

Publication

Hybrid ultrasound/magnetic simultaneous acquisition and image fusion for motion monitoring in the upper abdomen

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Objectives: The combination of ultrasound (US) and magnetic resonance imaging (MRI) may provide a complementary description of the investigated anatomy, together with improved guidance and assessment of image-guided therapies. The aim of the present study was to integrate a clinical setup for simultaneous US and magnetic resonance (MR) acquisition to obtain synchronized monitoring of liver motion. The feasibility of this hybrid imaging and the precision of image fusion were evaluated. Materials and Methods: Ultrasound imaging was achieved using a clinical US scanner modified to be MR compatible, whereas MRI was achieved on 1.5- and 3-T clinical scanners. Multimodal registration was performed between a high-resolution T1 3-dimensional (3D) gradient echo (volume interpolated gradient echo) during breath-hold and a simultaneously acquired 2D US image, or equivalent, retrospective registration of US imaging probe in the coordinate frame of MRI. A preliminary phantom study was followed by 4 healthy volunteer acquisitions, performing simultaneous 4D MRI and 2D US harmonic imaging (F-o = 2.2 MHz) under free breathing.Results: No characterized radiofrequency mutual interferences were detected under the tested conditions with commonly used MR sequences in clinical routine, during simultaneous US/MRI acquisition. Accurate spatial matching between the 2D US and the corresponding MRI plane was obtained during breath-hold. In situ fused images were delivered. Our 4D MRI sequence permitted the dynamic reconstruction of the intra-abdominal motion and the calculation of high temporal resolution motion field vectors. Conclusions: This study demonstrates that, truly, simultaneous US/MR dynamic acquisition in the abdomen is achievable using clinical instruments. A potential application is the US/MR hybrid guidance of high-intensity focused US therapy in the liver.

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