

# Exercise 1: Medical Ultrasound Scanning

## How big is the heart?

### Theoretical questions:

#### Why do we put gel on the probe?

The acoustic impedance of air is quite different from water. If the probe surface put on the patients body comes in contact with air the large impedance difference will lead to that the we can not see the small variations in mass density and compressibility in the body. It becomes so small compared with the difference between air and human body, which in big parts is water. Using the gel with acoustic impedance close to water and the human body one will avoid the big differences in impedance, and the small variations in mass density and compressibility in the body becomes more visible.

#### What is the most important anatomical obstacles in order to assess good images of the heart?

The heart is protected by the rib cage. The bones in the rib cage will dominate a ultrasound image will lead to poor images of the heart. Also the breathing process with inhaling and exhaling will lead to the lungs pushing on heart and lead to noise in the image of the heart.

#### What elements of danger are associated with the use of medical ultrasound?

The health dangers of ultrasound imaging is thought to be small. A potential danger with ultrasound imaging is local temperature variations in the imaged area, due to the introduced high energy ultrasound waves, which can introduce biological effects on the body. Ultrasound waves can heat the tissues slightly.

#### What advantages and disadvantages has ultrasound compared to other images techniques (e.g MRI)?

Ultrasound imaging is based on non-ionizing radiation, which makes it the imaging technique with the least severe health issues. Ultrasound imaging is an real-time imaging technique. MRI and X-ray do not have the property of real-time imaging.

Ultrasound will be attenuated by air or bone structures. This is a limitation which leads to difficulties to image som organs. The attenuation by bone leads to difficulties in producing brain images. In the case of brain cancer it would in many cases not be beneficial to use ultrasound imaging as a tool for diagnostic testing, but other imaging techniques would properly be used. Due to big difference in acoustic impedance between air and water it is also difficult to image the bowel where gases can occur.

Using ultrasound imaging for cancer treatment can lead to false positive results. Ultrasound image may identify problems even do the area is not malignated. Ultrasound imaging might detect a cancer cell or lump, but other diagnosis methods and imaging techniques must be used for diagnosing whether the cell or lump is benign or malignant.

## **What sort of probe did you use in this exercise?**

In this exercise we use ultrasound to image the heart. For imaging of the heart one uses an phased linear array.

## **What is the function of the LED on the probe?**

The LED is a tool to identify the relation between the probe direction and the produced image. The LED and a marker on the probe is given in the produced image, and makes it easier to know how to move the probe around to produce a good image of e.g the heart.

## **What views did you find it most difficult to asses?**

To produce the apical 4-chamber one needs to hold the probe in a specific positon on the side of the chest with little room for movements in any direction. Also the image is easily contaminated by the breathing process where the inhaling/exhaling leads to lung pushing on the heart.

## **What is octave imaging (harmonic imaging)?**

In harmonic imaging one separates between the harmonic frequencies in the received signal and fundamentals frequencies. Following in harmonic imaging one process only the harmonic frequencies.

## **What did you see in the images?**



