

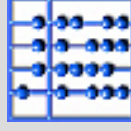
# Augmented Reality for Port Placement and Navigation in Robotically Assisted Minimally Invasive Cardiovascular Surgery

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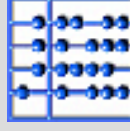
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# Acknowledgements

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  - Jörg Traub
  - Martin Bauer
  - Eva Schirmbeck
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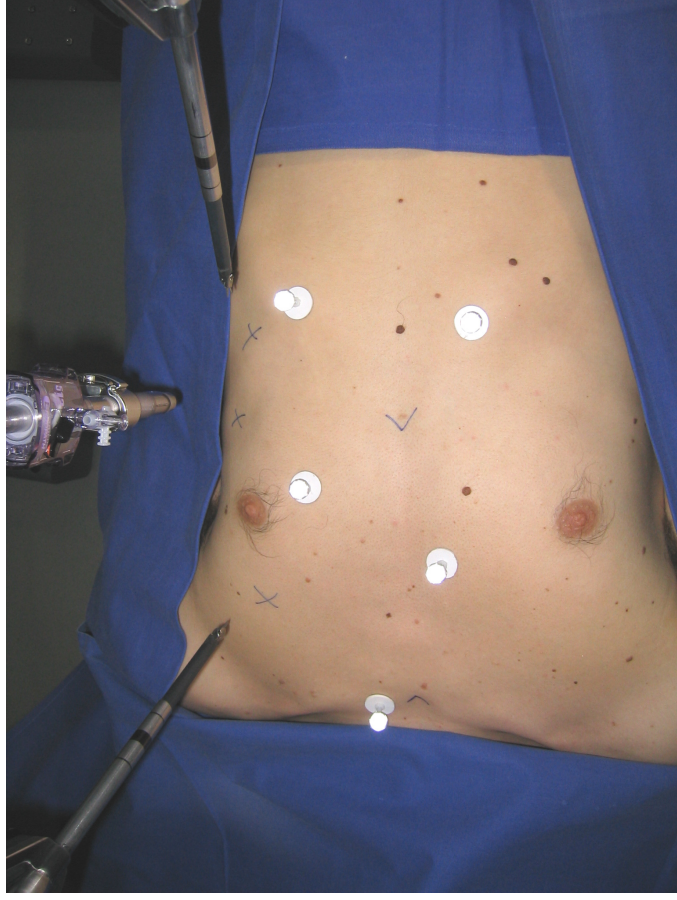
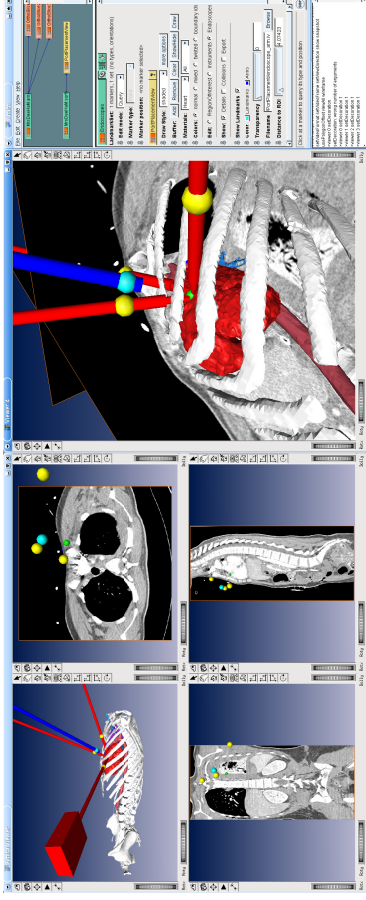
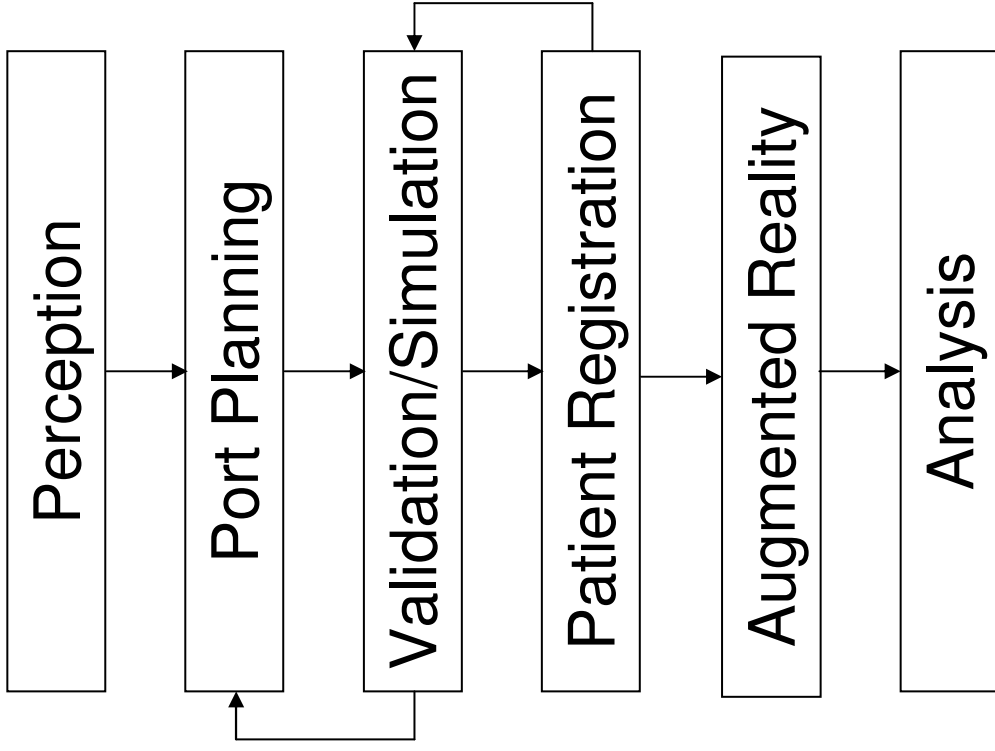


