MedVis-Questions:

Imaging

What types of medical image data you know? Why there are different medical imaging techniques? What are their advantages/disadvantages and applications? What is their spatial resolution

I will not ask about the physical processes, principles and about specific artifacts. It is sufficient for this lecture to have a black box understanding.

If necessary use the lecture slides on image acquisition

Image Processing

Name a few methods for segmenting medical image data? How segmentation methods can be assessed and compared? Name two methods for vessel segmentation. What is centerline extraction? Name one method and explain briefly how it works.

I will not ask details about special cases when centerline extraction may fail or may get inaccurate.

If necessary use the lecture slides on image processing.

Radiology/Nuclear Medicine/Radiation Treatment

Describe briefly how a radiologist and a nuclear medicine specialist works, which information she uses and which results they produce.

What is radiation treatment planning? What needs to be simulated and visualized?

What is the role of 3D visualization and of 2D visualization?

Surface Rendering

What is the standard method to transform segmented or raw medical volume data to surfaces?

Which improvements exist w.r.t. processing speed and quality of results?

Name some strategies to smooth surface visualizations? How they can be assessed? Explain one of them in detail. Why shrinkage often occurs in smoothing?

In medical visualization, we are interested in high accuracy and easy-to-interpret (smooth) visualizations. How can we achieve a good trade-off between these conflicting goals.

Volume Rendering

Raycasting is a frequently used method for medical volume rendering. How does a basic raycaster works (without shadow computation or any advanced effects)?

Name two acceleration strategies.

There are two variants how to combine classification and interpolation. Discuss their advantages/disadvantages.

Which effects can be added to improve spatial perception? Explain one of them, i.e., describe an algorithm. // Shading, depth cueing, shadows, scattering, global illumination

For shading a surface normal is required. How can we approximate something similar in volume rendering?

Describe some strategies for transfer function design. What is the motivation for multidimensional transfer functions? What are specific examples?

Transfer Functions

Which context information is essential for adjusting TFs? Why it is so difficult to create TFs for rendering MRI data? Which advanced TF methods you know? // Gradient-, curvature-, size-based-, stroke-based, distance-based

How to efficiently apply a TF? // Lookup-Table

Does this also work for 2D TFs?

Multimodal Medical Visualization

Discuss the need for the integrated visualization of two datasets with examples.

Discuss strategies for the integrated slice-based visualization. Consider the use of colors.

Discuss strategies for integrated 3D visualizations. Consider occlusion problems and possible remedies. Consider transfer function design. What is a „visibility transfer function“?

Interaction

Name and describe frequent interactions to explore medical volume data.

How measurements can be integrated in medical visualizations? What has to be considered?

Basic clipping is restricted to planar clip geometries. Discuss an example that goes beyond this simple strategy.

What is selective clipping?

Vessel Visualization

Describe different tasks where vessel visualization is essential. Explain MIP, CVP and MPR.

Which model-based surface visualizations do you know? Explain one of them? What are possible applications?

Virtual Endoscopy

Explain the basic principle of virtual endoscopy. Compare virtual and real endoscopy. How can we assess the performance of a virtual endoscopy system, e.g. in virtual colonoscopy. How virtual endoscopy can be used for therapy planning?

Which rendering techniques are used in virtual endoscopy?

General

Your task is to design a system for path planning, e.g. biopsy planning or tumor ablation. Which image modality is used? Which features need to be included? Therapy planning is about reducing risks. Which risks may occur and how to reduce them? A short path is typically better than a longer one. In which cases longer paths are preferred? Which information should be visualized? Which visualization and interaction techniques should be applied? Which quantitative analysis techniques may be provided?

Which questions would you ask a physician to better runderstand the task.

Your task is to design a system for surgery planning, e.g. surgery of liver, lung, kidney or prostate. What needs to be segmented? Which information needs to be displayed? How would you visualize it? Which interactions are useful to explore and measure the data?