

Mississippi Tech Startup Weekend Technology Catalog

[Predictive Environmental Modeling System \(PEMS\)](#)

What is it?

Imagine you've created a wondrous new chemical compound and can't wait to get it out into the world. Before you do though, you need to figure out how production will impact the local environment. Will it wreck the local ecosystem, or can you make it without creating any issues? Rather than hiring an ecologist to do months of calculations, you can have your answer in a single day using AI-powered computer modeling.

How's it better than what's already out there?

This technology offers easy-to-use tools for computational testing of environmental impacts, significantly reducing the need for costly lab testing through accurate predictive models. Its comprehensive, ever-expanding database provides reliable emissions modeling information that updates in real-time as new research emerges. Additionally, it normalizes emission data by converting native units into comparative concentration levels, ensuring consistent and meaningful analyses.

What problem/challenge/inconvenience does this solution aim to address?

Predicting how an environment will change and evolve is hard enough, but that's doubly hard when introducing an unknown substance into it. Now you don't need a PhD or months of specialized work to get a comprehensive prediction of your environmental footprint.

[Modular Bathymetry](#)

What is it?

While you can model water flow using computers, you often need to verify by running actual water through an actual physical model. Until now, concrete has been the best material to create these models out of, but we can do better. Using a CNC machine specially calibrated to cut polystyrene foam, we can now quickly, cheaply, and repeatedly create models for testing in this space.

How's it better than what's already out there?

Foam is a superior material for modeling due to its versatility and practicality. While concrete is undeniably strong and durable, it has several drawbacks for modeling purposes. Concrete is heavy, challenging to use for creating highly detailed models, and difficult to deconstruct after testing is complete. On the other hand, foam allows for rapid testing, as it sets much faster and is easier to work with compared to concrete. This capability makes iterative testing more efficient, reducing construction costs by 30-60% and enabling construction times to be up to 60% faster than with concrete modeling.

What problem/challenge/inconvenience does this solution aim to address?

Good question for the inventor/researcher. If you're interested in this technology, we'll connect you with the inventor for a brief Q&A session.

Portable Gamma Radiation Detector

What is it?

This is a lightweight, portable device for detecting the direction of radiation without needing bulky protective materials (shielding). It uses less power, works in noisy environments, and is ready for use in real-world settings.

How's it better than what's already out there?

This solution improves on current radiation detectors by offering directional sensing, enabling users to locate radiation sources rather than just measure levels at their location. It is also lightweight and low-power, providing similar capabilities without the bulk or high energy demands of traditional tools. Additionally, its strong signal-to-noise ratio ensures reliable performance even in noisy environments.

What problem/challenge/inconvenience does this solution aim to address?

The ability to locate the source of radiation without needing to go into an irradiated space can save time, money, and lives.

The aforementioned technologies are currently owned by the U.S. Army Engineering Research & Development Center

Portable Osteometric Device

What is it?

This technology uses lasers to measure the distance between two black bookends placed on either side of an object, such as a bone. It provides precise measurements of the object's length quickly and accurately.

How's it better than what's already out there?

The Laser Caliper stands out for its combination of portability, precision, ease of use, and versatility, making it a more efficient and accurate alternative to traditional measuring devices.

What problem/challenge/inconvenience does this solution aim to address?

Having a device that is small and easy to carry allows for faster, easier, and more reliable measurements than using other measuring devices. You can get an accurate and precise measurement without having to touch the object.

Potential Market Size: \$1-10 million (archeology)

Timeline to market: 1 year

TRL: 8

Applications: Field archeology, academic archeology, forensics

In situ forming microparticles for intra-articular drug delivery

What is it?

This drug delivery method involves using a pomegranate juice extract that's been wrapped in tiny plastic particles (called micro-encapsulation) and then injected to provide long-lasting pain relief. The plastic particles slowly release the extract over time, allowing for more sustained effects rather than a quick burst of relief that wears off quickly.

How's it better than what's already out there?

This solution offers longer-lasting pain relief, reducing the need for frequent injections and doctor visits. Unlike existing injectable compounds that target specific types of inflammation, the extract punicalagin acts as a broad-spectrum anti-inflammatory, providing more comprehensive pain management.

What problem/challenge/inconvenience does this solution aim to address?

The ability to slowly release the pain reliever for lasting effects is beneficial to patients with chronic pain. The choice of punicalagin is significant because the exact causes of osteoarthritis vary, so a broad anti-inflammatory compound has the potential to help more patients than existing, targeted solutions.

