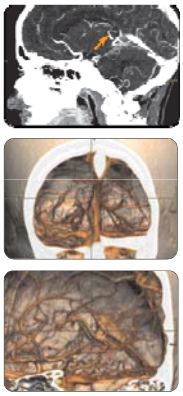


Visualisation using Knowledge Assisted Sparse Interaction

Eduard Gröller

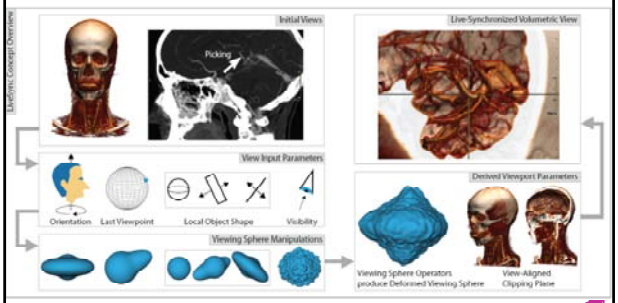
Institute of Computer Graphics and Algorithms
Vienna University of Technology

Overview of Presentation

- Knowledge-Assisted Visualization
  - LiveSync: Knowledge-Based Navigation
  - Contextual Picking
  - Knowledge-Assisted Sparse Interaction
  - Semantics Driven Illustrative Rendering
- Smart Super Views

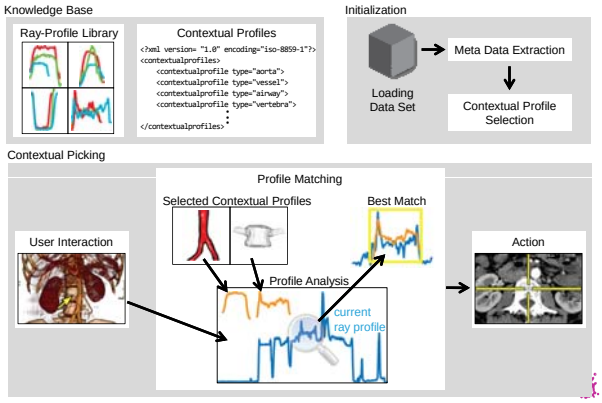
LiveSync: Knowledge-Based Navigation

- Interaction with 2D slices
- Automatic generation of expressive 3D views

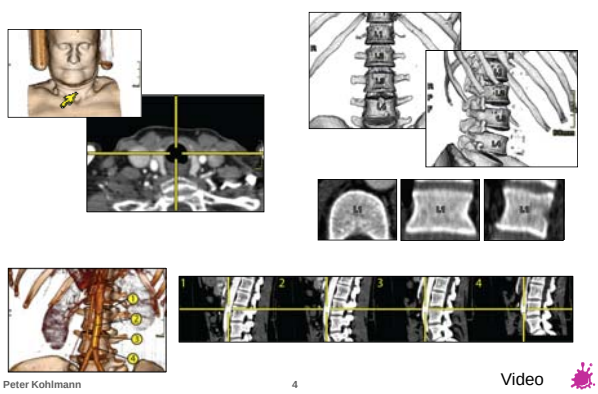


 Video

Contextual Picking - Overview



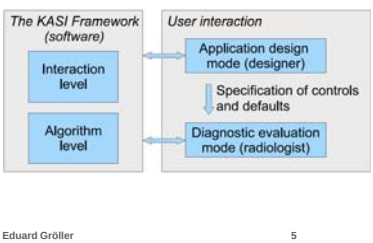
Contextual Picking - Results

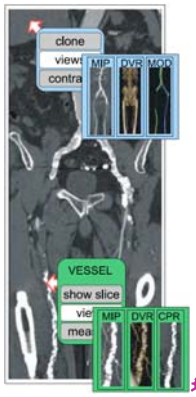


 Video

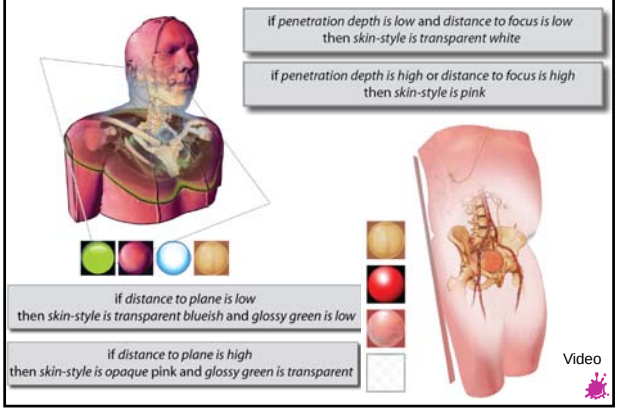
KASI Project

- **K**nowledge **A**ssisted **S**parse **I**nteraction for Peripheral CT Angiography





