

Re-Exam in Scientific Visualization, Fall 2012

1TD389

Time and Place: 8:00 – 13:00, Monday January 14, 2013, Polacksbacken (Skrivsal)

Instructions:

- Only paper, pen(cil), erasers, rulers, and dictionaries are allowed.
- Calculators are not allowed.
- Check that you have received the correct exam.
- The cover sheet shall always be filled in and returned, even if no exam questions have been answered.
- Write your name or code on all papers you hand in.
- Do not use ink.
- Start on a new paper for each question.
- Write only on one side of each paper.
- Sort the answer sheets in the order of the questions before you turn them in.

Grades (bonus points not accounted for): 3: 20pts; 4: 28pts 5: 36pts

1. Basic Concepts of Rendering and Visualization

(5p)

- a) The *Phong*-model is a very central model in graphics/visualization to model illumination and reflection of light. Describe verbally and with equations the different components in the *Phong* reflection model and what parameters affect them. (2p)
- b) Briefly describe how texture mapping works. Explain why and how texture mapping is useful for visualization of 3D scalar data! (3p)

2. Visual data exploration by probing

(5p)

- a) Describe the different steps involved in the process of *probing* in visualization! (2p)
- b) Briefly describe one example of *probing* of your own choice and use a graphical illustration of it! (1)
- c) What is the main purpose of *probing*? (1p)
- d) Describe potential problems with *probing*! (1p)

3. Vector field visualization

(5p)

- a) Briefly describe the visualization techniques *Streamlines*, *Particle Tracing* and *Streaklines* and point out their major difference! (3p)
- b) Describe how vector magnitude can be graphically encoded in *Streamlines* and discuss potential limitations of this! Discuss why *Hedgehogs* could provide a better graphical representation of vector fields if the assessment of vector magnitudes is of interest! (2p)

4. Direct Volume Rendering

(5p)

- a) Explain the principles of *ray-casting* and *splatting* in direct volume rendering! (2p)
- b) In context of *splatting* discuss the relation between *footprint* of a voxel and screen resolution and how visual artifacts can be avoided! (2p)
- c) For what kind (in terms of the content) of data sets is *splatting* a more efficient rendering technique than *ray-casting* from a performance (runtime) point of view? (1p)

5. Perceptual aspects in visualization (5p)

- a) Describe what *circular receptive* fields are and their role for the perception of contrast! (2p)
- b) Briefly discuss what is important to consider when color is used
 - as a label in visualization
 - to visually map quantitative information
 - to present fine detailed structures on a background(3p)

6. Iso-surfaces (5p)

- a) What is an iso-surface and give an example of what it can be used for? (3p)
- b) What is an ambiguity in context of iso-surface reconstruction and what method for creating iso-surfaces avoids ambiguities? (2p)

7. Interpolation (5p)

- a) Why is linear interpolation performed in marching squares? Give an example showing the benefit of using it! (3p)
- b) Explain how bi-linear interpolation is different from quadratic interpolation! (2p)

8. VTK-Visualization and -pipeline (5p)

- a) Explain how the **vtkColorTransferFunction** can be used in a VTK program! What is the purpose of it and give an example when it can be used? (3p)
- b) If we want to use the color transfer function mentioned above, where in the pipeline will we connect it for your example, and using what member function? (2p)

Good luck!