

# **AMCS / CS 247 – Scientific Visualization**

## **Lecture 4: Introduction, Pt. 4**

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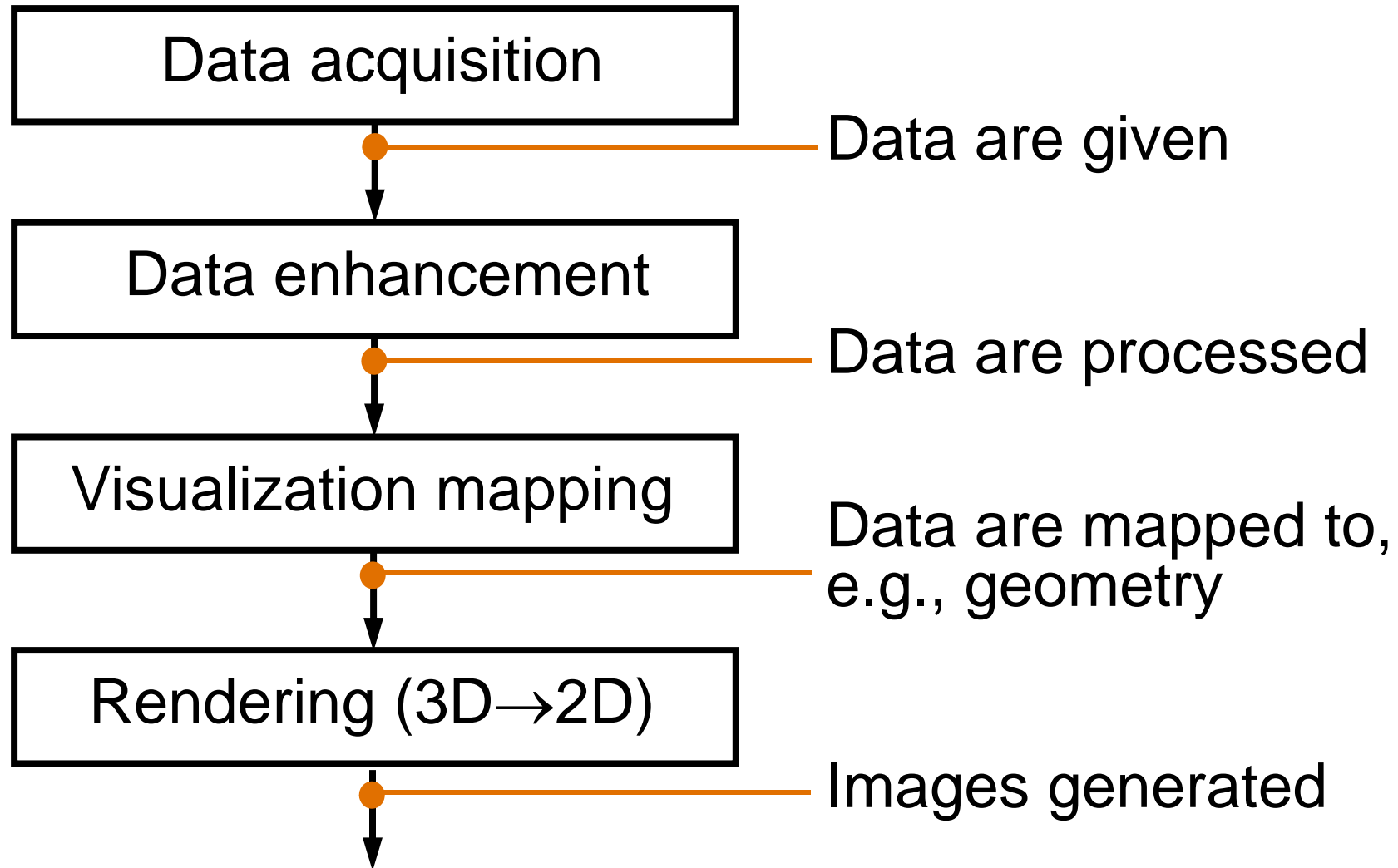
# Reading Assignment #2 (until Sep 7)



Read (required):

- Data Visualization book, finish Chapter 2
- Data Visualization book, Chapter 4 until 4.1 (inclusive)
- Continue familiarizing yourself with OpenGL if you do not know it !