Semantics Driven Illustrative Rendering



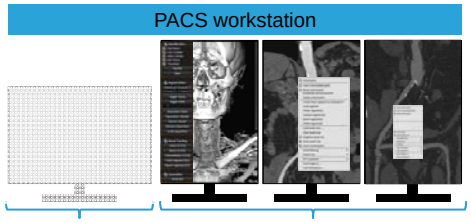
Video

Overview of Presentation

- Knowledge-Assisted Visualization
  - LiveSync: Knowledge-Based Navigation
  - Contextual Picking
  - Knowledge-Assisted Sparse Interaction
  - Semantics Driven Illustrative Rendering
- Smart Super Views

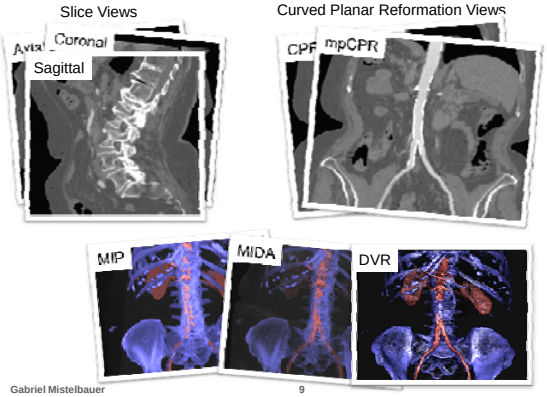
Smart Super Views - Motivation (1)

- A Knowledge-Assisted Interface for Medical Visualization



- Additional monitor
- Internet connection
- Supporting
- Diagnostic monitors
- Predefined set of visualizations
- User must choose

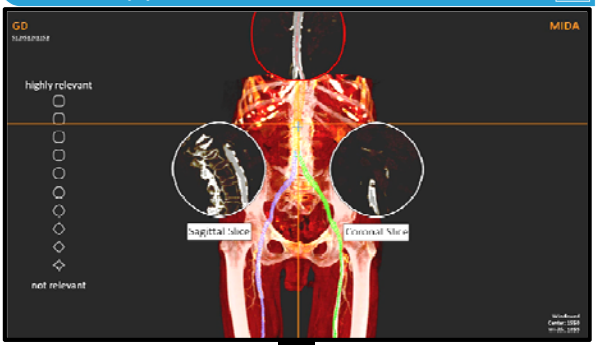
Smart Super Views - Motivation (2)



Smart Super Views - Motivation (3)

- Currently
  - a lot of views
  - always shown, even if not applicable
- Goals
  - only relevant views
  - shown if suitable

Outline (1)



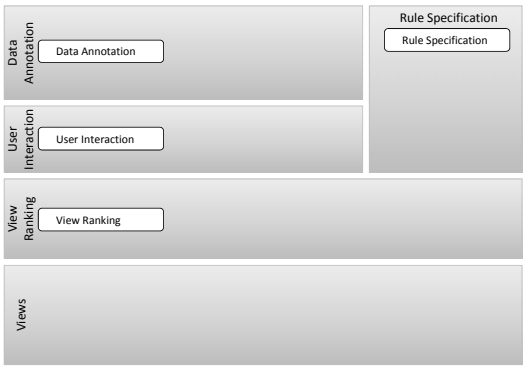
Video

Outline (2)

- Views depend
  - on user interaction
  - on the region under the cursor
- Views interactively provided
- Selection of a view for detailed inspection

➡ **Image becomes the user interface**

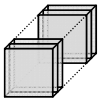
Smart Super Views



Smart Super Views

Data Annotation (1)

CTA
- Computed Tomography Angiography
- Contrast agent for vessel enhancement
- Data set consists of slice images

