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Artificial Immune Systems

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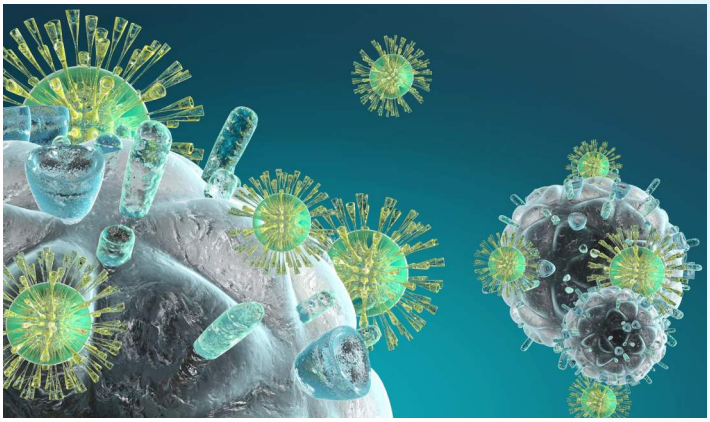
People have had a keen interest in the biosphere since ancient times and have gotten inspiration from the structures and functions of biological systems and their regulatory mechanisms continuously. Artificial Immune System (AIS) is a computational intelligence system inspired by the working mechanism and principles of the biological immune system. Based on the concept and idea of "getting wisdom from nature, and by simulating the working mechanism of biological immune systems, artificial immune systems successfully achieve many advantages of biological immune systems, including noise patience to learn without a teacher, distributed, self-organized, no centre control, and strengthening memory, and other features. Artificial immune systems have developed into a hotspot research field of computational intelligence and attracted many interested researchers. In precise, AIS mimic the behaviour of the human immune system to solve computational problems, particularly those related to pattern recognition, anomaly detection, optimization, and classification. The working of AIS involves several key components and processes:

- **Initialization:** The AIS algorithm starts with an initial population of artificial immune cells, often referred to as detectors or antibodies. These detectors are typically randomly generated or initialized based on some predefined criteria.
- **Antigen Presentation:** In AIS, data instances or patterns to be classified or monitored are represented as antigens. These antigens are presented to the detectors, which attempt to recognize and classify them based on their similarity to known patterns.
- **Clonal Selection:** When an antigen is presented to the detectors, those detectors that recognize it with sufficient affinity undergo clonal selection. This process involves replicating and mutating the selected detectors to create a population of new detectors that are specific to the presented antigen.
- **Affinity Maturation:** The newly generated detectors undergo affinity maturation, where they compete with each other based on their ability to recognize the presented antigen. Detectors with higher affinity (i.e., better recognition capability) are more likely to survive and proliferate, while those with lower affinity may be eliminated.
- **Memory Formation:** Detectors that successfully recognize and respond to antigens are retained in the memory of the AIS system. This memory allows the system to recall past encounters and adapt its response to future stimuli.
- **Immune Regulation:** To prevent overreaction or false positives, AIS incorporate mechanisms for immune regulation and tolerance. These mechanisms help maintain the balance between detecting anomalies and tolerating normal variations in the data.
- **Learning and Adaptation:** Over time, the AIS system learns from its experiences and adapts to changing environments or patterns. This learning process may involve adjusting the parameters of the algorithm, refining the detectors through mutation and selection, or incorporating feedback from the environment.
- **Response Generation:** Based on the output of the detectors, the AIS system generates responses or decisions, such as class labels for input patterns, anomaly scores for detection tasks, or optimization solutions for optimization problems.
- **Feedback and Iteration:** AIS algorithms often involve a feedback loop, where the system's responses influence future iterations of the algorithm. This iterative process allows the system to continuously improve its performance and adapt to new challenges.



Benefits of Artificial immune systems (AIS) across various applications:

- **Robustness:** AIS can adapt to changing environments and evolving threats, making them robust against previously unseen attacks or anomalies. Their ability to learn and evolve over time allows them to maintain effectiveness in dynamic situations.
- **Anomaly Detection:** AIS excel in detecting anomalies or deviations from normal behaviour in complex systems. This makes them valuable for intrusion detection in computer networks, fraud detection in financial transactions, and fault diagnosis in industrial processes.
- **Self-Learning:** Like biological immune systems, AIS possess self-learning capabilities. They can improve their performance over time through experience and exposure to new data,

without the need for manual intervention or reprogramming.

