Ultrasound and AI – Where are We?

Ultrasound is an amazing technology. Compared to other imaging modalities (like CT and MRI) it is convenient, cheap, non-claustrophobic and it delivers results in real-time. With so much current interest in AI, *where are we with AI approaches to ultrasound?*

Let's first consider the broader context of AI systems for medical imaging. In the last five years especially, the scientific literature has exploded with examples of teams developing AI systems (many using imaging) for diagnosing a wide range of diseases. AI systems use a set of machine learning techniques (such as neural networks and boosted decision trees) which has the potential to achieve diagnostic accuracy more accurate than the best human clinicians. Several AI systems for ultrasound have now been approved by the FDA and other regulators. It is all but certain that we will see the development of ever more sophisticated AI systems for medical imaging.

In the context of AI, ultrasound has a significant *disadvantage* compared to other types of medical imaging. X-ray, CT and MRI involve the acquisition of an image which can be easily aligned with anatomical features, by following fixed, tried and tested protocols. This results in standard inputs which is what AI systems rely on to be 'trained'. But with ultrasound, imaging is done by sweeping the probe over the surface of the body, giving a flowing time series of more qualitative impressions. The constantly shifting image means that a standard image is less relevant and harder to obtain. Therefore, training AI systems for ultrasound can be more challenging.

So, ultrasound is a 'hard case' for AI. Does this mean that there has been no AI development in ultrasound? Far from it. Actually, the future looks promising for AI ultrasound systems. This is a testament to the versatility of how AI can be applied in medical imaging. Essentially, AI software for ultrasound has been developed to search for a standard image and use this to make measurements by other AI algorithms. So, AI software uses ultrasound in quite a different way compared to a human practitioner. And AI software for ultrasound is also different from how AI systems work in other types of imaging: it has an additional step when it searches for a standard image.

Several AI products for ultrasound have already been approved by the FDA. Let's briefly look at three examples, to get an insight into how this field is developing.

1. *ClearView by ClearView Diagnostics*

   ClearView was the first piece of AI ultrasound software to gain FDA approval, which it did in 2016. It uses machine learning to classify the shape and orientation of user-selected regions of interest in breast images.

2. *Auto 3D Bladder Volume Tool by Butterfly Network*

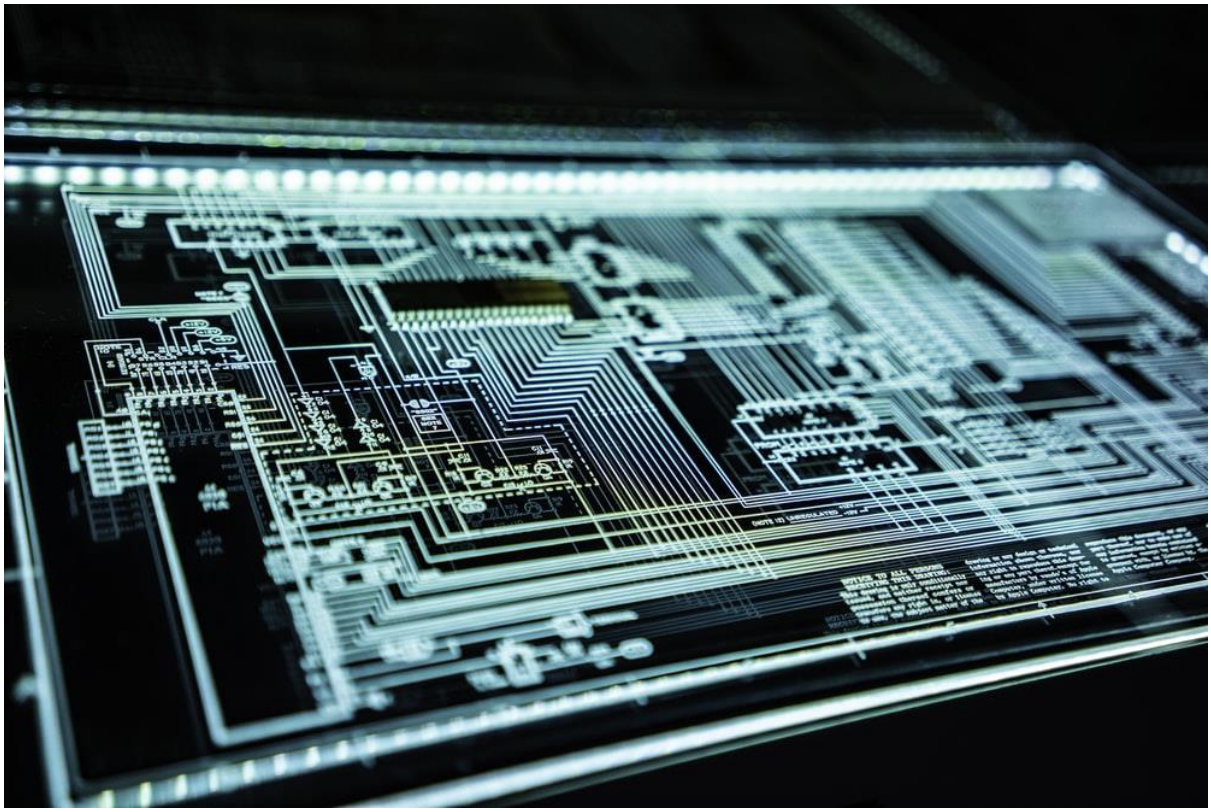
   Auto 3D Bladder uses machine learning to quantify bladder volumes. It only works with Butterfly Network's handheld ultrasound devices. It received FDA approval in 2020.

3. *LVivo by DiA Imaging Analysis*

   LVivo uses deep learning to quantify left ventricular ejection fraction (LVEF) from ultrasound images of the heart. It received FDA approval in February 2021.

Currently, AI ultrasound systems are not used as standalone diagnostics systems. Instead, they are used only to *support* diagnostics by a human physician. They do this by performing clinically relevant physiological measurements, for example, the thickness of the carotid artery wall or the volume of the bladder or heart ventricles. However, fully-fledged AI-based diagnostics is only a step away. Many would argue that the main obstacle is not technical, it is about regulation and perceptions. Patients might be suspicious of AI-based diagnostics, and radiographers might have ethical or legal concerns, or might simply be worried about their job security.

AI imaging diagnostics is a rapidly developing field but the pace at which AI systems are adopted will depend crucially on the attitudes of practitioners of ultrasound.



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