Potential Market Size: \$6 billion (osteoarthritis treatment); 500 billion (injectable drugs)

Timeline to market: 10-12 years (average timeline for new drug development)

TRL: 1

Applications: Treatment of osteoarthritis and other joint diseases where sustained drug release is beneficial

An Explainable Mapping-guided High-Risk Cancer Evaluation Software

What is it?

This is a type of AI software that looks at medical scans (like X-rays or MRIs) and can detect head and neck cancer more accurately than doctors or specialists. It helps identify high-risk areas of cancer, so doctors can focus on those spots and potentially avoid unnecessary tests or procedures that might be more invasive or uncomfortable. The software essentially helps doctors make quicker, more precise decisions about treatment.

How's it better than what's already out there?

It reduces the need for biopsy. For head and neck carcinoma, critical information such as cancer stage is only detectable after surgery by analyzing tissue for extracapsular extension. It's also more accurate than professionals. This software uses a machine learning approach called gradient-based class activation mapping (grad-CAM) to achieve a 95% test accuracy, picking up on details that humans cannot physically see.

What problem/challenge/inconvenience does this solution aim to address?

AI software can assist by analyzing these images more quickly and often with greater precision, identifying subtle signs of cancer that might be overlooked by humans. It also helps provide consistency and faster results, allowing doctors to focus on high-risk areas more effectively.

Potential Market Size: \$4.5 billion (head and neck cancer)

Timeline to market: 2-5 years

TRL: 4

Applications: Detecting head and neck cancers at hospitals and clinics.

Vision-based Seismocardiography

What is it?

Using a smartphone or tablet, users can take videos from of a patient's chest to determine heart rate and other important health information just from the video. In the future, it will be able to detect early signs of heart disease too, helping catch problems sooner

How's it better than what's already out there?

Care on the go: In contrast to existing heart monitors, which are expensive and are usually located in hospitals, this technology can work with any smartphone camera anywhere in the world.

Taking care of the weakest among us: This technology can be integrated with mounted cameras for hospitals to monitor the heart conditions of newborns, as traditional heart monitors are too heavy and risk harming them.

What problem/challenge/inconvenience does this solution aim to address?

Good question for the inventor/researcher. If you're interested in this technology, we'll connect you with the inventor for a brief Q&A session.

Potential Market Size: \$50 billion (cardiovascular devices), \$150 billion (cardiovascular drugs), \$17 billion (cardiovascular surgery)

Timeline to market: 4 years

TRL: 4-5

Applications: Monitoring heart health in vulnerable individuals, especially in areas with no or limited doctors (outer space; rural communities; understaffed hospitals, nursing homes, and NICUs)

EMI Mitigation Technique

What is it?

This technology is designed to reduce electrical interference (EMI) that can disrupt the performance of electric vehicles. EMI can cause communication devices and other electronics to fail, including key vehicle components such as airbags and anti-lock braking systems. By minimizing this interference, it makes it easier to build and test the next generation of electric vehicles, ensuring they work more reliably and efficiently.

How's it better than what's already out there?

More bang for your buck: By accounting for the signal phase, this technique can reduce EMI with less error and less computing power than existing methods which rely only on the frequency and amplitude. Plays well with friends: existing techniques only work on single devices, so when you put devices in a network, errors propagate unpredictably. Our method can work on a network of devices, such as are encountered in large vehicles and aircraft.

What problem/challenge/inconvenience does this solution aim to address?

High-voltage battery-powered vehicles produce high levels of electromagnetic interference, which can disrupt nearby devices. This technique dramatically reduces EMI, making it easier to build and test the next generation of electric vehicles.

Potential Market Size: 150 billion (e-vehicles), 7 billion (electromagnetic interference shielding)

TRL: 7

Applications: High voltage technologies

Impact wave amplifier

What is it?

A modular unit that turns low-pressure water into high-pressure water without high-pressure pumps or valves. A jackhammer-like striker hits a chamber of water, pushing it through a specially designed nozzle that amplifies the pressure from that of a garden hose to a stream of water that can cut through 1/8 inch aluminum in seconds.

How's it better than what's already out there?

Pressurizing water to a high enough speed to be destructive requires expensive high-pressure pumps and valves. If those valves fail, lives can be lost. The impact wave amplifier allows low-pressure water to reach high pressures only as it exits the nozzle, eliminating the need for high-pressure pumps and valves and increasing safety. It conserves water. The wave amplifier increases pressure waves rather than relying on the water's velocity to create pressure, meaning that it can use a fraction of the water required by traditional techniques.