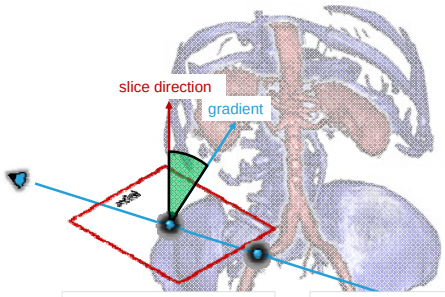


512 x 512 x 1500

Mask Information
- Vessel & bone masks
- Defined by radiological assistants

Vessel Tree Information
- Acyclic graph
- Edges are segments between branchings
- Segments can be selected
- Defined by radiological assistants

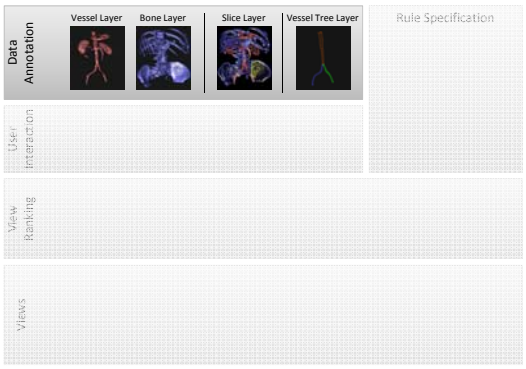
Data Annotation (2)



if dot(gradient,direction) = 0
⇒ gradient lies in slice plane
⇒ slice is highly relevant

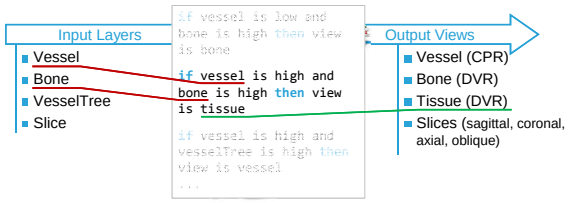
Store depth of first hit with masks
⇒ vessel mask depth layer
⇒ bone mask depth layer

Smart Super Views



Rule Specification (1)

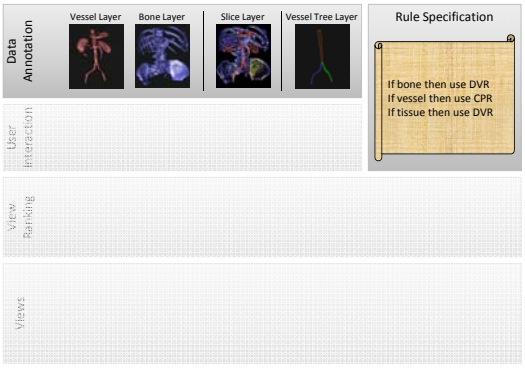
- Relations between input and output
- User-defined rules
- If-then clauses



Rule Specification (2)

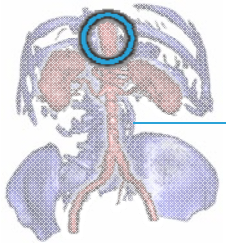
- Rules stored in an external file
- Adapted to specific demands of users
- Defined by domain experts
- Flexible extension by adding new rules
- Human readable form

Smart Super Views



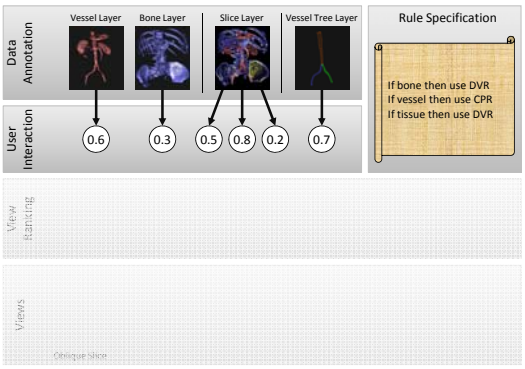
User Interaction

- User defines a ROI by moving the mouse
- Compute input values for all variables
- Layers are used inside the ROI



- One value for every input variable
- Sum over all pixels inside the ROI
- Pixels weighted with distance to center
- Specific layers for input variables

