
Hybrid Medical Visualizations: Creation and Evaluation

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Outline

- Motivation and Related Work
- Combination of Several Rendering Methods
- Evaluation of the Produced Visualizations
- Conclusion & Future Work

Christian Tietjen, Tobias Isenberg, and Bernhard Preim.
*Combining Silhouettes, Shading, and Volume Rendering for
Surgery Education and Planning*. In *Proceedings of Eurographics /
IEEE VGTC Symposium on Visualization*, pages 303–310, 2005.
Eurographics Association.

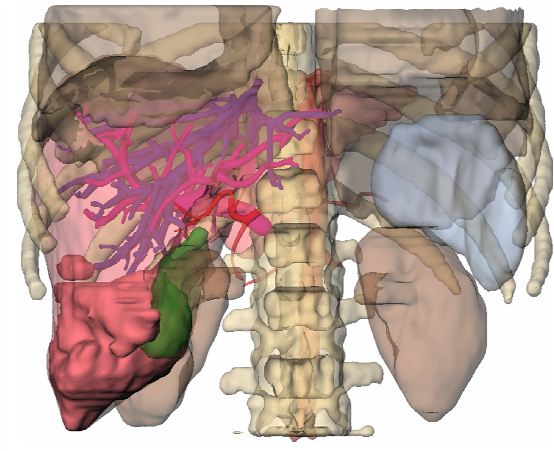
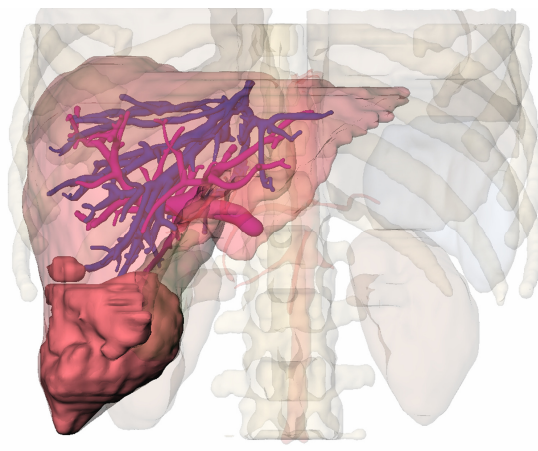
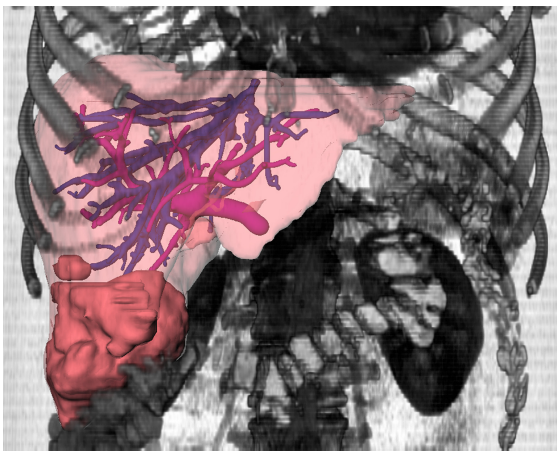
Motivation and Related Work

- Surgery planning and education
 - Surgery planning, radiation treatment planning, tumor ablation planning
 - Computer support (usually) based on image analysis
- Segmentation information available
- Visualization in Intervention Planning Systems
 - More and more visualization options and parameters are available and useful in some cases (direct volume rendering, isosurfaces, colors, opacity maps, silhouettes, ...)

Motivation and Related Work

Traditional computer-supported medical visualizations:

- 3D-interaction is possible
- Context visualization hampers interpretation
 - Context structures cannot be discriminated or
 - Context is hiding the focus object



