Computer-guided Restoration of Ultrasound Scan Poses by Optical Tracking

Technology #15884

Applications

Applications for this technology are found in ultrasound image-image registration, volume-volume registration, image-volume registration, longitudinal studies, and monitoring of localized therapy

Problem Addressed

Ultrasound is a widely used tool for non-invasively monitoring pathologies over time in longitudinal studies and localized therapies. In those procedures, it is crucial to acquire ultrasound scans at the same position, angle, and even compression level, with respect to the body part, in order to make an objective comparison between the scans. In current practice, sonographers would repeat the scan by placing the probe at roughly the same body location with the aid of body fiducials on the skin surface. Although this method is convenient and inexpensive, it is not accurate enough for detecting visually insignificant changes in tissues, especially when a slight deviation in probe orientation could result in substantial change in tissue appearance. This method also falls short when maintaining the insonification angle (the angle between the ultrasound beam and the direction of blood flow) is essential. Previously described methods of visual servoing yielded promising results; however, they require expensive and bulky robotic systems.

Technology

This invention presents a novel visual feedback system for steering an ultrasound probe to a predetermined acquisition state. The system provides real-time visual guidance for accurate realignment of the ultrasound probe in six degrees of freedom (6-DoF)1 and significantly improves alignment of tissue structures in repeated ultrasound scans. This system uses one or more of small low-cost cameras mounted on the ultrasound probe to track natural and artificial skin features of the patient and estimates the current probe position relative to the target position. At each ultrasound scan acquisition, the skin features are captured by the camera(s), and from the camera images, the system estimates the relative distance between the target and current probe positions and provides sonographers with intuitive visual feedback to guide the probe to the target position. This method is unobtrusive and less expensive than robotic visual servoing and more accurate than using body fiducials. This method can also be utilized as an extension of the body fiducial approach to realign the probe in the complete 6-DoF with improved accuracy.

1. Six degrees of freedom (6-DoF) refers to the forward/backward, up/down, left/right movements of a rigid body in three dimensional space along the three perpendicular axes combined with the pitch, yaw, and roll rotations around the three axes.

255 Main Street, room NE 18-501
Cambridge, MA 02142-1601
Phone: 617-253-6966 Fax: 617-258-6790
http://tlo.mit.edu
Contact the Technology Manager: tlo-inquiries@mit.edu

Advantages

- Improved accuracy of probe realignment; provides real-time visual guidance to sonographers for accurately returning the probe to a target position at which a reference ultrasound scan was previously acquired
- Inexpensive and unobtrusive
- Provides 6-DoF probe motions and positions
- Does not require additional sensors for estimates in the complete 6-DoF

Categories For This Invention:

Medical Devices
Life Sciences
Biotechnology
Health
Clinical Applications
Radiology
Diagnostics
Other (Diagnostics)
Imaging
Ultrasound
Instrumentation
Other (Instrumentation)

Intellectual Property:

User interface for ultrasound scanning system
Issued US Patent
9,538,982

Inventors:

Brian Anthony
Shih-Yu Sun

Publications:

Computer-guided Ultrasound Probe Realignment by Optical Tracking
IEEE International Symposium on Biomedical Imaging: From Nano to Macro
2013

External Links:

Device Realization, Computational Instrumentation @MIT
https://devicerealization.mit.edu/

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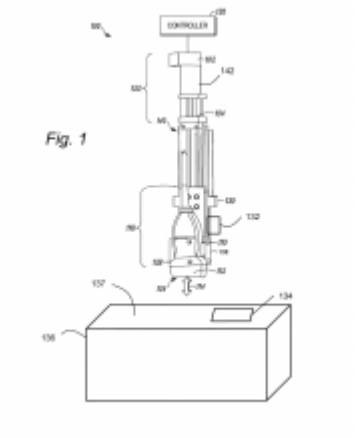
Image Gallery:



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