# The Visualization Pipeline – Overview

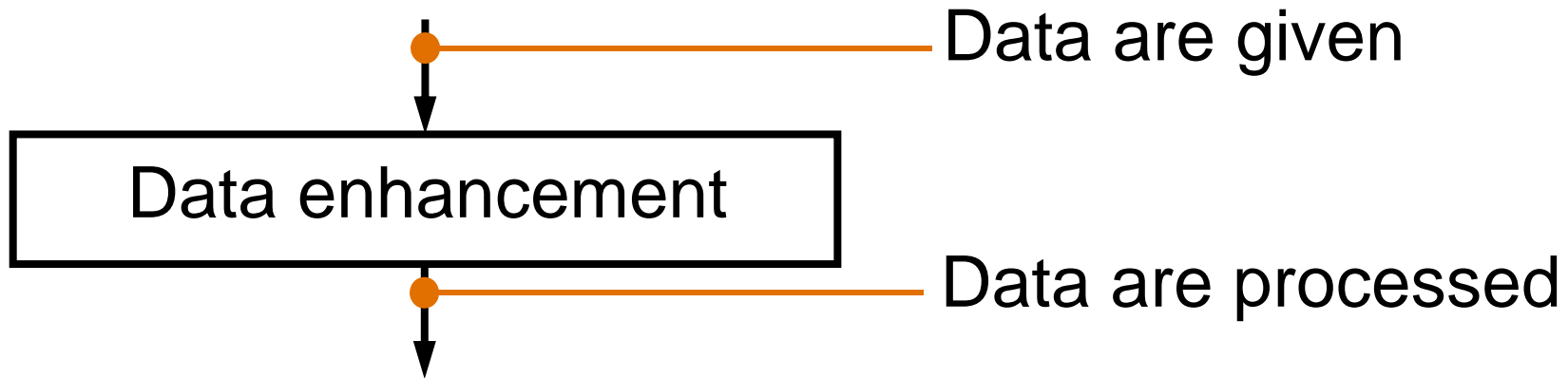


# The Visualization Pipeline – Stage 1



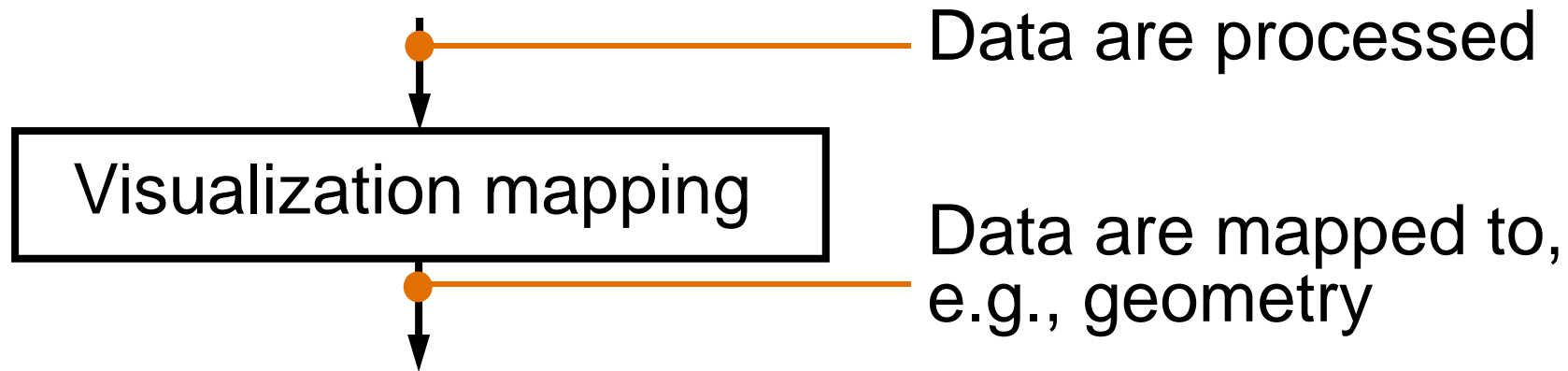
- Measurements, e.g., CT/MRI
- Simulation, e.g., flow simulation
- Modeling, e.g., game theory

# The Visualization Pipeline – Stage 2



- Filtering, e.g, smoothing (de-noising, ...)
- Resampling, e.g., on a different-resolution grid
- Data derivation, e.g., gradients, curvature
- Data interpolation, e.g., linear, cubic, ...

