SpinLaunch shifts focus from technology development to commercial offerings," said Jonathan Yaney, Founder, and CEO of SpinLaunch.

Eliminating more than 70% of fuel and structure requirements

SpinLaunch will fly NASA's payload as part of a developmental flight test later this year, after which it will recover the payload for analysis, the company explains in its statement. Both NASA and SpinLaunch will analyze the data collected after launch

in order to assess the viability of the system for future missions.

SpinLaunch's Orbital Accelerator system features a rotating carbon fiber arm inside a 300-ft diameter steel vacuum chamber that is used to accelerate a payload-carrying launch vehicle to speeds of up to 5,000 mph. The arm lets go of the rocket at just the right moment, launching it out of the chamber and up towards orbit.

The company claims its system eliminates more than 70 percent of the fuel and structure requirements of typical rocket launches. NASA, for example, typically uses half a million gallons of water per launch — and that's before taking into account the vast amounts of propellant required to send its rockets into orbit.

SpinLaunch's catapult-like system is definitely one of the more unusual and potentially disruptive ideas we've seen obtain a Space Act contract.

Another high-profile Space Act Agreement contract recipient is Jeff Bezos' Blue Origin, which recently reached an agreement with NASA to build a commercial space station or "space business park" called Orbital Reef.

NASA's Space Act Agreement is part of its ongoing initiative to help the private sector build new space innovations that the agency could use in its pursuit of furthering science, exploring the cosmos, and establishing a network of future space colonies.

"SpinLaunch is offering a unique suborbital flight and high-speed testing service, and the recent launch agreement with NASA marks a key inflection point as SpinLaunch shifts focus from technology development to commercial offerings," said Jonathan Yaney, Founder, and CEO of SpinLaunch.

"What started as an innovative idea to make space more accessible has materialized into a technically mature and game-changing approach to launch," he added. "We look forward to announcing more partners and customers soon, and greatly appreciate NASA's continued interest and support in SpinLaunch."

SpinLaunch says it will eventually be able to send about 440 lbs of payload to orbit at a fraction of the cost of other satellite launch services, such as those provided by SpaceX, ULA, and other space companies. In November last year, the company announced it would conduct roughly 30 suborbital test flights from Spaceport America over the following eight months. Stay posted for future updates on this medieval-inspired launch system that has the potential to revolutionize the way NASA launches satellites to space

In 1966 its Project HARP successfully used a massive cannon to launch a 400lb projectile into space. It reached an altitude of 180km, well above the Karman line, the internationally recognised boundary of space at 100km.

06

OCEAN CLEANING TECHNOLOGY

HARISH M
20BME037

At 16 years of age, Boyan Slat saw more plastic bags than fish when scuba diving in Greece. He thought: “Why can’t we just clean this up?” This question led him to research the plastic pollution problem for a school project. He learned about plastic accumulating in five large oceanic gyres, the largest one being the Great Pacific Garbage Patch. In 2012, Boyan Slat held a TEDx talk about how to rid the world’s oceans of plastic using technology. The video went viral, and the momentum that followed allowed him to drop out of school and found The Ocean Cleanup.

A huge floating device designed by Dutch scientists to clean up an island of rubbish in the Pacific Ocean that is three times the size of France has successfully picked up plastic from the high seas for the first time.

Boyan Slat, the creator of the Ocean Cleanup project, tweeted that the 600 metre-long (2,000ft) free-floating boom had captured and retained debris from what is known as the Great Pacific Garbage Patch.

The vast cleaning system is designed to not only collect discarded fishing nets and large visible plastic objects, but also microplastics The plastic barrier floating on the surface of the sea has a three metre-deep (10ft) screen below it, which is intended to trap some of the 1.8tn pieces of plastic without disturbing the marine life below.The device is fitted with transmitters and sensors so it can communicate its position via satellites to a vessel that will collect the gathered rubbish every few months.

OCEAN SYSTEMS

Plastic, once trapped in a gyre, will slowly break down, fragmenting into pieces called microplastics. Microplastic debris (< 5mm) is not only more challenging to clean up but is also easily mistaken for food by marine life. The time to clean up is now.

The ocean garbage patches are massive. To effectively clean an area of such magnitude, a calculated and energy-efficient solution is required. With a relative speed difference maintained between the cleanup system and the plastic, we can concentrate the plastic for extraction. Learn more about our ocean technology and System 002, our current ocean system iteration.

The harvested plastic will be brought back to shore for recycling. We have made our very first product – The Ocean Cleanup Sunglasses – using the catch of System 001/B in 2019.

Going forward, we do not intend to make our own products, but partner with companies who will use our ocean plastic

in their products.
On july 25th 2022 their operation in the Pacific Ocean reached an exciting milestone: The Ocean Cleanup has now officially removed more than 100,000 kg of plastic from the Great Pacific Garbage Patch (GPGP).
Since deployment in August 2021, System 002 (or “Jenny”) has now collected 101,353kg of plastic over 45 extractions, sweeping an area of ocean of over 3000km2 comparable to the size of Luxembourg or Rhode Island. Added to the 7,173 kg of plastic captured by our previous prototype systems, The Ocean Cleanup has now collected 108,526 kg of plastic from the GPGP – more than the combined weight of two and a half Boeing 737-800s, or the dry weight of a space shuttle.

HOW IT WORKS

TARGET - The circulating currents in the garbage patch move the plastic around, creating natural ever-shifting hotspots of higher concentration. With the help of computational modeling, we predict where these hotspots are and place the cleanup systems in these areas.

CAPTURE - By maintaining a relative speed difference to the plastic, the plastic can be caught in the retention zone of the cleanup system. The wingspan, speed and direction are corrected and maintained by the vessels.

EXTRACTION - By maintaining a relative speed difference to the plastic, the plastic can be caught in the retention zone of the cleanup system. The wingspan, speed and direction are corrected and maintained by the vessels.

RECYCLING - Once our containers are full of plastic onboard, we bring them back to shore for recycling. For each system batch, we plan on making durable and valuable products. Supporters getting the products will help fund the continued ocean cleanup. Catch, rinse, recycle and repeat - until the oceans are clean. The sunglasses are a proof of concept for this.