AbstractID: 8236 Title: A Generalized Method for Freehand Three-dimensional Ultrasound Acquisition

Three main technologies are available to acquire 3D-ultrasound (3DUS) images: dedicated mechanical 3D-probe, 2D-transducer array, or freehand. Freehand techniques have most generally been based on acoustic, magnetic, or mechanical sensors recording the position of the probe as the images are acquired. We developed a fast freehand 3DUS acquisition system using optical sensors that can be adapted to any 2DUS system. The ultrasound probe position is tracked using a CCD camera focused on an infrared light emitting diodes array rigidly attached to the probe. After attachment of the array, a probe calibration is performed to determine the ultrasound image position based on the probe tracking. For the 3DUS image acquisition, the probe is manually moved across the surface of the patient, and the 3D-image-volume is filled using the 2DUS video images and their associated optically measured position. After the acquisition, the remaining unfilled voxels are filled using a linear interpolation algorithm. Using a specially designed optically track ultrasound phantom, the stability and accuracy of the probe calibration procedure was determined to be submillitmetric on average (AP=0.4+/-0.3mm, lat =0.9+/-0.4mm, Ax=0.3+/-0.2mm). The developed system takes 12 seconds to acquire 100 ultrasound images (450x391) in a 60 mm volume length (160 slices), requiring 40 second of interpolation time (using a SGI R10000, 195 MHz). Visual comparisons with a high-end dedicated 3D-ultrasound system show good quality of the acquired 3DUS images, sufficient for image-guided procedures. This system has been integrated within an image-guided positioning system and is currently being clinically tested.

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