



Two-Step Strain Estimation Method to Improve Ultrasonic Elasticity Imaging

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WARF: P05393US

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing an improved post-processing method to enhance the resolution of elastographic imaging.

Overview

Breast cancer is the second most commonly diagnosed cancer in women. Currently in the U.S., 2.4 million women have been diagnosed and treated for breast cancer. The most common method of detecting breast cancer is palpation, in which a physician feels the difference in elasticity between healthy and cancerous tissues. Ultrasound imaging systems also can characterize the elasticity of tissues, called ultrasonic elasticity imaging, to diagnose breast cancer and other diseases that alter the elastic properties of tissues.

In ultrasonic elasticity imaging, pre- and post-deformation images are compared to analyze the local strain, or displacement, of the tissue. Each image is taken over a specific area, called a window, and at a fixed radio frequency echo wavelength. The number of wavelengths per window length determines the resolution of the final image; that is, fewer wavelengths in a smaller window produce images of greater resolution.

The normalized cross-correlation algorithm commonly is used to compute the strain components for the image by tracking tissue deformation in the window. The accuracy and precision of strain calculation is related to the window size. For example, one-dimensional strain estimation would require a window length of at least 10 wavelengths to attain acceptable signal-to-noise ratio.

UW-Madison researchers previously developed a technique for measuring multiple strain-tensor components aside from the commonly utilized axial strain (see WARF reference number P04092US). The other strain tensors include lateral, elevational and shear strain. This method enables reconstruction of Young's modulus without use of interpolation or iteration to provide complete characterization of tissue motion during compression.

The Invention

UW-Madison researchers have developed an improved method for computing local strain components in ultrasonic elasticity imaging. The new two-step cross-correlation technique allows a smaller window to be used, enhancing image resolution while improving the signal-to-noise and contrast-to-noise ratios. In the first step of the process, coarse local displacement estimates with a high signal-to-noise ratio are obtained via a window length equal to or greater than 10 wavelengths. Then the displacement estimates are interpolated with a second order polynomial fitted to the coarse data to produce a fine local displacement map. The local displacement map guides the second correlation step using one to two wavelength overlapping windows to attain accurate, precise and highly detailed strain images.

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algorithms. However, given the speed of current processors the increase in time is negligible. With improved image resolution and signal-to-noise and contrast-to-noise ratios, the new two-step cross-correlation technique will make ultrasonic elasticity imaging a more accurate, precise and explicit medical diagnostic tool.

Applications

- Diagnosis of diseases, including breast cancer, atherosclerosis, cardiovascular disease and abdominal pathogens
- Monitoring transplanted kidneys
- Skin and tissue engineering
- Muscle dynamics
- Structural evaluation in material science and research

Key Benefits

- Increases axial resolution of strain images five- to 10-fold
- No reduction in signal-to-noise ratio
- No reduction in contrast-to-noise ratio
- Processing time only increased by a few seconds
- Performs over a large range of window lengths
- Can utilize 1-, 2- or 3-D image cross-correlation processing

Stage of Development

The improved two-step method has been proven by simulation and field testing to enhance image resolution five- to 10-fold and significantly increase signal-to-noise and contrast-to-noise ratios when compared to the traditional single window cross-correlation method.

Additional Information

For More Information About the Inventors

- [Tomy Varghese](#)

Related Technologies

- [For more information about techniques that provide direct estimates of strain tensor components, see WARF reference number P04092US.](#)

Publications

- Chen H., Shi H. and Varghese T. 2007. Improvement of Elastographic Displacement Estimation Using a Two-Step Cross-Correlation Method. *Ultras. in Med. & Bio.* 33, 48-56.

Tech Fields

- [Medical Imaging : Ultrasound](#)

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