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Chapter 2
Mobile Ultrasound for Remote Medical Services
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MOBILE ULTRASOUND FOR REMOTE MEDICAL SERVICES

To date, patients have had to see a doctor to get an ultrasound scan. Not anymore though: Now a new data-processing method developed by Israeli Technion University is helping to digitalize ultrasound imagining. Once freed from cumbersome conventional devices, ultrasound imagines could be used to provide remote medical services at emergencies sites or in undeveloped areas. Read More

A few years ago, Prof Yonina Eldar and her team at Technion University's Signal Acquisition Modeling and Processing Lab (SAMPL) in Israel did not actually know that much about medical technology. The lab develops innovative data-acquisition and processing methods. Starting with a theoretical model, Eldar and her team have developed an approach that allows data rates to be substantially downsampled. Low data rates can help reduce processing time and downscaling on computer systems, and eventually result in lower power consumption and cost.

Several years ago, Prof. Eldar was contacted by a colleague interested in finding a way to apply the lab's data-acquisition and processing methods to ultrasound imaging. During an ultrasound scan, a high-frequency sound is transmitted into the body, where it hits the tissue of the organs. Some of the sound is reflected back to the transmitting probe, which transmits these returning signals to a large computer via a cable. The computer then translates the speed of sound though tissue and the time of each echo's return into a sepia and white image, like those images of unborn babies so familiar to us. In addition to examining unborn babies, ultrasound imaging can be used to evaluate blood flow, assess cardiac issues, and detect tumors. Ultrasound imaging is very popular among medical professionals, since it is a radiation-free, non-invasive method for assessing structures in the body.

But so far, high quality ultrasound scans have required massive and costly machines. "I was surprised to see that at their core, ultrasound devices are still similar to those produced 30 years ago," Prof. Eldar says. "There are so many algorithm experts involved in communication and gaming, but digitalization doesn't seem to have reached ultrasound machines yet." Most of the components used in ultrasound imaging are still analog and hardware based.

Using the approach they developed to lower the sampling rate without compressing the data, Prof. Eldar and her team are working to make these old cumbersome devices a thing of the past.

Once the data rate is lower, it will enable high-quality image processing using software instead of hardware. Furthermore, a low data rate means the raw ultrasound data can be uploaded to the cloud to enable remote processing and interpretation. The image can then be read via smartphone or tablet.

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As a second step, SAMPL is currently developing a smaller and portable probe for ultrasound imaging. Using a portable probe instead of a big ultrasound machine is an opportunity to take ultrasound imaging out of the doctor's office and into the field.

The technology could be ready for clinical applications in a couple of months. The SAMPL team is currently contacting manufacturers of ultrasound devices for collaboration and looking into commercializing its portable device. The portable probe will be connected to the internet.

"There are a huge number of possible applications, once we send the ultrasound data to the cloud," Prof Eldar says. Medical services could be more flexible. Just imagine an ambulance has the portable ultrasound probe on board. The paramedics could do an ultrasound scan right at the site of an emergency and upload it to the cloud. A doctor from a distant hospital could then download the image and send back an instant diagnosis the EMTs could then use to treat the patient immediately on site.

The probe could have similar applications on the battlefield or in remote areas. In Mongolia for example, where 36.7% of the population live in rural areas earning their living raising livestock and face geographical barriers to accessing medical supply. These communities receive health services from the bagh feldsher, government health workers who travel to the remote herder communities by car, hand-drawn ferry, and on reindeer and foot, and provide vaccinations. Now imagine these bagh feldsher carried remote ultrasound probes. This would allow pregnant women in these communities to have an onsite scan of their unborn children. Given internet access in the field, the image could immediately be sent via the cloud to a doctor in a hospital in the capital Ulan Bator, around 800 kilometers away. Otherwise the bagh feldsher can send it later once they have cloud access. Either way, medical exams using ultrasound imaging would be an immense improvement for these remote, rural communities.

Once it has moved out of doctors' offices, digitalized and portable ultrasound imaging will surely find a vast number of useful applications. And when it catches on, it will open the door for many other creative ways of improving and digitalizing medical technology.

Yonina with an ultrasound device

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