Mechanical Engineering Thesis Defense

"Development of an Ultrasound Device for Characterizing Soft Materials and Investigation of Thickness and Force Effects on Peak Density Results"

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Abstract

This thesis investigates the impact of sample thickness and applied force variations on density of peaks results for soft materials. The objective is to develop a deeper understanding of how these factors influence the accuracy of ultrasound analysis in homogeneous and non-homogeneous tissue phantoms.

A specialized device was designed to record ultrasound waveforms while precisely measuring force applied and sample thickness. Homogeneous gelatine and fiber tissue phantoms were used in initial experiments, revealing that peak density values remained relatively consistent across different sample thicknesses and forces applied. Non-homogeneous tissue phantoms with ground pepper and pepper flake inclusions showed varying peak density results, indicating potential challenges in accurately detecting inhomogeneities from a single peak density measurement.

The study concludes that while the developed device provides accurate measurements of force and thickness, there is significant variability in peak density values, especially in non-homogeneous samples. Future work is suggested, including testing with real tissue samples and automating the device for faster intraoperative margin detection processes. This research contributes to the advancement of quantitative ultrasound analysis and provides valuable insights for the design of medical devices aimed at tissue characterization and margin detection during surgical procedures.

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