Motivation and Related Work

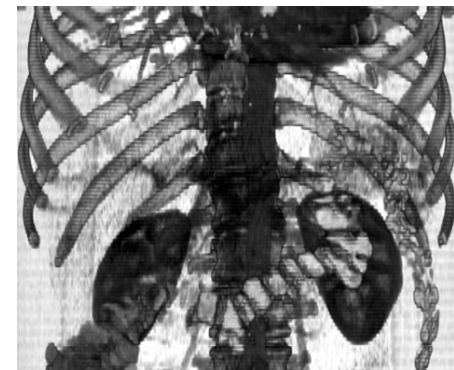
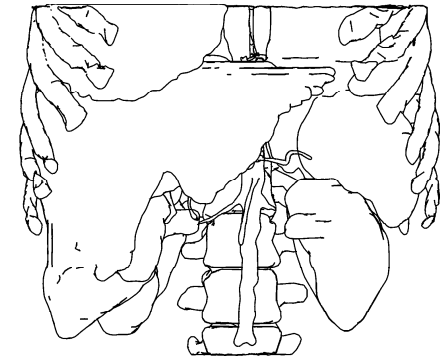
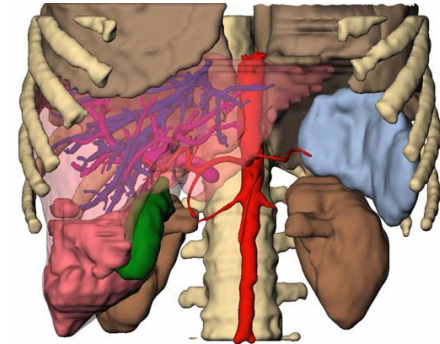
Computer generated line graphics with 3D-models

- Silhouettes, feature lines
 - Abstract visualization of the model
 - Support visual perception
- Hatching
 - Lighting information
 - Clarification of the objects shape
 - Surface structure of the object (like muscle fibres)

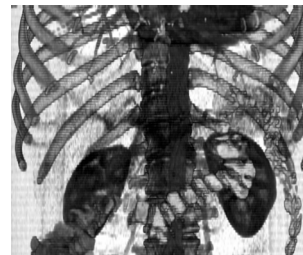
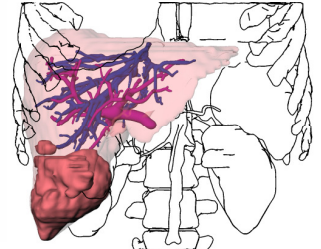
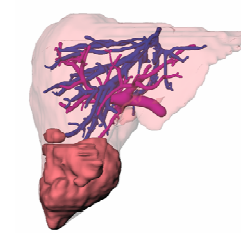
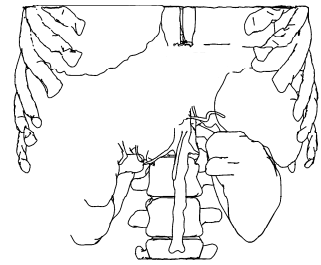
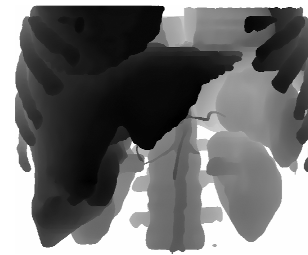
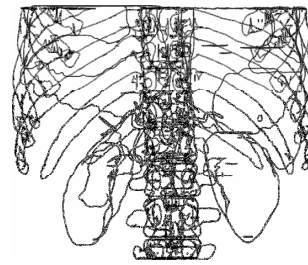
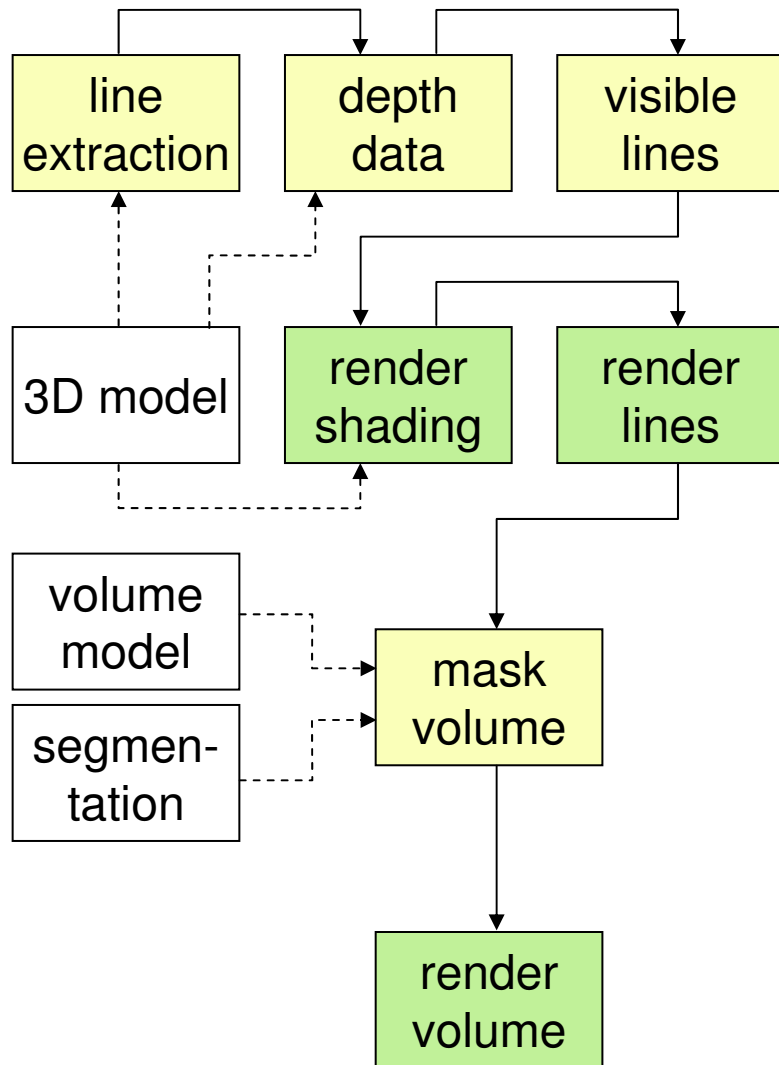