What problem/challenge/inconvenience does this solution aim to address?

Good question for the inventor/researcher. If you're interested in this technology, we'll connect you with the inventor for a brief Q&A session.

Potential Market Size: \$100-1000 billion (mining), 1 billion (water jet cutting), 100 billion (demolition), 100 billion (Search and Rescue)

Timeline to market: 3-7 years

TRL: 4-5

Applications: Mining, Water Jet Cutting, Demolition, Search and Rescue,

Rhodococcus Food Supplement

What is it?

This technology is a special bacterial supplement that helps black soldier fly larvae grow faster and become more nutritious, making them better for use in animal feed and other applications.

How's it better than what's already out there?

This technique increases black soldier fly larvae mass by 25% compared to traditional feeds, a significant increase in production ability.

What problem/challenge/inconvenience does this solution aim to address?

Good question for the inventor/researcher. If you're interested in this technology, we'll connect you with the inventor for a brief Q&A session.

Potential Market Size: \$4 billion (black soldier fly rearing)

Timeline to market: 2-10 years (depending on results of shelf-life testing)

TRL: 5-6

Applications: Black soldier fly rearing for animal consumption (catfish, pigs, chickens)

Lookahead Aware Noise Cancellation for Wireless Earbuds

What is it?

These selectively noise-canceling earbuds come with a soundwave-detection device that can be placed on the ground, a table, or another hard surface. Because sound travels faster through solid objects than through air, it reaches the detection device before it hits the user's ears. Then the device sends a Bluetooth signal (which travels at the speed of light), telling the earbuds to activate noise cancellation to block the loud noise.

How's it better than what's already out there?

Existing selectively noise-canceling earbuds tend to struggle with sudden, unpredictable sounds such as crashing dishes and dogs barking, while this solution is aimed at solving that problem.

What problem/challenge/inconvenience does this solution aim to address?

Good question for the inventor/researcher. If you're interested in this technology, we'll connect you with the inventor for a brief Q&A session.

Potential Market Size: \$13 billion (noise cancellation headphones), \$23 billion (earbuds)

TRL: 5

Applications: noise canceling headgear of any type

3D Arterial Model

What is it?

A 3D benchtop testing system designed for studying vascular calcification, providing a valuable tool for research and education. This system is cost-effective, easy to produce, and enables preliminary testing of treatments without the need for human or animal subjects.

How's it better than what's already out there?

Existing models are typically 2D, meaning that the model arteries are laid flat on the lab bench. This is a poor approximation of real arteries which exist in 3D. This arterial model goes an additional step by using biosynthesized artery walls that closely match the biomechanics of real arteries in living humans.

What problem/challenge/inconvenience does this solution aim to address?

There is a large leap between relatively inexpensive *in vitro* lab testing and relatively expensive *in vivo* studies of animals or human subjects. Unfortunately, many drugs that seem promising in the lab fail in animals or humans, and part of that is because of biomechanical factors, such as the force and direction of blood flow and gravity. Using lab models that are as close to living beings as possible has the potential to save researchers millions of dollars in unnecessary research.

Potential Market Size: \$500 million (heart disease research funding), \$90 billion (medical education market size)

TRL: 3

Applications: Heart disease research, medical education

[Bio-Based Self-Healing Adhesive](#)

What is it?

It is a bio-based, self-healing adhesive made from two monomers that enhance bonding properties, thermal stability, and mechanical strength. Tested at an adhesive strength of 24 MPa, it is one of the strongest self-healing adhesives (SHA) available, offering economic and environmental benefits by being non-petroleum-based while extending material lifespan through its unique flexible and rigid regions. (*visit link for more info*)

[Fungal Attractant to Enhance Termite Bait Stations](#)

What is it?

A natural attractant for wood-targeting pests that can fit the needs of existing bait stations (*visit link for more info*)

How's it better than what's already out there?

Infusing bait with blue-stain fungi enhances bait effectiveness by making it more attractive to wood-targeting pests, drawing them away from structures and reducing damage. The fungi preserve the wood's strength, increase pesticide permeability and retention, and can be applied to both wood and non-wood substrates. Blue-stain wood is compatible with existing bait stations and pesticides, promotes higher consumption rates compared to other attractants, and provides an eco-friendly solution when paired with low-toxicity pesticides.