- **Scalability:** AIS algorithms can scale to handle large volumes of data and complex systems efficiently. This scalability makes them suitable for real-time monitoring and analysis in applications such as network security and industrial automation.
- **Adaptability:** AIS are inherently adaptive and can respond to novel threats or changes in the environment without the need for extensive reprogramming. This adaptability is particularly valuable in dynamic and unpredictable scenarios.
- **Parallelism:** Many AIS algorithms can be parallelized, allowing for efficient implementation on parallel computing architectures. This parallelism enables faster processing and real-time response in applications requiring rapid decision-making.
- **Cost-Effectiveness:** By automating the detection and response to anomalies, AIS can help reduce the need for manual intervention and human oversight in monitoring systems. This can lead to cost savings and increased efficiency in various domains.
- **Interdisciplinary Applications:** AIS techniques are applicable across a wide range of domains, including computer security, bioinformatics, optimization, and data mining. Their interdisciplinary nature makes them versatile tools for solving complex problems in diverse fields.

Artificial immune systems (AIS) find applications across a wide range of domains due to their ability to mimic the behaviour of the human immune system and solve complex computational problems. Some notable application areas of AIS include:

- **Healthcare and Medical Diagnosis:** AIS are used in healthcare for medical diagnosis, disease prediction, patient monitoring, and personalized treatment planning. AIS-based healthcare systems can analyse patient data, detect abnormal patterns, and assist healthcare professionals in decision-making processes.
- **Pattern Recognition:** AIS algorithms are used for pattern recognition tasks such as image classification, speech recognition, handwriting recognition, and bioinformatics. AIS-based pattern recognition systems can learn from examples and adapt to variations in data, making them suitable for real-world applications with noisy or incomplete information.
- **Optimization:** AIS are applied to optimization problems in areas such as engineering design, logistics, scheduling, and resource allocation. AIS-based optimization algorithms, such as immune-inspired optimization (IIO) and clonal selection algorithm (CSA), can efficiently search for solutions in complex and high-dimensional search spaces.
- **Data Mining and Knowledge Discovery:** AIS techniques are used for data mining tasks such as clustering, classification, association rule mining, and outlier detection. AIS-based data mining systems can uncover hidden patterns, trends, and relationships in large datasets, leading to valuable insights and knowledge discovery.
- **Robotics and Autonomous Systems:** AIS are utilized in robotics and autonomous systems for tasks such as path planning,

navigation, exploration, and coordination. AIS-based robotic systems can adapt to changing environments, avoid obstacles, and optimize their behaviour based on feedback from sensors and actuators.

- **Bioinformatics and Computational Biology:** AIS are applied to bioinformatics and computational biology tasks such as protein structure prediction, gene expression analysis, sequence alignment, and drug design. AIS-based bioinformatics tools can help researchers analyse biological data, identify functional elements, and discover potential drug targets.
- **Computer Security and Intrusion Detection:** AIS are used for intrusion detection systems (IDS) in computer networks to identify and respond to malicious activities, such as cyber-attacks, viruses, worms, and other forms of malware. AIS-based IDS can adapt to evolving threats and detect previously unseen attack patterns.
- **Anomaly Detection:** AIS are employed for anomaly detection in various domains, including network traffic analysis, industrial processes, financial transactions, and healthcare. By identifying deviations from normal behaviour, AIS-based anomaly detection systems can detect fraud, faults, errors, and other unusual activities.

Overall, artificial immune systems offer a powerful and flexible approach to solving complex problems in dynamic and uncertain environments, making them valuable assets in today's interconnected world.

Elon Musk to take on Gmail, says Alternative Xmail is Coming

Highlights

- *Elon Musk Hints at Launching Xmail, A Potential Rival to Gmail, on X Platform*
- *Xmail Sparks Buzz on Social Media Following Musk's Tease, Users Eager for Details*
- *Speculations Mount on Xmail's Features Amid Claims of Enhanced Privacy and Speed*

Elon Musk, in an exchange, said that Xmail is coming. The product is being seen as an extension of Musk's broader vision for his X platform After creating his own version of ChatGPT, Grok, now Elon Musk seems to be set to take on popular email provider Gmail, owned by Google. The X chief seems to be on his way to creating his own version of Gmail named Xmail, something that goes with the name of his microblogging site X (formerly Twitter).