# Problem Statement

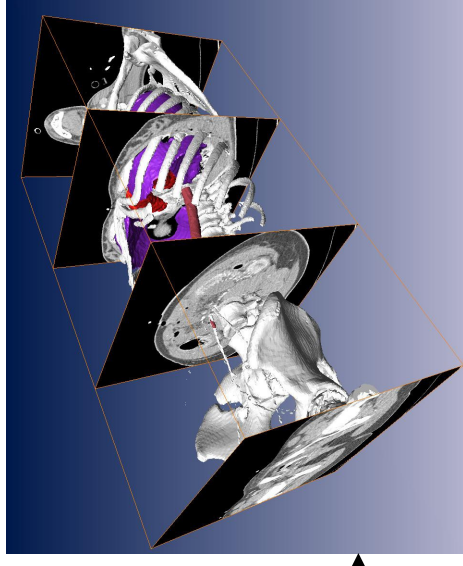
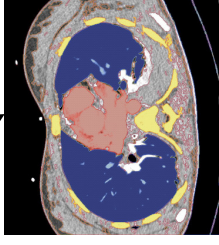
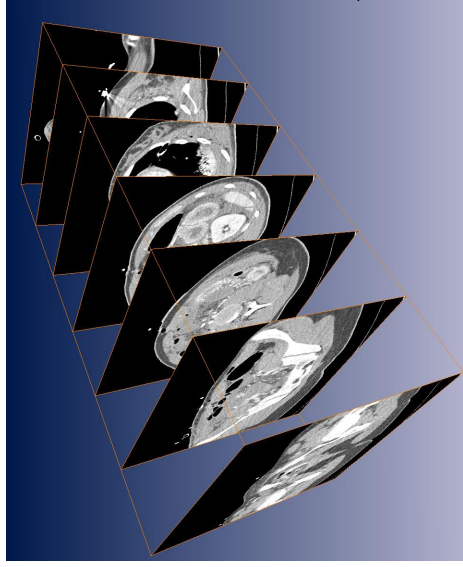


- Surgeon on a master console controls a slave teleoperator
- Where to place the ports for the teleoperator arms?
- Where are the teleoperator arms inside the patient's body?

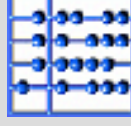
# Workflow



# Perception

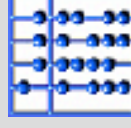
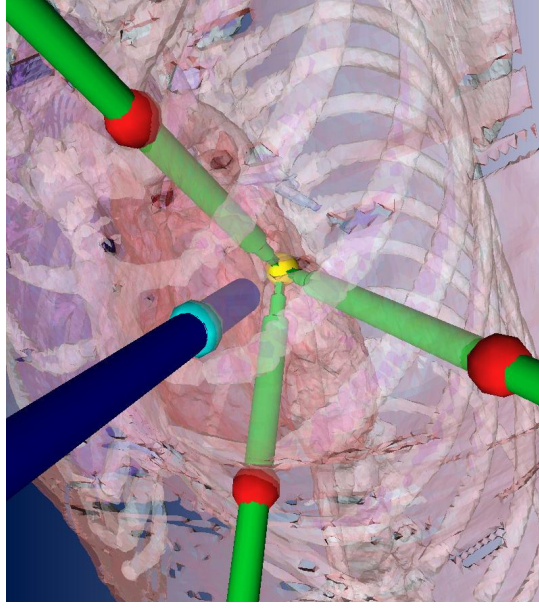


