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Ultrasound System for Characterization and Image-guided Therapy of Blood Vessel Diseases (20100155)

Identifies and Localizes Vessel Walls

A dual mode ultrasound array system provides real-time 2D/3D displacement and strain imaging in the vicinity of a vessel to identify and localize the vessel walls. The system uses a real-time monitoring and feedback image control of the therapy based on imaging data acquired using the dual mode ultrasound array (DMUA) of transducer elements, and adaptive, real-time refocusing improves imaging and therapy by using array directivity vectors obtained from DMUA pulse echo data. The technique provides simultaneous imaging of the vector flow field and the wall/tissue motion and the corresponding strains at high spatial and temporal sampling, which may provide an essential tool in modeling fluid-solid interactions between the blood and blood vessel. The DMUA imaging capability is sufficient for target identification and treatment, and the high resolution imaging removes the “shooting in the dark” element from image-guided HIFU procedures when targeting vascular structures.

2D Speckle Tracking

Most relevant ultrasound work on vascular imaging relies on grayscale data and uses normal frame rates. By using 2D/3D speckle tracking with specialized imaging modes for identification of the vessel boundaries, this new approach improves the localization of the vessel wall and constructs its boundaries, making it easier to identify plaques and other abnormalities. The method images displacement and strain fields in the vicinity of flow channels and shows that, at sufficiently high frame rates, speckle tracking methods produce well-behaved displacement estimates of both the tissue motion and flow in the channel.

Real-Time Vessel Wall Dynamics and Blood Flow Imaging

No existing focused ultrasound devices employ vessel wall and flow imaging in the planning and execution of thermal and nonthermal treatment of target vessels. Current treatment probes lack the special characteristics this technology offers, such as an applicator that not only measures wall motion and flow using speckle tracking, but can measure flow directly within the vessel using vector Doppler methods exactly at or in the vicinity of the treatment site. This technology offers real-time, non-invasive imaging of vessel wall dynamics and blood flow that provides important information that may help plan, assess or predict outcomes of treatment.

BENEFITS AND FEATURES:

- Thermal and nonthermal applications of focused ultrasound
- Large-aperture DMUAs
- High resolution imaging of the target vessel
- Characterizes blood flow
- Focused or unfocused ultrasound, with or without drugs
- Real-time, non-invasive imaging of vessel wall dynamics and blood flow
- Provides information that may assess treatment or predict treatment outcome

Technology ID
20100155-20120287

Category
Life Sciences/Diagnostics & Imaging
Life Sciences/Human Health
Life Sciences/Medical Devices
Agriculture & Veterinary/Veterinary Medicine

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APPLICATIONS:

- Vascular disease diagnosis and treatment
- Modeling fluid-solid interactions between blood and blood vessels
- Vessel disease treatment (e.g. atherosclerosis, thrombosis, tPA, etc.)
- Renal denervation
- Treatment planning, evaluation, or outcome prediction

Phase of Development - In vivo results obtained from carotid artery imaging in a healthy volunteer.

Researchers

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Publications

Multiband center-frequency estimation for robust speckle tracking applications
Journal of the Acoustical Society of America, October 2014, Vol.136(4), pp.2124-2124
Real-time monitoring and control of thermally induced lesions using high intensity focused ultrasound
Journal of the Acoustical Society of America, April 2011, Vol.129(4), pp.2438-2438