According to a report in the Dailymail, in an exchange on X platform, Musk revealed that a product named Xmail is coming. There are no more details on this and it is unclear when it will be available. However, it is expected that the mail will be integrated into the X app.

The development came to fore after Nate, an engineer at X, made a post, asking, "*When we making Xmail/*" To this, Musk replied in his characteristic nonchalance, "*It's coming*".

While Musk is known for making tall claims, he has also made some sweeping changes to X after he acquired it. Even if Xmail makes it, taking on Gmail would be a mammoth task. Reportedly, Gmail has over 1.8 billion users as of 2024.

After the exchange was noticed, Xmail began trending on X with over 15K posts. Several users reacted to the development by sharing memes, and expressing strong opinions on Musk's new endeavour. Here are some reactions from the platform.

What is known about Xmail?

Apart from Mr Musk's two words, nothing officially. But the term X (he is obsessed with it) is already being used with at least three other mail services, as per Forbes. If Mr Musk is planning such a new service, he has already taken this into account, and given the amount of money he has, Mr Musk will be able to purchase the right to use the name.

Though nothing is confirmed about XMail, several messages circulating on various platforms suggest it will be an upgrade from the existing mail services. Users claim that XMail will promise better privacy, speedy delivery and a minimalist design. However, either Mr Musk or X has to confirm these claims.

This is yet another announcement by Mr Musk who is already busy with developing other features, like online payments and video calls.

Whats App now Lets You Create Lists & more in Your CHATS

Highlights

- *WhatsApp Introduces New Text Formatting Options: Lists, Quotes, and Code*
- *Spice Up Your Chats: WhatsApp Rolls Out Exciting Features for Text Styling*
- *Enhanced Chat Experience: WhatsApp Users Now Have Seven Formatting Options*

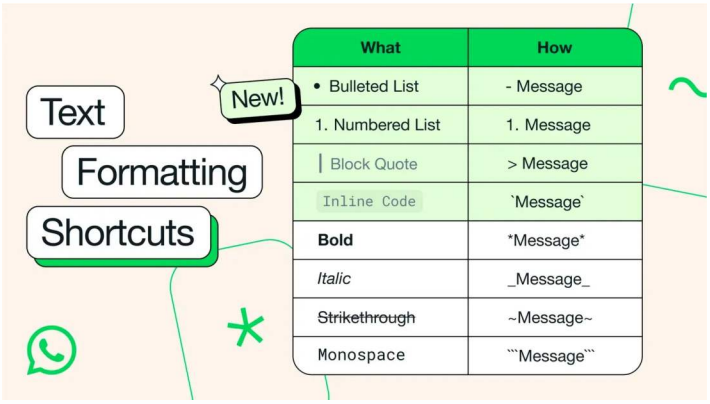
Want to spice up your WhatsApp chats? Check out the new text formatting options and how to use them.

WhatsApp has gained new options that let you spice up your chats with different styles and layouts, such as lists, quotes, and code. We've listed all the new formats below and shown how to use them.

Lists: You can now create bulleted or numbered lists in your messages, which is great for organising information or making plans. To create a bulleted list, start your text with a dash and a space, like "*- this.*" To create a numbered list, start your text with a number, a dot, and a space, like "*1. this*."

Quotes: You can now quote a part of your text to emphasise it or make it stand out from the rest. This is useful for highlighting important points or referencing previous messages. To create a quote, start your text with a greater-than sign and a space, like "*> this.*"

Code: You can now write text in a code format, which is handy for coders or anyone who wants to show some technical information. This format preserves the spacing and alignment of your text, and makes it look like it is written in a code editor. To create a code format, wrap your text with a backtick symbol, like "`*this*`."