- Acquisition of cross-sectional image slices (CT)
- Image segmentation
- Reconstruction of a polygonal triangle mesh, which is used to perform the planning



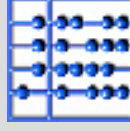
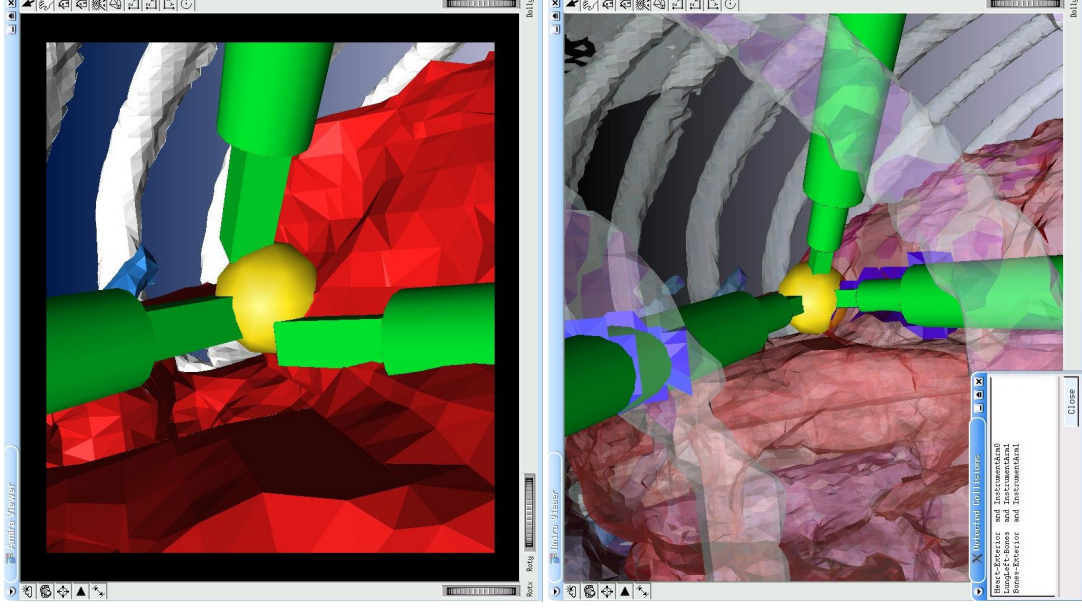
# Planning the Teleoperator Arms

- Definition of a region of interest by landmarks
- Placing of landmarks for the ports of the endoscope and instrument arms
- Visualization of corresponding teleoperator arms in a collision-free way
- Possibility to interactively adjust all landmarks



# Validation of Planned Data

- Simulation of the view of the endoscope of the arm's camera by a virtual endoscope view
- Collision detection between teleoperator arms and critical organs or bones



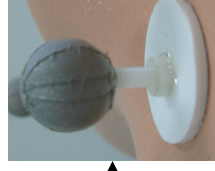
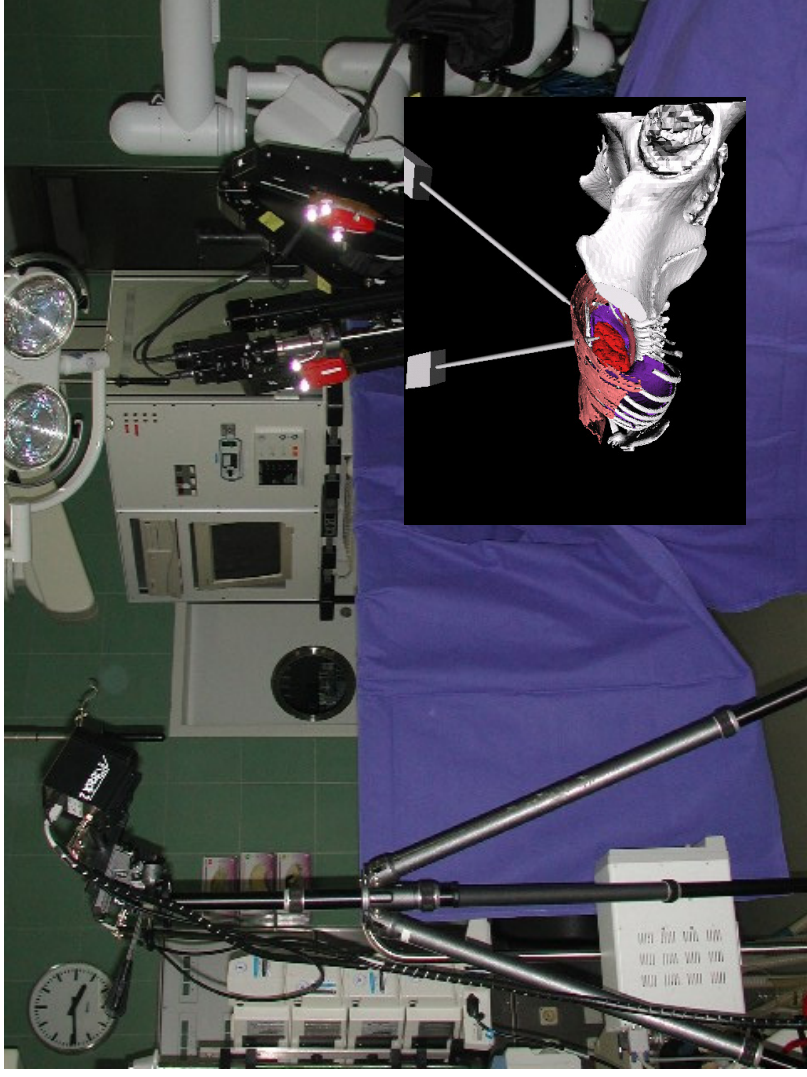
# Port Placement Movie





