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New algorithm tool may help reduce invasive heart procedures

Invasive procedures are often required to improve diagnosis and treatment of heart conditions. For example, invasive electrical procedures are used to identify and localise the source of atrial fibrillation (or abnormal heart rhythm).

New algorithms developed by University of California - Santa Barbara researchers allow for a high-resolution reconstruction of a patient's heart, which can help doctors in diagnosing cardiac disease without the need for invasive surgeries. The researchers describe their work in a report published in the journal APL Bioengineering.

"Electrical sources in your heart produce signals that permeate through your cardiac and body tissue to produce body-surface signals that we measure as [an ECG, or electrocardiogram], said UC Santa Barbara graduate student Abhejit Rajagopal, an author on the paper.

"Using these signals, we can try to reconstruct what's going on inside your heart," Rajagopal said. "This is typically done by assuming a model for the propagation of signals from your heart to the surface and inverting it. The 'inverted' model is known as an inverse operator. Typically, if the forward model is linear so is the inverse operator."

The main concept underlying the UC Santa Barbara group's work is that the inverse operator, in this case a function that maps body-surface electrocardiogram signals to endocardial potentials, can be nonlinear and optimised using a set of historical data.

This allows the research team to learn a model for predicting cardiac potentials from electrocardiograms that's "realistic, accurate, and amenable to general purpose use as a new cardiac imaging tool," Rajagopal explained.

There are myriad applications for the team's method. "Imagine a world where instead of a doctor

listening to your heart through a stethoscope they can see a live video of your heart beating via ultrasound with corresponding electrical measurements of the local potentials on or around the cardiac tissue," said Rajagopal. "The goal is for doctors to be able to treat patients with cardiac issues without needing to use invasive surgeries just to determine the cause."

In some cases of atrial fibrillation, for instance, doctors might be able to localise the source and determine whether surgery is recommended for the patient. "A lot of work remains to be done before we can make this a reality," he said. "But our work is a good step in that direction, since it shows that the resolution of the noninvasive reconstruction can be sufficiently high to aid in diagnosis and prognosis of such cardiac disorders."

Source: AIP - American Institute of Physics

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