What	How
• Bulleted List	- Message
1. Numbered List	1. Message
▏Block Quote	> Message
`Inline Code`	`Message`
Bold	*Message*
Italic	_Message_
~~Strikethrough~~	~Message~
Monospace	```Message```

These new text formatting options are available on all platforms, including Android, iOS, Web, and Mac. They were previously in testing, but now they are officially rolled out to all users. You can use them to make your chatting experience better and more fun.

With these new additions, *WhatsApp* now offers a total of seven ways to format your text.

Sora, the Text-to-Video model from OpenAI, is here: What is it & How does it Work?

Highlights

- *OpenAI Unveils Sora: Next-Gen AI Software Generates Hyper-Realistic Videos from Text*
- *Sam Altman Introduces Sora: OpenAI's Breakthrough Text-to-Video Model*
- *Sora: OpenAI's Latest Innovation Redefines Video Generation with Unprecedented Realism*

Sam Altman has introduced OpenAI's latest creation Sora which is capable of creating one-minute-long videos from text prompts.

After stunning the world with its sensational AI chatbot ChatGPT, OpenAI is back with yet another creation. The Sam Altman-led AI start-up has introduced a new software that can create hyper realistic one-minute videos based on text prompts. Called Sora, the software is currently in the red teaming phase, where the company is working towards identifying flaws in the system. OpenAI is also reportedly working with visual artists, designers, and filmmakers to gather feedback on the model.

Sam Altman, the CEO of OpenAI took to his X account to introduce Sora, the company's video generation model. Altman went on to share a host of videos on his profile to showcase the efficiency and visual capabilities of the new AI model. While the model is currently in the red teaming phase, OpenAI has not shared any information regarding its wider launch.

What is Sora?

According to OpenAI, Sora is a text-to-video model that generates one-minute-long videos while "maintaining the visual quality and adherence to the user's prompt." OpenAI claims that Sora is capable of generating complex scenes with numerous characters with specific types of motion and accurate details of the subject and background. According to the company, the model can understand not only what the user's prompt, but also be able to comprehend how these things will reflect in the real world.

Following the introduction of the model, Altman shared creations of Sora based on prompts requested by his followers. From cycling dolphins to a squirrel riding a dragon, here are some sample videos that showcase the versatility of Sora.

Sora is essentially a diffusion model that can generate entire videos all at once or extending generated videos to make them longer. The model uses a transformer architecture that unlocks superior scaling performance much similar to GPT models. The AI model shows videos and images as collections of smaller units of data which are known as patches. Each of these patches is similar to tokens in GPT. OpenAI stated that Sora is built upon past research conducted for DALL-E and GPT Models. It borrows the recapturing technique from DALL-E 3 which includes generating descriptive captions for visual training data.

Apart from generating videos from prompts in natural language, the model is capable of taking an existing image and generating a video from it. According to OpenAI, It will essentially animate the image's components accurately. It is also capable of extending existing videos by filling in missing frames.

Capabilities and limitations

OpenAI claims that Sora has an in-depth understanding of language which allows it to interpret prompts with accuracy and create characters that showcase vibrant emotions. Interestingly, Sora is also capable of creating multiple shots within a single generated video with persisting visual style and characters.

The company also highlighted that Sora has its own set of limitations. At present, the model may struggle with creating the "*physics of a complex scene*" with accuracy. It may also struggle to understand specific instances of cause and effect. The company illustrated by stating a scenario where a person may take a bite out of a cookie, however, the cookie may not have the bite mark. Similarly, Sora may also confuse spatial details in a prompt such as it may confuse left and right, and may struggle with precise descriptions of events that take place over time.

Is Sora safe?

On its official website, OpenAI has stated that it has been taking several safety measures before making Sora accessible in its products. The company went on to assert that they are working with a team of domain experts specific to misinformation, hateful content, and bias. These experts will be adversarially testing Sora. Besides, the company is also building tools like a detection classifier that can detect misleading content and tell if a video was generated by Sora.

