University of California, Los Angeles

Medical Imaging Informatics Group

BE 224A Ultrasound Lecture

Lecture notes on ultrasound tissue characterization

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1 Introduction

This text is a collection of lecture notes to explain tissue characterization using ultrasound imaging in the clinical setting.

2 Noise

Rayleigh distribution: speckle noise in ultrasound images follows this distribution

3 Summary

$$c = \lambda f \tag{1}$$

$$c = \sqrt{\frac{\mathrm{B}}{\rho}} \tag{2}$$

$$\mathrm{I} \propto \mathrm{P}^2 \tag{3}$$

$$\text{Relative intensity (dB)} = 10 \log \left(\frac{\mathrm{I}_2}{\mathrm{I}_1} \right) \tag{4}$$

$$\text{Relative pressure (dB)} = 20 \log \left(\frac{\mathrm{P}_2}{\mathrm{P}_1} \right) \tag{5}$$

$$\mathrm{Z} = \rho c \tag{6}$$

$$\mathrm{R_P} = \frac{\mathrm{P_r}}{\mathrm{P_i}} = \frac{\mathrm{Z}_2 - \mathrm{Z}_1}{\mathrm{Z}_2 + \mathrm{Z}_1} \tag{7}$$

$$\mathrm{R_I} = \frac{\mathrm{I_r}}{\mathrm{I_i}} = \left(\frac{\mathrm{Z}_2 - \mathrm{Z}_1}{\mathrm{Z}_2 + \mathrm{Z}_1} \right)^2 \tag{8}$$

$$\frac{\sin \theta_\mathrm{t}}{\sin \theta_\mathrm{i}} = \frac{c_2}{c_1} \tag{9}$$

$$\frac{\theta_\mathrm{t}}{\theta_\mathrm{i}} \cong \frac{c_2}{c_1} \tag{10}$$

$$\theta_\mathrm{c} = \arcsin \left(\frac{c_1}{c_2} \right) \tag{11}$$

$$\mathrm{Q} = \frac{f_0}{\text{Bandwidth}} \tag{12}$$

References