

## Popular scientific summary

### Ultrasound artefacts – Hidden treasure or fool's gold?

Ultrasound is an important medical imaging technique and recognizing errors or artefacts in the images is important. Some artefacts may be a sign of illness while others are not. Finding an ultrasound artefact that is a sign of illness and being able to use it to make a correct diagnosis is like finding a hidden treasure. The opposite can be said when finding an artefact that is not, then it is like finding fool's gold. Knowing the difference and what to look for is therefore the key and practicing on doing ultrasound examinations is crucial. Using ultrasound phantoms is one of the best ways to practice. An ultrasound phantom is an object filled with a material made to mimic tissue and the acoustic properties of tissue. In a phantom a vast number of objects can be placed to create a certain ultrasound image.

Three phantoms containing different items that create eight different common ultrasound artefacts have been designed. The reason behind designing these phantoms was to make the teaching and learning about ultrasound artefacts in the course '*Ultrasound physics and Technology*' more interactive than before (this is a course given at the Department of Biomedical Engineering). It was decided that the best way was to make phantoms that could be used by students in a laboratory exercise. The idea is for students to both learn about some of the most common ultrasound artefacts and how the ultrasound image of an object in many ways can be different from the true physical appearance of that object.

A vast number of materials and items were tested in order to find the perfect item for each of the artefacts. This was one of the biggest issues in the project, finding the right materials, since the items needed to have a very specific look in the ultrasound image. The tests to find the best items and materials were done in an experimental setup using water as the background material (instead of a tissue mimicking material). Water is a great medium to do tests like this in because sound loses very little energy when traveling in water. The next step in the testing was to test how the best items and materials looked when molded into the background material. After these tests the items and materials that looked best compared to a reference image were chosen to be molded into the final phantoms. Two background materials, agar and candle gel, were available and after many different tests, including tests of some of the acoustic properties of the two materials, it was decided that the best background material was the candle gel. With the background material and items decided the final design could be made.

The main goal was to design and build phantoms that could be used by students in a laboratory exercise and the phantoms were used by students for the first time in February 2015. The ultrasound images of the three phantoms were overall very good compared to the reference image that was used as inspiration and the eight different artefacts could be seen. Some improvements could be done with these phantoms. The work also opens up the possibility to design more phantoms showing off other artefacts.