AbstractID: 3794 Title: Freehand Scan Ultrasound Reconstruction based on Optimal 3D Grid Selection and Anisotropic Diffusion Interpolation

Purpose: presents a new algorithm for the reconstruction of the volume of human organ from multiple B-scans and the associated image plane position and orientation measurements as acquired by hand scanning across the surface of the human body with a probe attached to a a Microcribe articulating arm.

Method and Materials: The 3D reconstruction grid is optimized using an optimal method. A cost function is built for this problem as to minimize the registration errors between the scan planes and the reconstruction 3D grid while allowing for the largest possible voxel size. With the 3D grid defined, every B-mode scan is inserted into the grid. An anisotropic diffusion-based interpolation supported by the gradient vector flow is developed for empty voxel filling.

Results: We tested 'griddata3' in the MATLAB^{TM} for voxel nearest neighbor interpolation which is based on a Delaunay triangulation of the data. The out-of-memory problems prevented our 2 GB memory computer to run properly when the number of scans is large and/or full-resolution reconstruction is attempted. Several freehand US sweeps of a prostate phantom has been used to test the proposed reconstruction method yielding appealing visual results without having the out-of-memory problem any more.

Conclusion: Freehand 3-D US reconstruction generates a geometrically-registered 3-D volume of an organ out of multiple B-mode images acquired at irregular positions and from arbitrary view angles by inserting each 2-D image into a uniform 3-D grid using the position and orientation measurements of the scan plane. Depending on the voxel size, empty voxels may exist in the 3-D grid. To handle this problem of holes, a 3D Interpolation is needed which usually demands heavy computation and huge computer memory. The proposed diffusion-based reconstruction algorithm is computation-efficient and less memory sensitive for 3D US reconstruction.

Conflict of Interest (only if applicable): no