Combination of the Rendering Methods

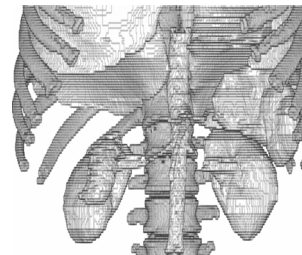
- Conventional rendering (surface shading)
- Illustrative rendering (silhouettes and feature lines)
- Direct volume rendering (DVR)



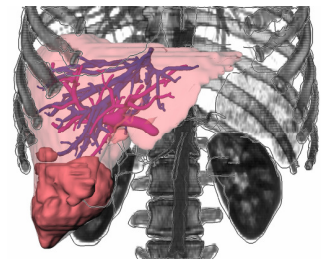
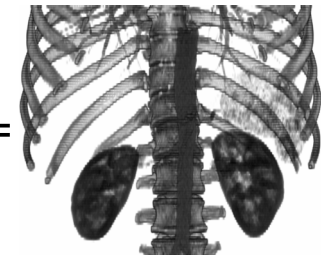
Combination of the Rendering Methods



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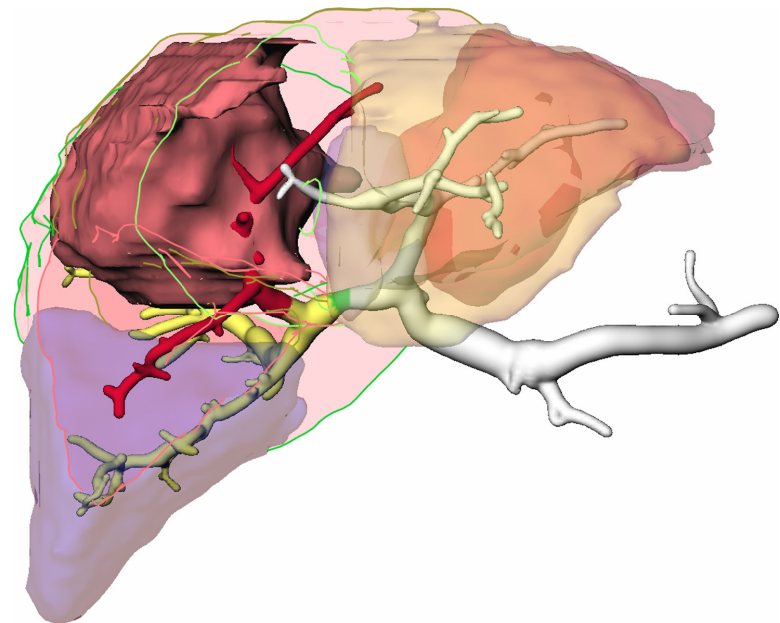
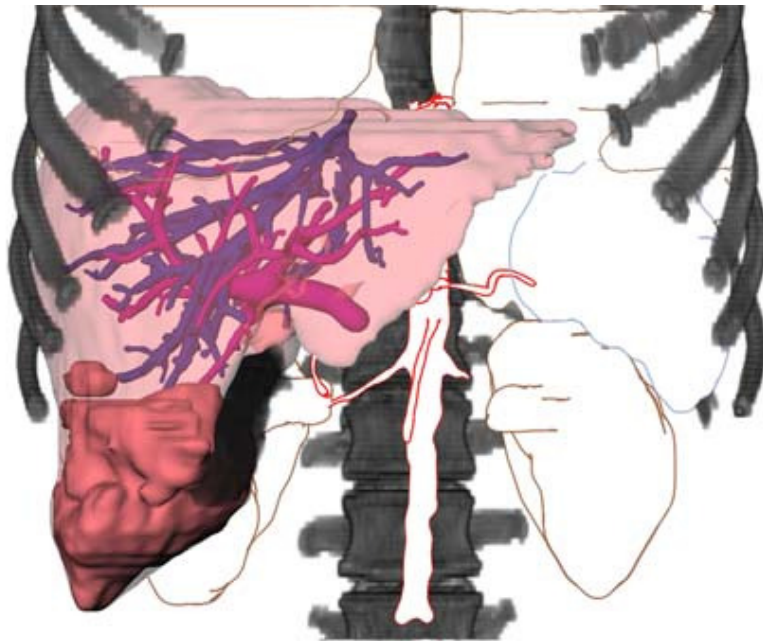


