Optimizing Ultrasonic Elasticity Imaging with Selectable Inputs

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WARF: P07464US

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing an improved method and apparatus for calculating material displacement used to produce an ultrasound elasticity image.

Overview

Breast cancer is the second most common 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 of the healthy and cancerous tissues. In addition, ultrasound machines can perform elasticity imaging to characterize tissue.

In common ultrasonic elasticity imaging, pre- and post-deformation images are taken and compared to analyze the local strain, or displacement, of the tissue. One key aspect of analyzing tissue displacement is identifying motion patterns of specific points in the ultrasound images. The elasticity of an area of tissue can be measured by constructing a region of points, called a kernel, in the pre-deformation image and comparing it to a search window in which the corresponding post-deformation kernel is expected to occur. The process of matching the pre- and post-deformation kernels is called block matching. To make this method efficient, the search window must be small enough to limit computational time but large enough to accommodate likely tissue deformation.

UW-Madison researchers previously developed two methods for assisting in the analysis of ultrasonic elasticity imaging. The first method uses an empirical equation to combine different quality image descriptors, providing the ultrasound operator a real-time corrective signal to improve the overall quality of the data acquired (see WARF reference number P04300US). Another technique uses parallel computer processing of the column-by-column imaging data to create real-time elastographic image while minimizing computational burden by reducing the size of search windows and kernels (see WARF reference number P05056US). Both of these technologies have advanced the field of ultrasonic elasticity imaging.

The Invention

UW-Madison researchers have developed an improved method of ultrasonic elasticity imaging that uses cost functions, a type of mathematical optimization, to weight the differences between the correlation and continuity for different forms of tissue. The correlation of the tissue refers to the restoration of signal coherence, where as the continuity refers to the correctness of kernel block matching with respect to other matches. This method also will allow the operator and the computer program to fine-tune the image based on *a priori* knowledge of the tissues or imaging situation and information acquired during the scanning process.

The new method improves upon previous techniques of elasticity imaging, namely the use of empirical equations and parallel computer processing to enhance image acquisition, by providing additional input parameters from both the ultrasound operator and the imaging software. Specifically, the operator can input information about the type of tissue, specific imaging task, appropriate cost functions, tissue boundaries and other imaging protocol. The computer software can select specific or general cost functions, shorten the computational process with a Viterbi algorithm, integrate equations into the block matching process and manage calculations across tissue boundaries. Together, the operator input and computer analysis greatly improve the speed and precision of the ultrasonic elasticity imaging process, increasing the probability of tumor identification and accurate diagnosis.

Applications

- Integration into conventional ultrasound scanners to image several tissue types, including breast, liver, cranial, thyroid, prostate, uterine and vascular tissue

Key Benefits

- Improves imaging of multiple types of tissue
- Permits operator and computer input to aid in imaging process
- Provides protocol for selecting empirically derived cost functions
- Permits general cost functions when empirical data has not been established
- Reduces computation time with Viterbi algorithm
- Able to distinguish between tissue boundaries

Stage of Development

The method and apparatus can reduce error variance by approximately five fold for non-axial displacement computer simulations. The method also was tested with *in vivo* breast data sets and found to provide high quality lateral displacements, resulting in better motion compensation between deformation images.

Additional Information

For More Information About the Inventors

- Timothy Hall

Related Technologies

- For more information about an elastography method for parallel processing of tissue displacement estimates, see WARF reference number P05056US.
- For more information about automated ultrasonic elasticity image formation with quality measures, see WARF reference number P04300US.

Publications

- Jiang J., Hall T.J. and Sommer A.M. 2006. A Novel Performance Descriptor for Ultrasonic Strain Imaging: A Preliminary Study. IEEE Trans. Ultrason. Ferroelectr. Freq. Control 53, 1088-1102.
- Neves L., Jiang J., Hall T. and Carneiro, A. 2007. Acoustic Elastography Under Dynamic Compression Using One-Dimensional Track Motion. Engr. Med. Bio. Soc., 2007. EMBS 2007. 29th An. Inter. Conf. of the IEEE, 83-86.

Tech Fields

- Medical Imaging : Ultrasound

For current licensing status, please contact Jeanine Burmania at jeanine@warf.org or 608-960-9846