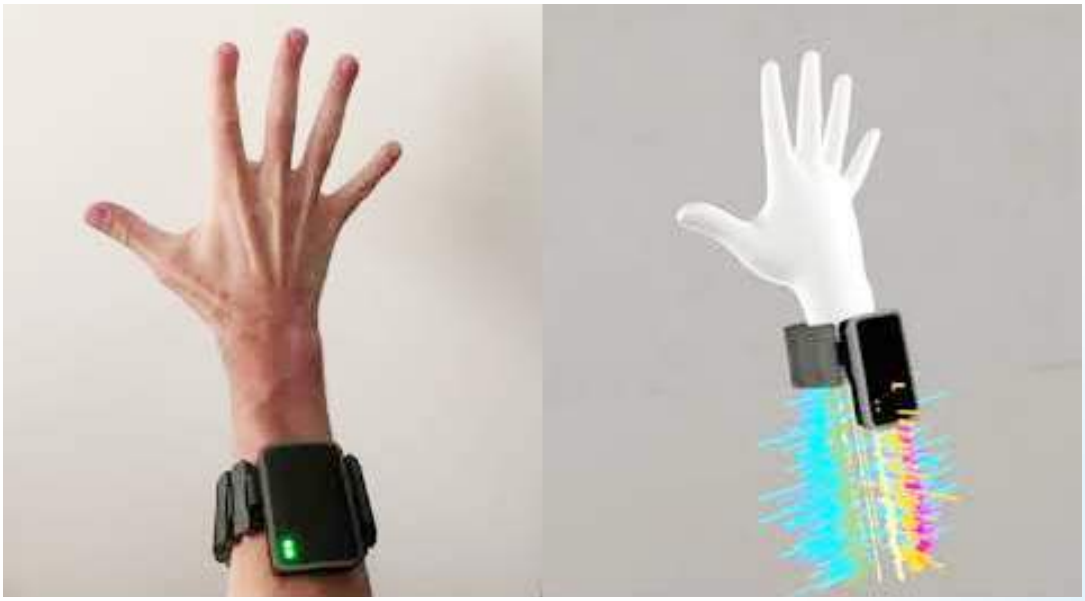
OpenAI also said that it will be including C2PA metadata in the future if we deploy the model in an OpenAI product. In simple terms, C2PA is an open technical standard that allows publishers, companies, and others to embed metadata in media to verify its origin and related information. The company has also said that it is leveraging the existing safety measures that have been built into its products that use DALL E-3.

OpenAI's Sora comes at a time when text-to-video models from the likes of Stability AI have shown the astounding capabilities of AI video generation. The Sam Altman-led company has its eyes set on Artificial General Intelligence and sees Sora as a step further in that direction. From what we are seeing, Sora is clearly miles ahead of existing generative AI video creation models. Google introduced a similar model in October 2022, named Imagen Video, however, there is no model that has been accessed by the public from the tech giant. Google has also worked on Phenaki, its text-to-video model, and Meta too had its stint with the Make-A-Video tool. However, OpenAI seems to have surpassed all.

Meta's Experimental Neural Wristband could let You type Simply by Thinking

Highlights

- *Meta's Futuristic Wristband Revolutionizes Human-Computer Interaction with Neural-Machine Interface*
- *Mark Zuckerberg's Meta Set to Redefine AR/VR Interaction with Non-Invasive Neural Wristband*
- *Meta's Vision for Wearable Tech: Wristband Allows Users to Type by Thought Alone*
- *Zuckerberg's Meta Advances towards Consumer Product with Mind-Controlled Wristband Technology*



Companies are finding newer ways to engage with users with wearable tech. At a time when Apple's Vision Pro is making headway in what the company calls "*spatial computing*," Meta seems to be working on a wristband which has neural-machine interfacing. This is a device that tracks your hand and finger movements by detecting neural signals passing through the nerves in your arm.

It uses a non-invasive technique known as electromyography (EMG). Basically, a wristband controller will let you type by just thinking. This is not simply a fancy device to help you move a mouse or game controller. Meta seems to have a grand vision for this technology. However, more details are awaited about the company's vision.

Interestingly, this is not a recent development. **Mark Zuckerberg's** Meta showcased it as an experimental prototype in 2021. Zuckerberg, in his recent interview with the Morning Brew Daily podcast, said that he is working on bringing this technology to consumers. "We've been working on this for a while, it's not a one-year project. But we're quite a few years into it, and we're close to having something, to having a product in the next few years," he was heard saying during the interaction.

This is in contrast to Elon Musk's Neuralink, which requires chips to be implanted into the brain. In his interview, Zuckerberg indicated that the human nervous system has several spare bandwidths which can use its signalling to send control inputs without making any significant physical motions.