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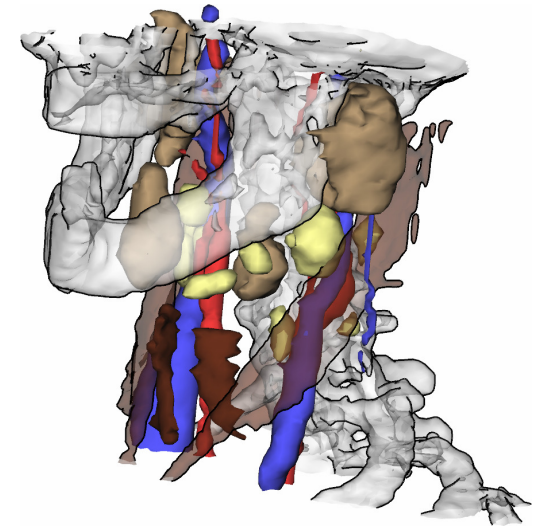
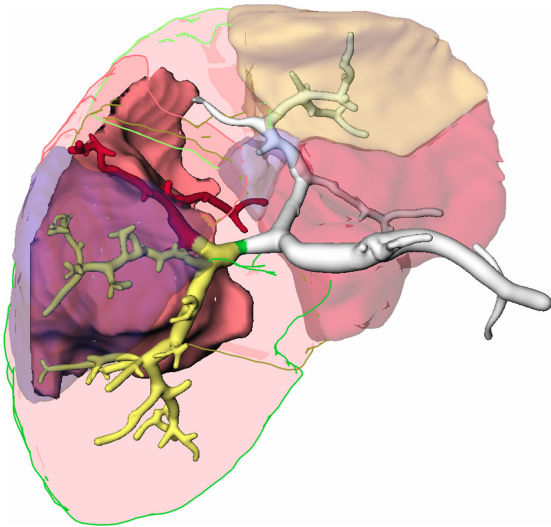
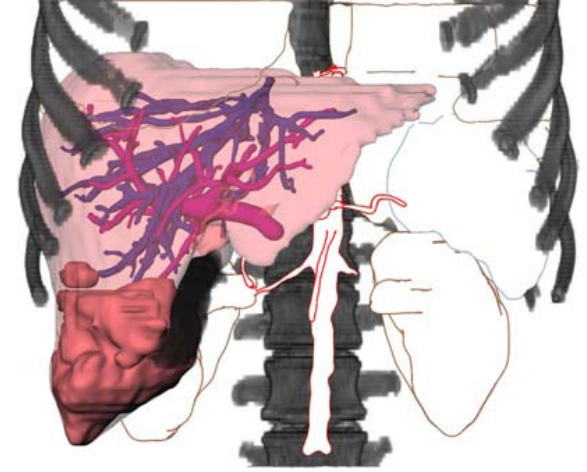
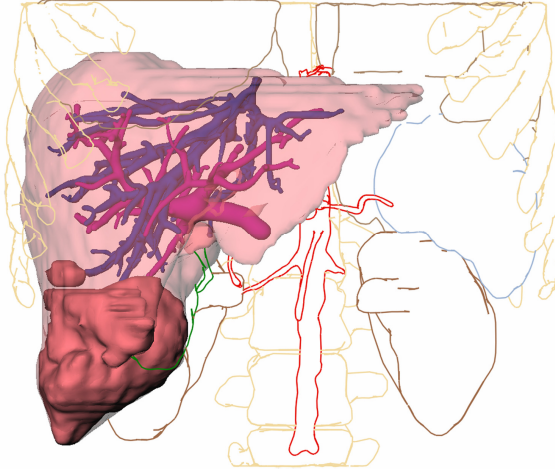
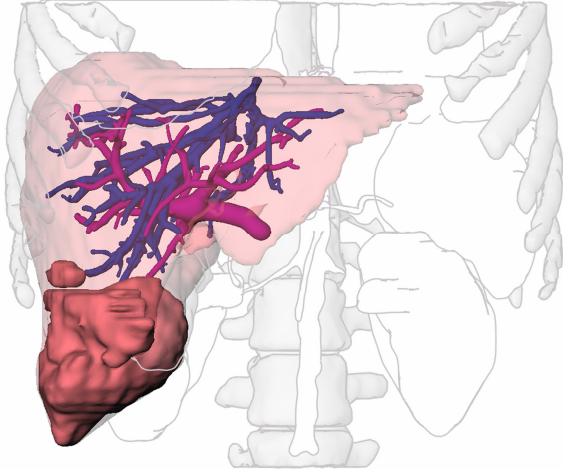
Combination of the Rendering Methods

