ENGI 5631 Signal and Imaging Processing in Biomedical Applications

**Ultrasound L**aboratory

Ultrasound imaging, is the medical technique in which high-frequency sound waves are used to visualize soft tissues such as internal organs. By this procedure we can generate the real-time images that reveal movement of the tissues or blood flow. An ultrasound machine contains a handheld device that produces ultrasonic sound waves i.e. above the range of human hearing that reflect off different layers of body tissue. The transducer attached to it converts the echoes into electrical signals that are used to create an image and display it on a screen. The image found is based on the frequency and strength of the sound signal and the time it took for the echoes to return. The ultrasound is basically of two types: -

**Diagnostic ultrasound is a non-obtrusive diagnostic procedure used to image inside the body. Ultrasound tests, called transducers, create sound waves that have frequencies over the limit of human hearing (over 20KHz), however most transducers in current utilize work at considerably higher frequencies (in the megahertz (MHz) run). Most diagnostic ultrasound tests are set on the skin. Be that as it may, to advance picture quality, tests might be put inside the body by means of the gastrointestinal tract, vagina, or veins. Furthermore, ultrasound is in some cases utilized amid surgery by putting a clean test into the region being worked on.**

**Therapeutic**[**ultrasound**](javascript:;) likewise utilizes sound waves over the scope of human hearing however does not deliver pictures. Its purpose is to connect with tissues in the body to such an extent that they are either changed or annihilated. Among the adjustments possible are: moving or pushing tissue, heating tissue, dissolving blood clusters, or conveying medications to areas in the body. These dangerous, or ablative, capacities are made conceivable by utilization of high-intensity beams that can obliterate infected or irregular tissues, for example, tumors. The advantage of utilizing ultrasound treatments is that, by and large, they are non-intrusive. No entry points or slices should be made to the skin, leaving no injuries or scars.

**Methods: -**

Ultrasound waves are delivered by a transducer, which can both emit ultrasound waves, and in addition identify the ultrasound echoes reflected. As a rule, the dynamic components in ultrasound transducers are made of extraordinary ceramic crystal materials called piezo electrics. These materials can deliver sound waves when an electric field is connected to them, yet can likewise work backward, creating an electric field when a sound wave hits them. At the point when utilized as a part of a ultrasound scanner, the transducer conveys a light emission waves into the body. The sound waves are reflected to the transducer by limits between tissues in the way of the bar (e.g. the limit amongst liquid and delicate tissue or tissue and bone). At the point when these echoes hit the transducer, they produce electrical signs that are sent to the ultrasound scanner. Utilizing the speed of sound and the time of each echo's return, the scanner computes the distance from the transducer to the tissue limit. These separations are then used to create two-dimensional pictures of tissues and organs.

**Result:**

Mentioned in Jupyter Notebook.

References:

1. Hauff, Peter, Michael Reinhardt, and Stuart Foster. "Ultrasound basics." *Molecular Imaging I* (2008): 91-107.
2. Azhari, Haim. *Basics of biomedical ultrasound for engineers*. John Wiley & Sons, 2010.
3. Chan, Vincent, and Anahi Perlas. "Basics of ultrasound imaging." *Atlas of ultrasound-guided procedures in interventional pain management*. Springer New York, 2011. 13-19.