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Dynamic Multi-Modality Imaging for Radiotherapy

•US is singular in its ability to measure organ boundaries precisely in real time, but also in its difficulty in interpretation.

•We propose to develop a system that superimposes real time dynamic US images onto static 3D CT images.

•Applications include radiation therapy, image-guided biopsy, brachytherapy, education and training.

Specific Aims:

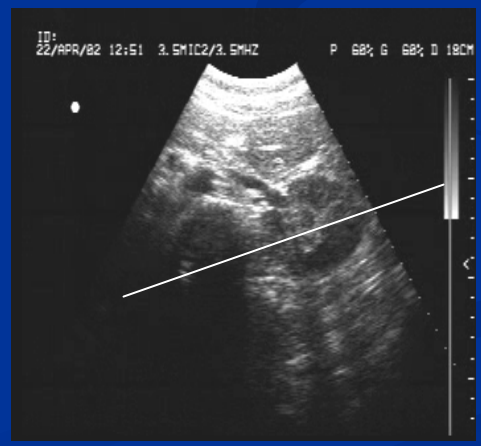
- Development of a system for simultaneous, multi-layer display of computed tomography (CT) and dynamic ultrasound (US) images
- Develop and test a mechanical registration method
- Analyze the clinical utility

Specific Aim 1:

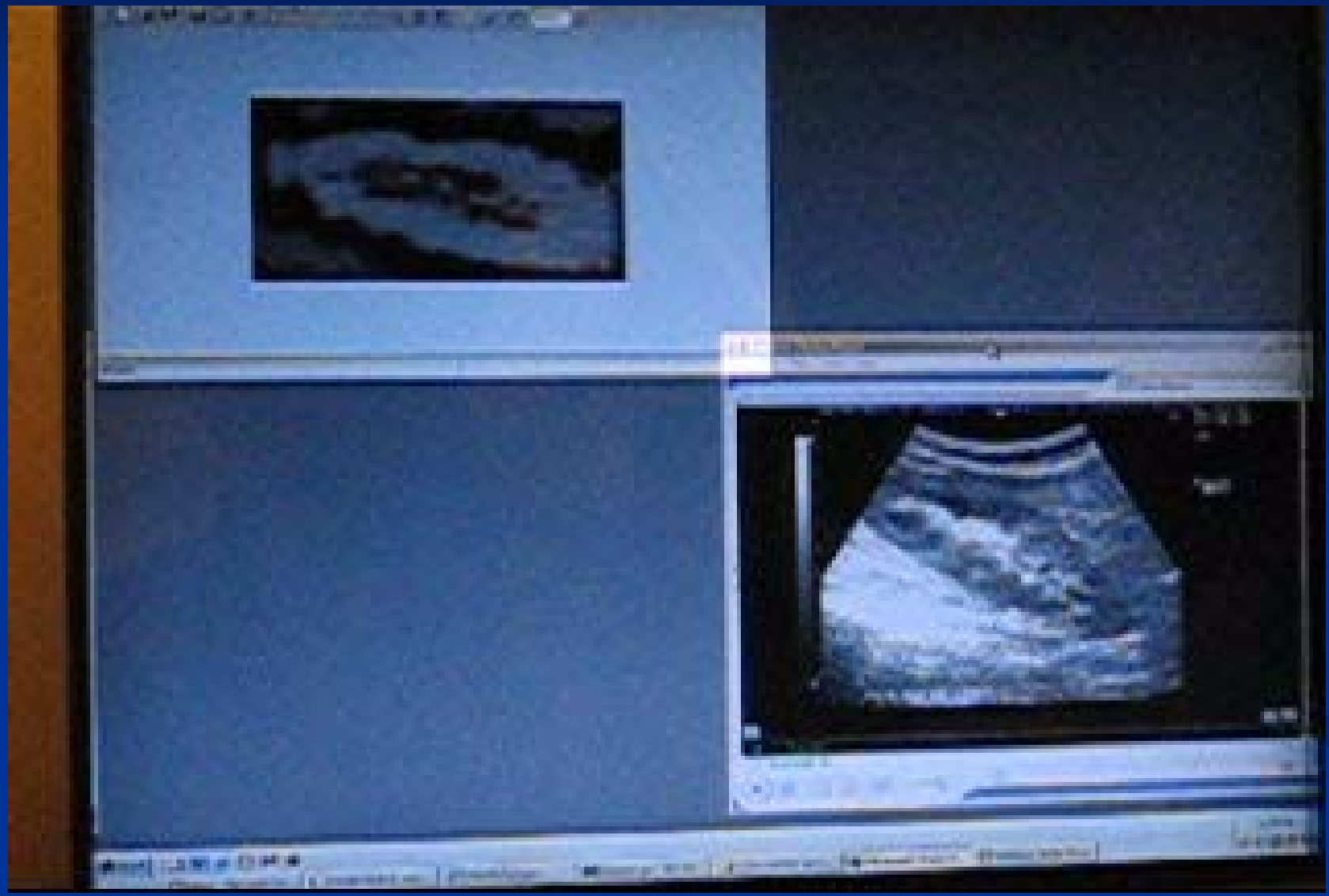
Development of a system for simultaneous, multi-layer display of CT and dynamic US images

Input: Real-time ultrasound image and a corresponding dynamically reoriented CT image. Display will be facilitated using a unique multi-layer monitor for superposition and simultaneous viewing of the two images.

A unique user interface will be developed to facilitate image interpretation



Multi-Layer Display



Specific Aim 2:

Develop and test a mechanical registration method

We will calibrate the system so that the positions, in addition to the orientations, of the two image planes are registered in absolute spatial coordinates to an accuracy of +/- 2 mm in each of the three cardinal dimensions.

The spatial position and orientation of the ultrasound image will be accurately registered via an articulating arm

Specific Aim 3:

We will use the system to collect preliminary data on its clinical utility by measuring the variation in the structure boundary location due to respiratory motion in the liver, kidneys, pancreas and prostate.

The dual-modality imaging system will be clinically tested on patients receiving radiation therapy for cancers in the pelvis, abdomen, and thorax

This data will be used to guide future directions for application of the system. Anatomical sites in which the respiratory induced motion differs compared to the treatment margins typically used in radiation therapy (e.g. 1-2 cm) will be considered candidates for further investigation

This imaging tool will enable radiation oncology physicians to precisely localize tumor and critical structure boundaries, both in space and in time. The interpretation of the dynamic ultrasound images will be feasible to the novice via the context provided by the superposition of the US and CT images.