Smart Super Views

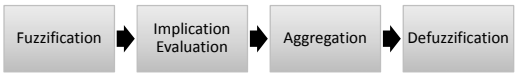


View Ranking

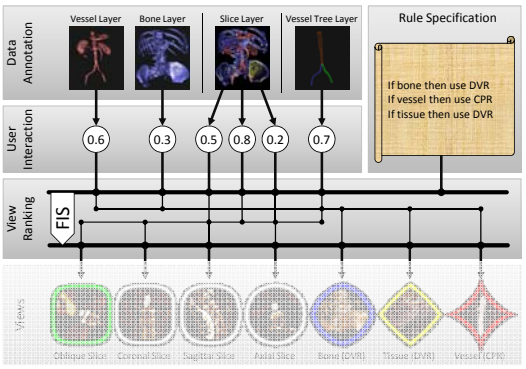
- Fuzzy logic for the inference system

⇒ Fuzzy Inference System

⇒ Fuzzy rules specified by domain experts

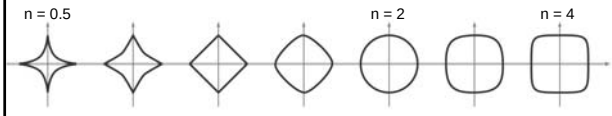


Smart Super Views



Visual Mapping (1)

- Super ellipse



- Various shapes with one parameter
- View relevance mapped to the exponent
- Highly relevant views are
  - bigger
  - rectangular

Visual Mapping (2)

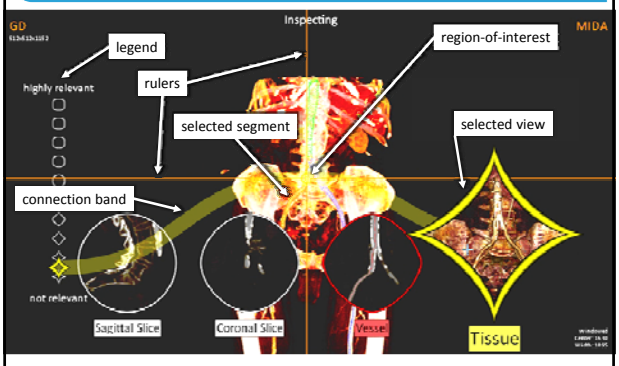
Shape mapping function
- Avoid very thin star shapes
- Cover most dominant shapes (rectangles, circles, stars)

$$\left|\frac{x - x_{pos}}{size}\right|^{m(rel)} + \left|\frac{y - y_{pos}}{size}\right|^{m(rel)} \leq 1$$

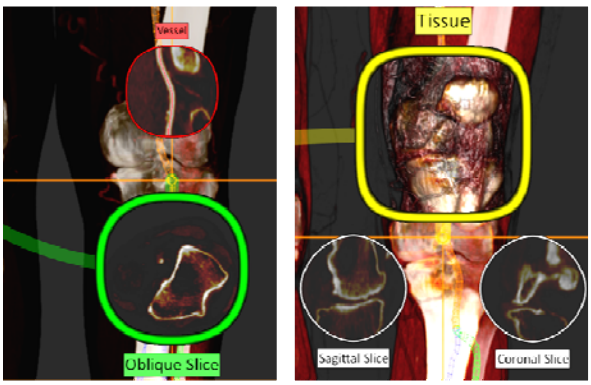
Size of view in pixels
- Increased if view selected

Results

Results (1)



Results (2)



Video

Smart Super Views - Conclusion

- Provide intelligent views
- Image becomes the user interface
- Deployable as an addition to the PACS workstation
- Applicable to other scenarios
  - Geo maps
  - CAD programs

Thank You ! - Questions ?

Acknowledgments

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Milos Sramek

Feedback

Feedback

- Smart Super Views provide
  - only relevant views
  - more interaction than static images (seen as fairly easy)
  - intuitive discrimination of views (with basic knowledge of underlying algorithms)
- Interaction: zooming, rotating, panning, windowing function, transfer function
- Additional view in a radiologists workflow

Scenarios (1)

- MIP or CPR solely not sufficiently accurate
- Some pathologies might remain unrevealed
- Most accurate is MIP + axial slices
- Provided by defining proper rules
- Axial slice image always highly relevant when using MIP or CPR

Scenarios (2)

- Interdisciplinary medical discussion rounds
  - Radiologist
  - Clinician
  - Surgeon
- Different requirements and perspectives
- Encoded within specific rules

Conclusion

- Provide intelligent views
- Image becomes the user interface
- Deployable as an addition to the PACS workstation
- Applicable to other scenarios
  - Geo maps
  - CAD programs

Motivation (1)

Office – Ribbon

Photoshop – Main Menu

Popup Menus

Control Panels

Results (2)