What problem/challenge/inconvenience does this solution aim to address?

Subterranean termites are one of the most destructive pests of wooden structures in the world, costing homeowners over \$5 billion annually in control and replacement costs. Control of termites using bait stations is an important method.

Potential Market Size:

- Globally - 1.3billion in 2023 and expected to reach 2.1 billion by 2033
- United States – 288.9 million in 2023 and expected to reach 465 million by 2033.

TRL: 3

Applications: Residential protection, commercial building protection, agricultural use, eco-friendly pest control

Thienylpiperidine donor NIR I &II xanthene-based dye for imaging

What is it?

These are near infrared dyes that are highly stable, prepared by short and synthetic routes. Very few Xanthene-based near-infrared (NIR) photoacoustic (PA) dyes with absorbance greater than 600 nm exist. The few that exist are difficult to access, which require long and tedious synthetic steps. Photoacoustic tomography is a biomedical imaging technique that is characterized by the conversion of absorbed light, to heat and finally ultrasound waves via the photoacoustic effect. This technique allows whole-body imaging of animals and human tissue.

The NIR dye created by researchers at Mississippi State indicates that the PA imaging can view the NIR dye more effectively since it can absorb over 800 nm, (with a recorded value of 880nm) and thus makes biological tissue more transparent as well as desirable for deep tissue imaging for techniques such as photoacoustic and fluorescence by accessing depths on the cm scale.

How's it better than what's already out there?

These dyes are mostly used in clinical applications where ultrasounds, magnetic resonance imaging (MRI), and computed tomography (CT) lack cellular resolution. While similar dyes are on the market, these dyes stand out due to their high fluorescence which is difficult to achieve with their organic construction.

What problem/challenge/inconvenience does this solution aim to address?

Current dyes for NIR imaging are not stable or require tedious synthetic preparation. These dyes can be prepared by short synthetic routes and are stable.

Potential Market Size: Depends on what market you aim in.

- Biomedical market: \$1.6 billion by 2026
- Consumer goods (broad): \$22 billion to \$400 billion

TRL: 8

Applications: These dyes are highly sought after for applications in biological imaging, laser, and photo-and electrochromes. These dyes can also be functionalized for sng applications as well as for fluorescence and photoacoustic imaging.

- Biomedical (imaging, pharmaceuticals, biotechnology)

- Defense (night vision, lasers, sensors)
- Consumer goods (automotive, electronics, eyewear, lasers, industrial)

A Method for Targeting Nanoparticles to Bacterial Biofilm Infections using Bacterial Surface Proteins

What is it?

MSU researchers have developed a simple and efficient strategy to direct nanoparticles to bacterial biofilms, after which photothermal therapy can be used to selectively kill bacteria without, or in combination with, traditional antibiotics. The nanoparticles are engineered with low protein binding, specific biofilm targeting, and efficient photothermal conversion. Targeting is attained using a bacterial cell-wall binding protein from *Staphylococcus epidermidis*. This directs nanoparticles to *S. epidermidis* (gram positive) biofilms based on an affinity for teichoic acid. Essentially the bacterial proteins themselves are used to target nanoparticles to the biofilm site.

How's it better than what's already out there?

Traditional antibiotics play an essential role in controlling biofilms; however, they are becoming less effective due to the emergence of drug-resistant bacterial strains. The need to treat biofilms on medical implants is particularly acute, and one persistent challenge is selectively directing nanoparticles to the biofilm site. As bacteria become more resistant to antibiotics, particles like these could become a nonsurgical intervention to reduce or eliminate infections.

What problem/challenge/inconvenience does this solution aim to address?

Nanoparticles provide an effective strategy for delivering therapies to tumors and infection sites. However, developing a strategy to target the nanoparticles to a specific tissue or cell type is challenging, because the nanoparticles must recognize the target at the molecular site. We aim to solve this problem for biofilm infections, making it easier to use nanoparticles to deliver payloads to bacterial biofilms.

Potential Market Size: Global - \$3.9 billion in 2023 and expected to reach around \$9.7 billion by 2030.

TRL: 4

Applications: This method has potential applications in human health with a focus on materials, medical devices, military or defense, nanotechnology and nanoscience.

Compositions and Methods for inducing Immune Response Against Staphylococcus Aureus Causing Bovine Mastitis

What is it?