- Improved context visualization
- More comprehensible renditions
- Classification in focus object, near focus object and context objects



Combination of the Rendering Methods

Visualization examples

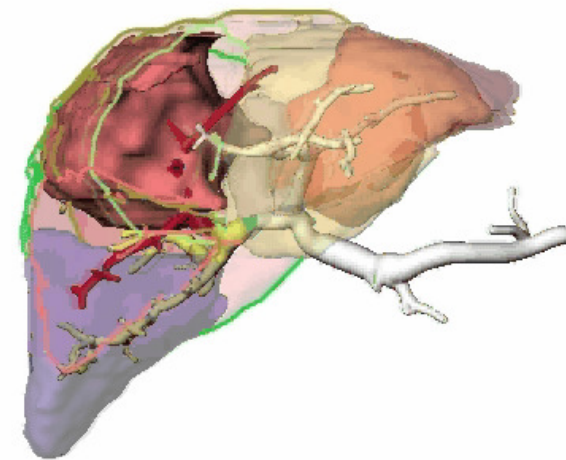
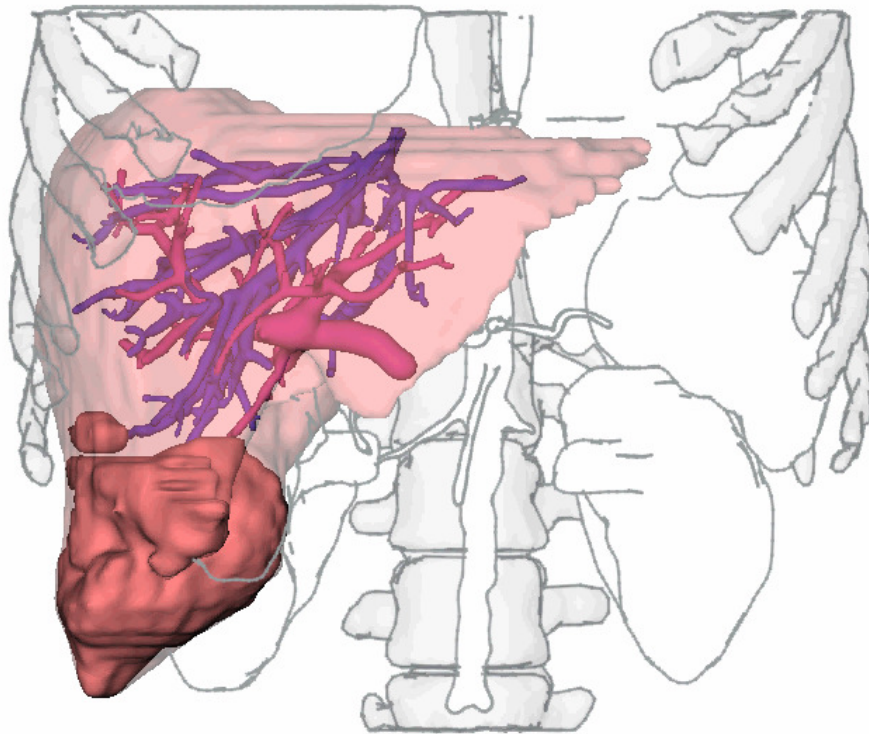


