A wearable ultrasound monitor that aids rehabilitation from injury

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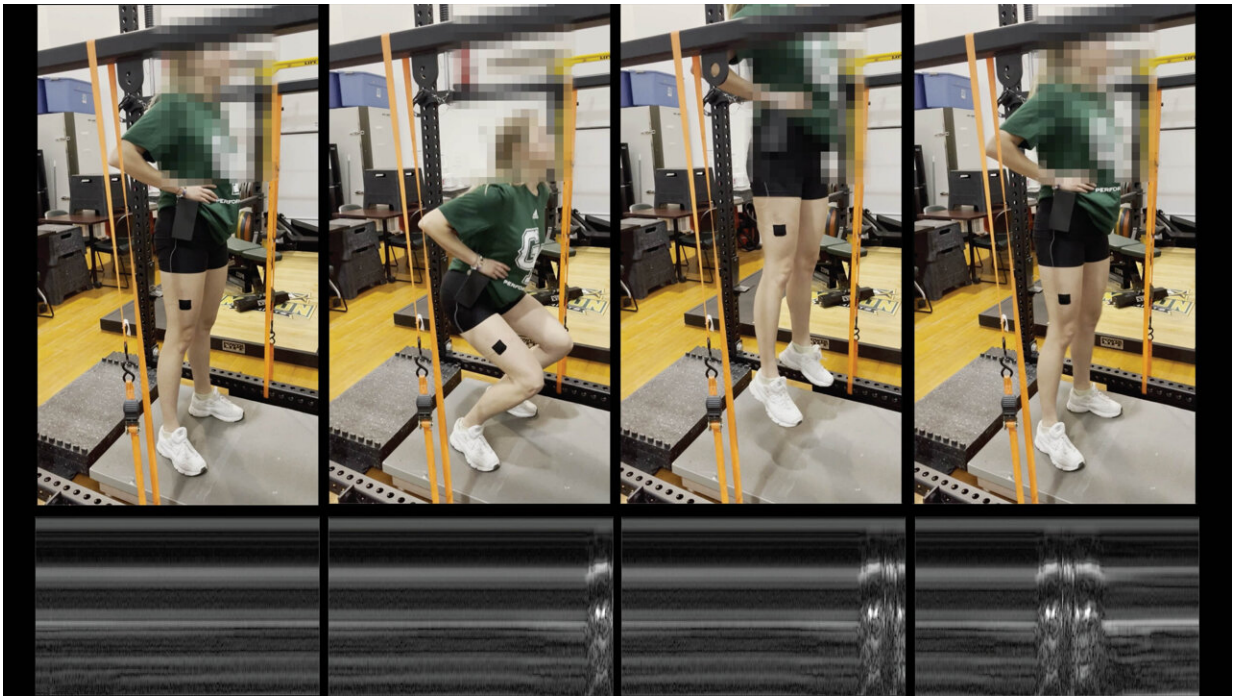

A wearable ultrasound monitor can provide insight into dynamic muscle movement during activities like jumping. Credit: Parag Chitnis

Millions suffer from musculoskeletal injuries every year, and the recovery process can often be long and difficult. Patients typically undergo rehabilitation, slowly rebuilding muscle strength as their injuries heal.

Medical professionals routinely evaluate a patient's progress via a series of tasks and exercises. However, because of the dynamic nature of these exercises, obtaining a clear picture of real-time muscle function is extremely challenging.

Parag Chitnis of George Mason University led a team that developed a wearable ultrasound system that can produce clinically relevant information about muscle function during dynamic physical activity. He will present his work as part of Acoustics 2023 running Dec. 4–8 at the International Convention Center Sydney.

Many medical technologies can give doctors a window into the inner workings of a patient's body, but few can be used while that patient is moving. A wearable ultrasound monitor can move with the patient and provide an unprecedented level of insight into body dynamics.

"For instance, when an individual is performing a specific exercise for rehabilitation, our devices can be used to ensure that the target muscle is actually being activated and used correctly," said Chitnis. "Other applications include providing athletes with insights into their physical fitness and performance, assessing and guiding recovery of motor function in stroke patients, and assessing balance and stability in elderly populations during routine everyday tasks."

Designing a wearable ultrasound device took much more than simply strapping an existing ultrasound monitor to a patient. Chitnis and his team reinvented ultrasound technology nearly from scratch to produce the results they needed.

"We had to completely change the paradigm of ultrasound imaging," said Chitnis. "Traditionally, ultrasound systems transmit short-duration pulses, and the echo signals are used to make clinically usefully images. Our systems use a patented approach that relies on transmission of long-

duration chirps, which allows us to perform ultrasound sensing using the same components one might find in their car radio."

This modified approach allowed the team to design a simpler, cheaper system that could be miniaturized and powered by batteries. This let them design an ultrasound monitor with a small, portable form factor that could be attached to a patient.

Soon, Chitnis hopes to further improve his device and develop software tools to more quickly interpret and analyze the ultrasound signals.

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