ARAS
Augmented Reality Aided Surgery

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Overview

- Introduction
- Project Status
  - Video textures
  - 3D textures
  - Manual vessel tree registration
- Future Work
Goals

Goal: Augmentation for intra-operative planning of liver surgery

- tracked, stereoscopic overlay of
  - offline generated polygonal data
  - image-based rendering of ultrasound data

- collaboration radiologist/surgeon
  - distributed system
  - video overlay for radiologist
  - manual registration by radiologist
  - hands-off interface for surgeon
System Setup

Optical tracker

Video camera

Surgeon

Vesseltree visualization

US Visualization

Radiologist

WS_{T}

WS_{S}

WS_{R}
Project Status

- vessel tree  
  (segmentation and polygonalization)
- proof-of-concept setup with optical tracker  
  (utilizing the Studierstube AR system (Stb))
- video textures for Stb
- 3D textures for Stb
- collaboration radiologist/surgeon  
  (distributed vessel tree using distributed OpenInventor (DIV))
- manual vessel tree registration
Vessel Tree

pre-operative CT or MRI data,
offline segmented & polygonalized using SMART (Surface models from by-axis-and-radius-defined tubes) algorithm (TR VRVis 2001 026)
Proof-of-concept System

- tested at LKH Graz
- tracker evaluation
- HMD evaluation
- vessel tree visualization
US-Visualization with Video Textures

- new IV-node: SoDynamicTexture
- tracked US-probe
- texture grabbed from video source (US)
- maintain history of slices to „render volume“
- blending mode: maximum intensity
- ability to save video and tracker data stream
Image Stack with Video Textures
3D Texture for US-simulation

- new IV-node: SoTexture3D
- tracked virtual probe
- clip slice at volume borders
- calculate texture coordinates
- maintain history of slices to „render volume“
- blending mode: maximum intensity

- possible size (GeForce3 with 64 MB):
  - 512*512*64 (without compression)
  - 512*512*256 (with S3TC_DXT1 compression)
3D Texture for US-simulation
Distribution of Vessel tree and US data

- distributed OpenInventor (DIV)
- sharing of scene (sub) graph via network

- radiologist‘s workstation:
  - maintains vessel tree geometry data and transformation

- surgeon‘s workstation:
  - maintains US-data (video textures)
Radiologist’s View

- Radiologist „sees what surgeon sees“
  - new IV-nodekit SoVideoTextureBackground
  - video background of camera mounted on surgeon’s HMD
  - vessel tree displayed correctly aligned

- Manual registration
  - radiologist manipulates transformation of virtual vessel tree until sufficiently accurate registration is achieved
Manual Vessel tree Registration

- multiple views:
  - 1 live view
  - 3 snapshot views

- screen-aligned manipulation of vessel tree
Surgeon’s View

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Project TODOs

- Integration of full 4 camera optical tracker setup
- Evaluation of calibration methods

- US-visualization
  - of live US-data
  - for radiologist

- Collaboration surgeon/radiologist
Future Work

Clinical Evaluation:
- at LKH Graz (Werkgartner, Sorantin)

Additional Features:
- semi-automatic registration of pre-operative data
- automatic registration of vessel tree via US-data
- utilizing Voxelstube for displaying overlays of more complex models for surgeon
Thank you for your attention!

www.vrvis.at/br1/aras/index.html