Combination of the Rendering Methods

- Automatically adding depth cues to the lines



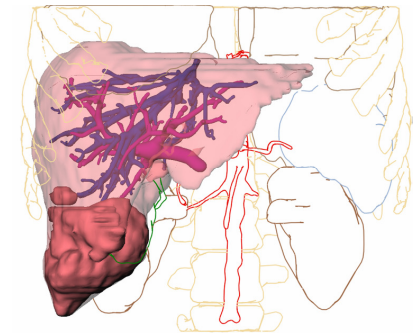
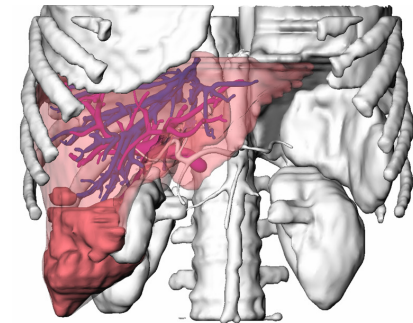
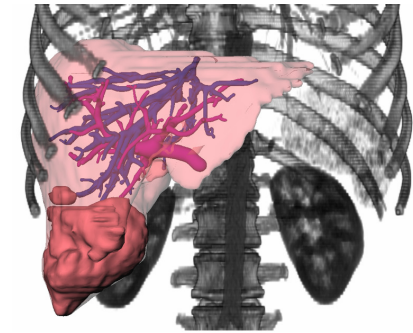
Combination of the Rendering Methods



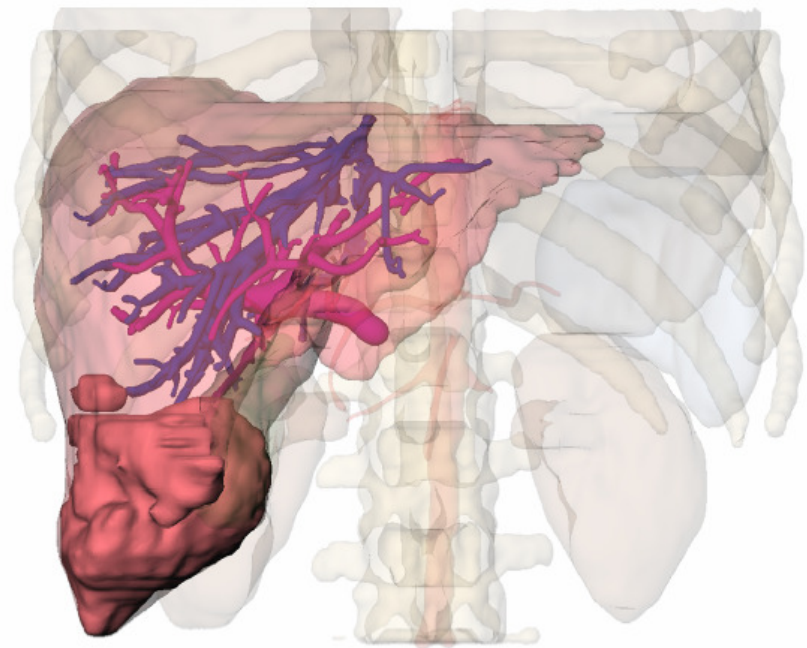
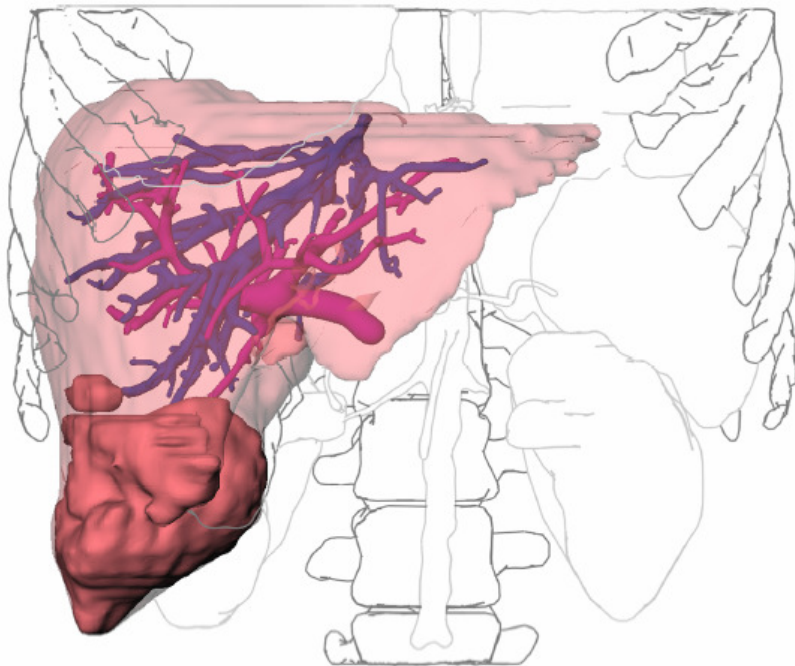
Evaluation

Is the application of illustrative techniques suitable for medical visualization?