Many bovine mastitis vaccines for *S. aureus* have used inactivated whole cell bacterium antigens to induce immune response to bacterial surface molecules involving colonization. However, most of these vaccines showed limited efficacy to prevent clinical bovine mastitis by *S. aureus*. It was hypothesized that bovine mastitis clinical symptoms by *S. aureus* are mainly induced by secreted toxins. MSU researchers

have selected most conserved secreted toxins in bovine mastitis, tested their role in bovine mastitis using knock out strain, generated recombinant toxoid proteins to prevent side effects, and demonstrated toxoid antigens in mice and lactating dairy.

How's it better than what's already out there?

Most prior bovine mastitis vaccines against *S. aureus* have used mixture of formalin inactivated whole *S. aureus* bacterium. This vaccine uses nine recombinant proteins which are secreted by *S. aureus*.

What problem/challenge/inconvenience does this solution aim to address?

Bovine mastitis is a significant economic burden in the US dairy industry estimating \$2 billion loss annually. Bovine mastitis caused by *S. aureus* is highly contagious, resistant to many antibiotics, often resulted in loss of gland function (low production). Thus, culling is generally recommended for cows with *S. aureus* infection.

Potential Market Size: Global - \$1.23 billion in 2019 and expected to reach \$1.84 billion in 2027

TRL: 4

Applications: Veterinary Medicine

DriVR, a Virtual Reality System

What is it?

DriVR, a virtual reality software, prepares persons with disabilities to drive in the real world. Using versatile clinical data, DriVR provides a customized driving experience with tailored scenarios, such as navigating crosswalks and police stops. The result builds confidence, reduces anxiety and prepares individuals for the real driving experience, ultimately providing independence to thrive personally and professionally.

How's it better than what's already out there?

Driving simulators do exist; however, the difference in this invention is the such simulators are 1) not customizable to the learning experience or scenarios the driver may need to learn to reduce anxiety or designed with the intent to serve individuals with disabilities (pre-teaching, dosage amount, etc.) 2) this would be the first application available in a VR store for a portable headset that can be purchased without being a driving instructor (coming at a significant reduced cost) and 3) DriVR sets itself apart in that it can accommodate use of adaptive driving equipment for those who may use a wheelchair or mobility equipment.

What problem/challenge/inconvenience does this solution aim to address?

This technology aims to provide training on driving to specifically reduce anxiety among individuals who may have a fear of driving or limited driving experience. Additionally, it aims to resolve driving deficits experienced by those with intellectual, emotional, and physical disabilities.

Potential Market Size: Global market is valued at \$24.88 billion in 2023 and projected to reach around \$166.58 billion by 2030

TRL: 5

Applications: Training and education, Rehabilitation

The aforementioned technologies are currently owned by Mississippi State University

[Natural Insect Repellent](#)

What is it?

Researchers at the University of Mississippi have discovered a natural mosquito repellent from a globally cultivated plant. This plant extract, containing a compound called "Compound 1," shows effectiveness comparable to DEET, the gold standard in repellents, against common mosquito species. It works well at slightly higher doses than DEET and provides similar protection for up to two hours. This discovery opens the door to developing a natural, effective mosquito repellent using Compound 1 or a standardized preparation of the plant extract. (Visit the link for more info)

[Vacuum Sweep Dehumidification for building A/C and Drying](#)

What is it?

This technology uses a special water-selective membrane to efficiently remove water vapor from the air, improving dehumidification and reducing energy use in air conditioning (A/C) systems. Unlike traditional methods, it avoids inefficiencies caused by low-pressure differences and uses less energy than cooling coils. It provides consistent humidity control without uncomfortable spikes and can be easily added to new or existing A/C systems in homes, businesses, and industrial settings. Unlike other systems, it doesn't use chemicals or create liquid condensation. Early tests show it could save up to 86% in energy when used with evaporative coolers, making it ideal for both residential and commercial applications like dryers and cold storage. (Visit the link for more info)

[Mobile Process for Solubilization and Disposal of Radioactive Scale & Sludge from Oil and Gas Production](#)

What is it?

Researchers at the University of Mississippi have developed a process to remove radioactive scale and sludge from oil and gas production, effectively eliminating over 90% of the radioactivity. This process, which can be operated by one person, handles up to eight 55-gallon drums of waste daily. It converts the radioactive material into a water-soluble form, making it safe to re-inject into the oil field. The method is portable, cost-effective, and reduces environmental risks. With millions of barrels of radioactive waste stored worldwide, this solution offers a significant improvement for the industry. *(Visit the link for more info)*

The aforementioned technologies are currently owned by the University of Mississippi