Why is it important?

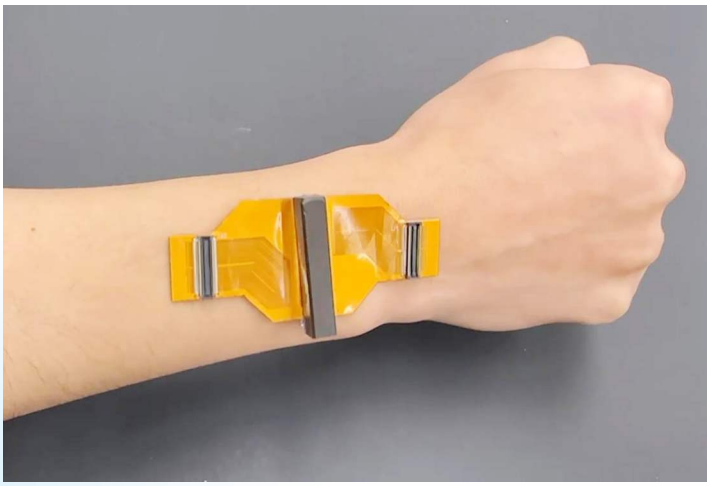
The neural wristband from Meta will likely revolutionise AR/VR as this experimental control will soon become a real product allowing users to type by simply thinking. All of this without any invasive brain implants. The device uses EMG to guide electrical signals from the brain to the fingers enabling finger tracking and control.

Reportedly, Zuckerberg envisions a future where users can communicate in real-time through a private and discrete interface by simply thinking or with minimal hand movements. This could potentially revolutionise human-computer interaction by offering a private and efficient input method for AR glasses and other devices.

MIT's Wearable Ultrasound Sticker Monitors Health of Deep Internal Organs

Highlights

- *MIT Engineers Develop Wearable Ultrasound Sticker for Continuous Monitoring of Organ Stiffness*
- *Breakthrough Ultrasound Sticker from MIT Promises Early Detection of Organ Failure*
- *MIT's Ultrasound Sticker Revolutionizes Organ Health Monitoring, Offers Potential for Timely Disease Intervention*
- *Wearable Ultrasound Sticker from MIT Could Transform ICU Care and Disease Management*



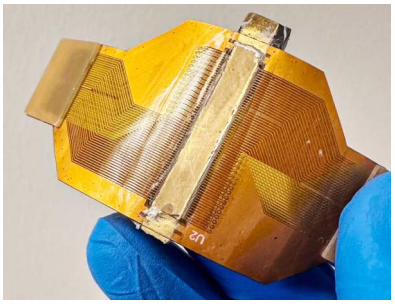
MIT's ultrasound sticker enables continuous monitoring of organ stiffness, revolutionizing the early detection of diseases such as liver and kidney failure.

MIT engineers have developed a small ultrasound sticker that can monitor the stiffness of organs deep inside the body. The sticker, about the size of a postage stamp, can be worn on the skin and is designed to pick up on signs of disease, such as liver and kidney failure and the progression of solid tumors.

In an open-access study published recently in Science Advances, the team reports that the sensor can send sound waves through the skin and into the body, where the waves reflect off internal organs and back out to the sticker. The pattern of the reflected waves can be read as a signature of organ rigidity, which the sticker can measure and track.

Advancements in Organ Monitoring

"*When some organs undergo disease, they can stiffen over time*," says the senior author of the paper, Xuanhe Zhao, professor of mechanical engineering at MIT. "*With this wearable sticker, we can continuously monitor changes in rigidity over long periods of time, which is crucially important for early diagnosis of internal organ failure*."



The team has demonstrated that the sticker can continuously monitor the stiffness of organs over 48 hours and detect subtle changes that could signal the progression of disease. In preliminary experiments, the researchers found that the sticky sensor can detect early signs of acute liver failure in rats.

The engineers are working to adapt the design for use in humans. They envision that the sticker could be used in intensive care units (ICUs), where the low-profile sensors could continuously monitor patients who are recovering from organ transplants.

