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16. Physics

Northeastern State University

Abstracts from the 2015 Oklahoma Research Day

Held at Northeastern State University

05. Mathematics and Science

16. Physics

05.16.01 The Slope Method Determination of the Acoustic Attenuation Coefficient of Liquids

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In medical physics the use of ultrasound to detect anomalies in patients is commonplace. The detection of anomalies depends upon the rejection of artifacts and texture of normal structures; this is done using phantoms. The phantom may be thought of as the 'known tissue' that is imaged. Phantoms should better represent human tissue structure. The measurement of attenuation coefficients is useful in many industrial fields such as milk and juice production as well. This research focussed on using a slope method to determine the acoustic attenuation coefficient of glycerol and distilled water rather than a direct calculation of the coefficient from the intensity equation. The amplitude of the signals were measured and allowed the calculation of the attenuation at several distances. The slope of graph of the attenuation versus the distance the sound traveled yielded the attenuation coefficient for the liquid. This research was done using 1, 2,and 4 MHz ultrasound transducers and an echo scope. The attenuation coefficient for glycerol was found to be .009031-.03434 dB/mmMHz. Similar ranges in values were found in the literature. The attenuation coefficient of distilled water was found to be -.002817 to +.008154 dB/mmMHz. The literature was full of a variable range of values for distilled water as well. This appeared to be a better method for determining the attenuation coefficient.

05.16.02 Whole Body-MRI Based Fat Measurement

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Body fat volume and fat distribution have significant medical implications in human pathology. The growing evidence that obesity is related to several metabolic disturbances such as insulin resistance, impaired insulin secretion, non-insulindependent diabetes mellitus (NIDDM), hypertension, and cardiovascular diseases, emphasizes the accurate measurement of the total body fat, subcutaneous fat, and the visceral fat. Two whole body Magnetic Resonance Imaging (MRIs) (2009 & 2011) were taken of a middle-aged female subject in a Caloric Restriction study. The axial DICOM-format images for each body region were imported and reconstructed in the visualization software Avizo® , and the body fat was manually segmented slice by slice. The segmented regions were merged together, and the fat volume of each region was calculated. The fat volume changes in two MRIs were evaluated, and the abdominal subcutaneous and visceral fat exhibited the greatest decrease in volume. Whole body fat segmentation using MRI scans and Avizo software gave a good depiction of the subcutaneous fat and visceral fat in the whole body.

05.16.03 Examining Polarimetric Characteristics of Electronic Interference in Weather Radar Data

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Meteorologists have been able to examine the atmosphere using weather radars to look at what kinds of precipitation have been occurring for many decades. With the recent upgrade to dual-polarization radars (dual-pol) for the WSR-88D (Weather Surveillance Radar 1998 Doppler), meteorologists can now examine the atmosphere with dual-polarization products. These products are: Velocity (V), Reflectivity (Z), Differential Phase on Propagation (PhiDP), Correlation Coefficient (RhoHV), Differential Reflectivity (Zdr), and Spectrum Width (SPW). Though the products are very useful in determining what type of precipitation are in the atmosphere, how large the precipitation event is, and how severe it can be, it picks up many non-meteorological echoes.Electronic interference is a type of non-meteorological echo that has high reflectivityvalues and is mistakenly forecasted as precipitation by automated systems. This study looks at the reflectivity, differential reflectivity, and correlation coefficient of electronic interference and precipitation to find objective criteria to distinguish a difference between them. The findings are meant to aid in the currentquality control algorithm to be more efficient for operational use.