- Informal user study (8 surgeons, 12 lay people, 13 CG researchers)
- Context visualization
- Simplifying complex visualizations
- Analysis by decision tree
 - Reference image was compared with all other images
 - Number of votes was counted



Evaluation



Welches Bild gefällt Ihnen auf den ersten Blick besser?

Auf dieser Seite geht es um die direkte Gegenüberstellung der beiden Visualisierungstechniken.

Wie gut ist die Leber von den umgebenden Strukturen zu unterscheiden?
(gar nicht (--)) bis sehr gut (++)

Können Sie die Lage der Leber zum Brustkorb einschätzen?
(nein, überhaupt nicht (--)) bis ja, sehr gut (++)

Wie gut sind die extrahepatischen Strukturen untereinander differenzierbar?
(gar nicht (--)) bis sehr gut (++)

Mit welchem Bild würden sie sich auf eine Tumorresektion vorbereiten wollen?

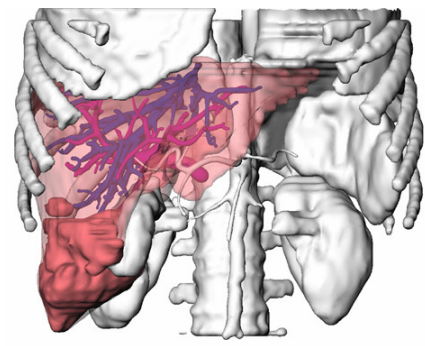
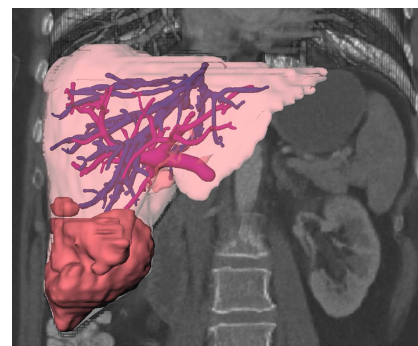
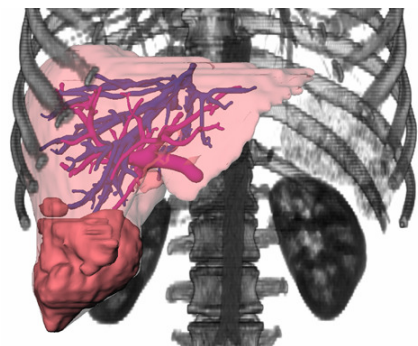
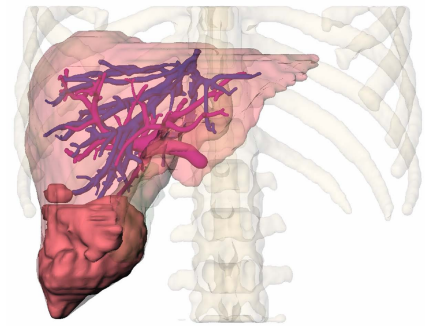
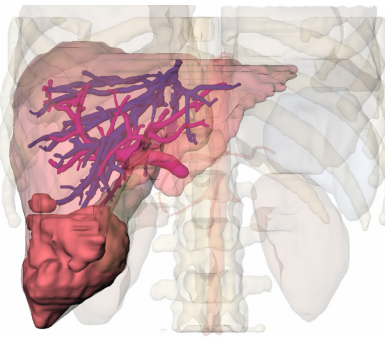
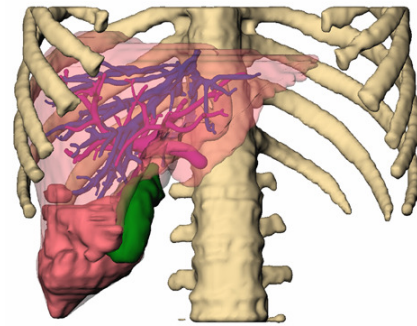
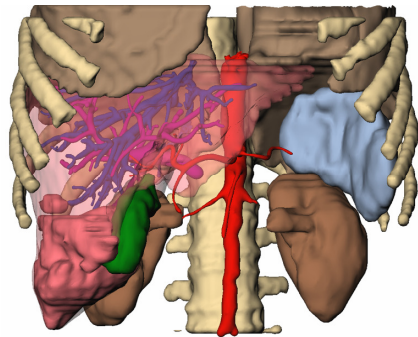
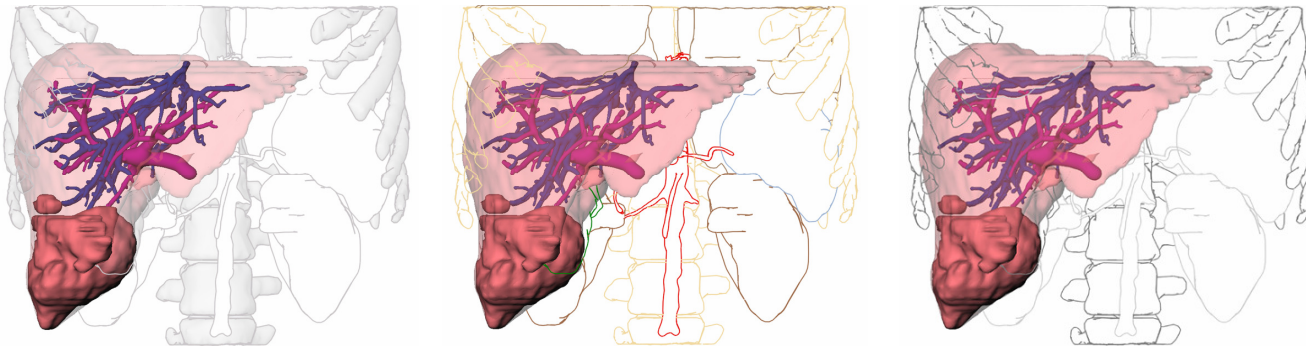
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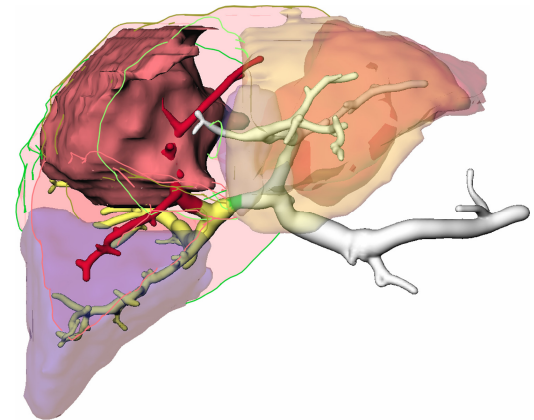
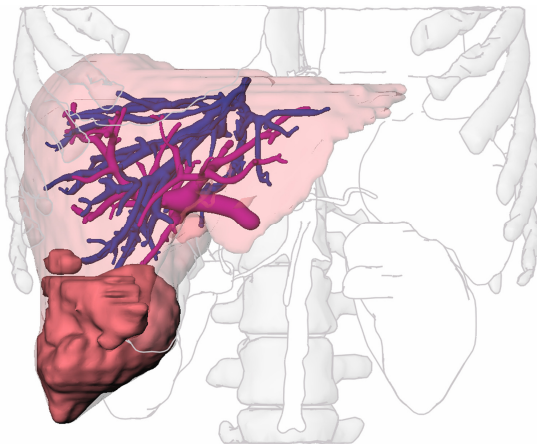
