Two-Step Strain Estimation Method to Improve Ultrasonic Elasticity Imaging

Published date: March 14, 2017

Technology description

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. 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.

The new method improves upon previous techniques by utilizing a refining step to guide a more exact

analysis of the tissue strain. The image resolution for the new two-step method is five to 10 times greater than that of traditional techniques. The processing time is doubled, approximately five to seven frames per second for the new technique compared to 10 to 15 frames per second for traditional 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.
The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing an improved post-processing method to enhance the resolution of elastrographic imaging.

Additional Information

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.

Application area

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

Advantages

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

Institution

Wisconsin Alumni Research Foundation

Inventors

Hairong Shi
Hao Chen
Tomy Varghese

联系我们

叶先生

电 话：021-65679356

手 机：13414935137

邮 箱：yeyingsheng@zf-ym.com