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laden gemeinsam zum

GASTVORTRAG

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"IllustraSound: Novel Methods for Visualization of Couinaud Liver Segmentation"

Abstract:
During liver examinations with ultrasound often a segmentation into eight Couinaud segments is facilitated to organize the spatial relation between diagnostically relevant anatomical and pathological features. In this talk, we present a new methodology for effectively conveying these spatial relations in the liver. We visualize the two-dimensional ultrasound slice in the context of a threedimensional Couinaud partitioning of the liver. This partitioning can be described by four planes in 3D reflecting the vascular tree anatomy. These planes are specified in the patient by the examiner using her natural interaction tool, i.e., the ultrasound transducer with positional tracking. The interactively located planes are then matched with the planes that are pre-defined in a generic model of the liver organ. The matching process maps the geometrical relationships among the planes as extracted from the patient to the planes in the generic liver model. The model is then transformed to perfectly fit the geometric properties of the extracted features, while in other areas of the liver the match is approximate. The approximative fit might be insufficient for areas that are of high diagnostic relevance. Therefore, we allow for using the ultrasound transducer for additional liver model editing, i.e., to sculpt mesh areas in order to precisely match the liver parenchyma where needed.

When the examiner is satisfied with the level of match between the patient's anatomy and the model, the examination is further supported by visual aids to best possibly convey the relationships between the placement of the ultrasound plane and the partitioned liver. The 2D ultrasound slice is augmented with Couinaud partitioning intersection information and dynamic label placement. A linked 3D view shows the ultrasound slice, cutting the liver and displayed using fast exploded view rendering. Automatic camera positioning guarantees that all important features are clearly visible from a canonical viewpoint.

Furthermore, we present two additions to the enhanced liver examination procedure. One method allows to better understand the spatial characteristics of the vascular trees by rendering a thin 3D slab out of tracked freehand 2D ultrasound. The second addition enables to extract the vascular tree from a 2D ultrasound image sequence utilizing a painting metaphor. These additional enhancements are important to convey the relationship between the liver segmentation and the vascular tree distribution. All described visual augmentations can be very supportive during the examination procedure, and also as a good basis for pre-operative case discussions.

Biography:
Ivan Viola is Associate Professor at University of Bergen, and Scientific Adviser at Christian Michelsen Research (CMR), Bergen, Norway. He received M.Sc. in 2002 and Ph.D. in 2005 from Vienna University of Technology, Austria. His research is focused on application of illustrative visualization for communication of complex scientific data. Viola co-authored several scientific works published in international journals and conferences such as IEEE TVCG, IEEE Visualization, and EuroVis and acted as a reviewer and IPC member for conferences in the field of computer graphics and visualization (e.g. IPC IEEE Visualization 2009, EuroVis 2009). He is member of Eurographics, NorSIGD, IEEE Computer Society, VGTC.

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