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Methods & Technologies for High Quality Medical Ultrasound Imaging

Introduction

Using Pulse-echo Technique, ultrasound imaging is considered to be Noninvasive, Portable, Real-time, and Cost Effective, which makes it a most popular diagnostic imaging modality in the world.

Based on Sonix RP, an advanced experimental ultrasound scanner, the project Objective is to develop and implement new methods and technologies for high quality medical ultrasound imaging, especially in the area of Speckle Reduction.

Imaging Process

Statistical Modeling for Ultrasonic Echo Signal

The backscattered ultrasonic echo from tissue follows some statistical distributions. Nakagami Distribution is used as a model for envelope-detected ultrasound signal in this project.

Histograms of ultrasonic echo signal are used to verify the Model. Results showed the Simplicity and Versatility of the model. Chi-square Tests are also conducted to test the hypothesis. The results are Acceptable within error limits.

Adaptive Speckle Reduction Filter

An Adaptive Filter based on Nakagami Distribution is proposed and the Windowing technique is used to remove the speckles.

\[ p(r, \mu, \omega) = \frac{2^{\mu^2}}{\Gamma(\mu)} e^{-\frac{r^2}{\omega}} \exp \left( \frac{-\mu r^2}{\omega} \right) \]

\[ \mu = \frac{E[X^2]}{\text{Var}[X^2]} \quad \omega = E[X^2] \]