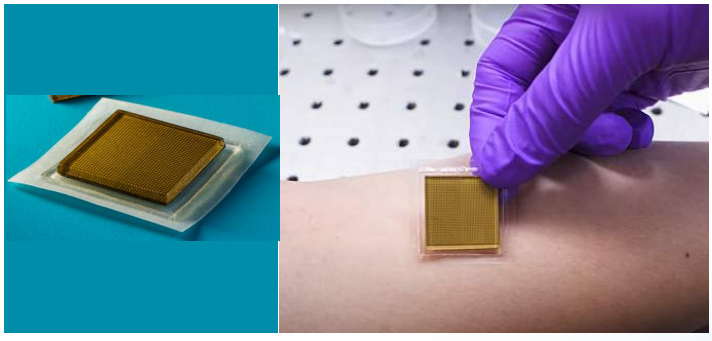
"We imagine that, just after a liver or kidney transplant, we could adhere this sticker to a patient and observe how the rigidity of the organ changes over days," lead author Hsiao-Chuan Liu says. "If there is any early diagnosis of acute liver failure, doctors can immediately take action instead of waiting until the condition becomes severe." Liu was a visiting scientist at MIT at the time of the study and is currently an assistant professor at the University of Southern California.

The study's MIT co-authors include Xiaoyu Chen and Chonghe Wang, along with collaborators at USC.

Ultrasound Elastography and Its Limitations

Like our muscles, the tissues and organs in our body stiffen as we age. With certain diseases, stiffening organs can become more pronounced, signaling a potentially precipitous health decline. Clinicians currently have ways to measure the stiffness of organs such as the kidneys and liver using ultrasound elastography- a technique similar to ultrasound imaging, in which a technician manipulates a handheld probe or wand over the skin. The probe sends sound waves through the body, which cause internal organs to vibrate slightly and send waves out in return. The probe senses an organ's induced vibrations, and the pattern of the vibrations can be translated into how wobbly or stiff the organ must be.

Ultrasound elastography is typically used in the ICU to monitor patients who have recently undergone an organ transplant. Technicians periodically check in on a patient shortly after surgery to quickly probe the new organ and look for signs of stiffening and potential acute failure or rejection.



"*After organ transplantation, the first 72 hours is most crucial in the ICU,*" says another senior author, Qifa Zhou, a professor at USC. "*With traditional ultrasound, you need to hold a probe to the body. But you can't do this continuously over the long term. Doctors might miss a crucial moment and realize too late that the organ is failing.*"

The team realized that they might be able to provide a more continuous, wearable alternative. Their solution expands on an ultrasound sticker they previously developed to image deep tissues and organs.

"*Our imaging sticker picked up on longitudinal waves, whereas this time we wanted to pick up shear waves, which will tell you the rigidity of the organ,*" Zhao explains.

Existing ultrasound elastrography probes measure shear waves, or an organ's vibration in response to sonic impulses. The faster a shear wave travels in the organ, the stiffer the organ is interpreted to be. (Think of the bounce-back of a water balloon compared to a soccer ball.)

Innovations in Ultrasound Technology

The team looked to miniaturize ultrasound elastography to fit on a stamp-sized sticker. They also aimed to retain the same sensitivity of commercial hand-held probes, which typically incorporate about 128 piezoelectric transducers, each of which transforms an incoming electric field into outgoing sound waves.

Future Applications and Impact

"*The real beauty of this system is that since it is now wearable, it would allow low-weight, conformable, and sustained monitoring over time,*" says Shrike Zhang, an associate professor of medicine at Harvard Medical School and associate bioengineer at Brigham and Women's Hospital, who was not involved with the study. "*This would likely not only allow patients to suffer less while achieving prolonged, almost real-time monitoring of their disease progression, but also free trained hospital personnel to other important tasks.*"

The researchers are also hoping to work the sticker into a more portable, self-enclosed version, where all its accompanying electronics and processing is miniaturized to fit into a slightly larger patch. Then, they envision that the sticker could be worn by patients at home, to continuously monitor conditions over longer periods, such as the progression of solid tumors, which are known to harden with severity.

"*We believe this is a life-saving technology platform,*" Zhao says. "*In the future, we think that people can adhere a few stickers to their body to measure many vital signals, and image and track the health of major organs in the body.*"