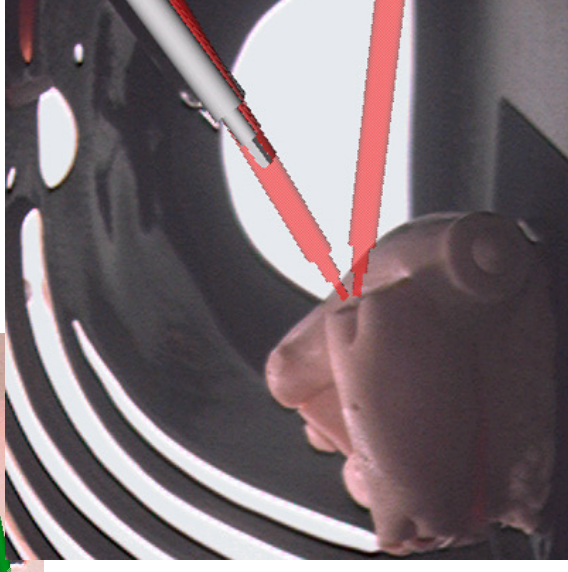
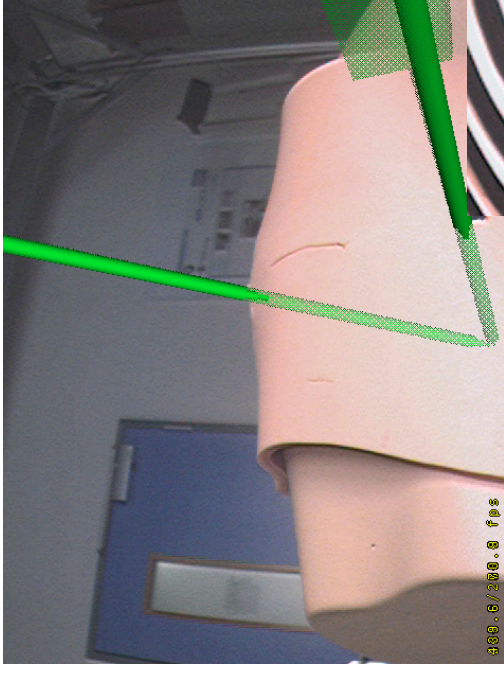
# Patient Registration

- Estimation of a rigid transformation from the virtual model to the real patient
- Point based registration to match fiducials
- Subsampling to find the correspondences



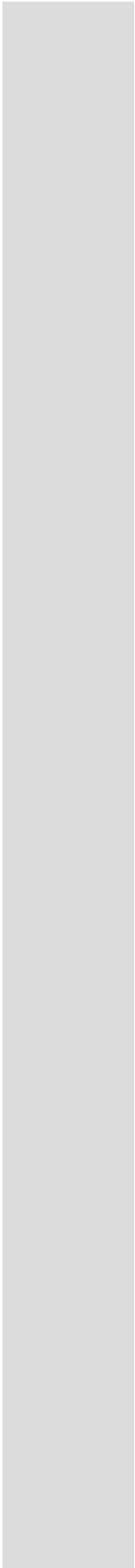
# Augmented Reality

- Intra-operative port placement by overlaying virtual planned teleoperator arms
- Endoscopic view additionally showing the real teleoperator arm position



# “Global Positioning System”





Thank you for your attention!



Augmented Reality for Port Placement and Navigation in RMICS  
Marco Feuerstein

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