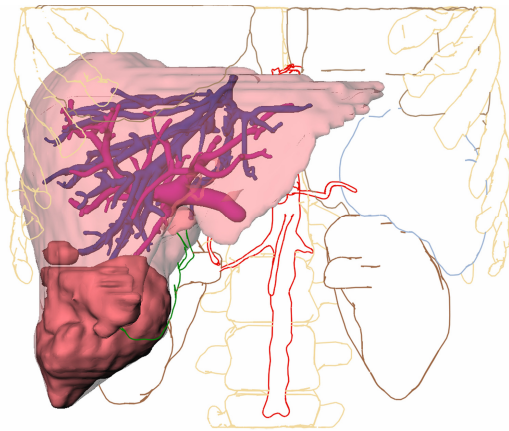
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Evaluation: Compared Visualizations



Evaluation: Interpretation

- In general, less context information is preferred
- Basic information about all objects is necessary
- b/w-silhouettes are not sufficient for displaying context
- Emphasize affected vascular territories using silhouettes regarded as appropriate by six of eight surgeons



Conclusion

- Method to enhance visualizations by combining surface shading, silhouettes, and volume rendering
- Visualizations from actual data sets
- Automatic removal of self-occluding lines
- Interactive presentation possible
- Evaluation by surgeons and lay people
 - Application of illustrative techniques was assessed as helpful
 - Illustrative techniques cannot replace but enhance conventional rendering techniques

Future Work

- Improve technical quality of illustration techniques
- Integration of further illustration techniques
 - Hatching
 - Stippling
- Continue evaluation of computer-generated visualization techniques
- Derive requirements from illustrators/graphic designers for the tools we create

Thank you for your Attention!



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