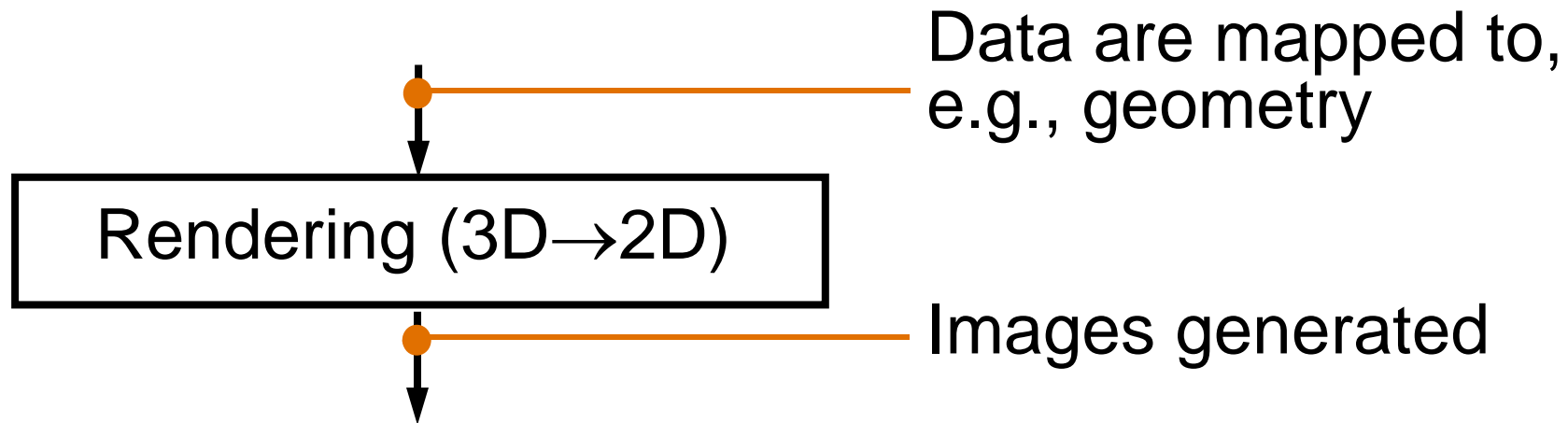
# The Visualization Pipeline – Stage 3



## Make data “renderable”

- Iso-surface calculation
- Glyphs, icons determination
- Graph-layout calculation
- Voxel attributes: color, transparency, ...

# The Visualization Pipeline – Stage 4



Rendering = image generation with computer graphics

- Visibility calculation
- Illumination
- Compositing (combine transparent objects, ...)
- Animation

# Data Generation, Visualization, Interaction



Coupling varies considerably:

- Data generation (data acquisition):
  - Measuring, simulation, modeling
  - Can take very long (measuring, simulation)
  - Can be very costly (simulation, modeling)
- Visualization (rest of visualization pipeline):
  - Data enhancement, visualization mapping, rendering
  - Depending on computer, implementation: fast or slow
- Interaction (user feedback):
  - How can the user intervene, vary parameters



# Passive Visualization



All three steps separated:

- Off-line data generation

- Measurements
- Simulation
- Modeling

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- Off-line Visualization

- Previously generated data are visualized
- Result: video or images/animation

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- Passive Visualization

- Viewing of the visualization results



# Interactive Visualization



Only data generation is separated:

- Off-line data generation

- Measurements, Simulation, Modeling

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- Interactive visualization

- Previously generated data are available
- Visualization program allows interactive visualization of the data
- Possibilities:  
choice, variation, parameterization of the visualization technique
- Nowadays widespread
- **Focus of this course!**



# Interactive Steering



All three steps coupled:

- **Interactive steering**

- Simulation and/or modelling (measuring) generate data “on the fly”

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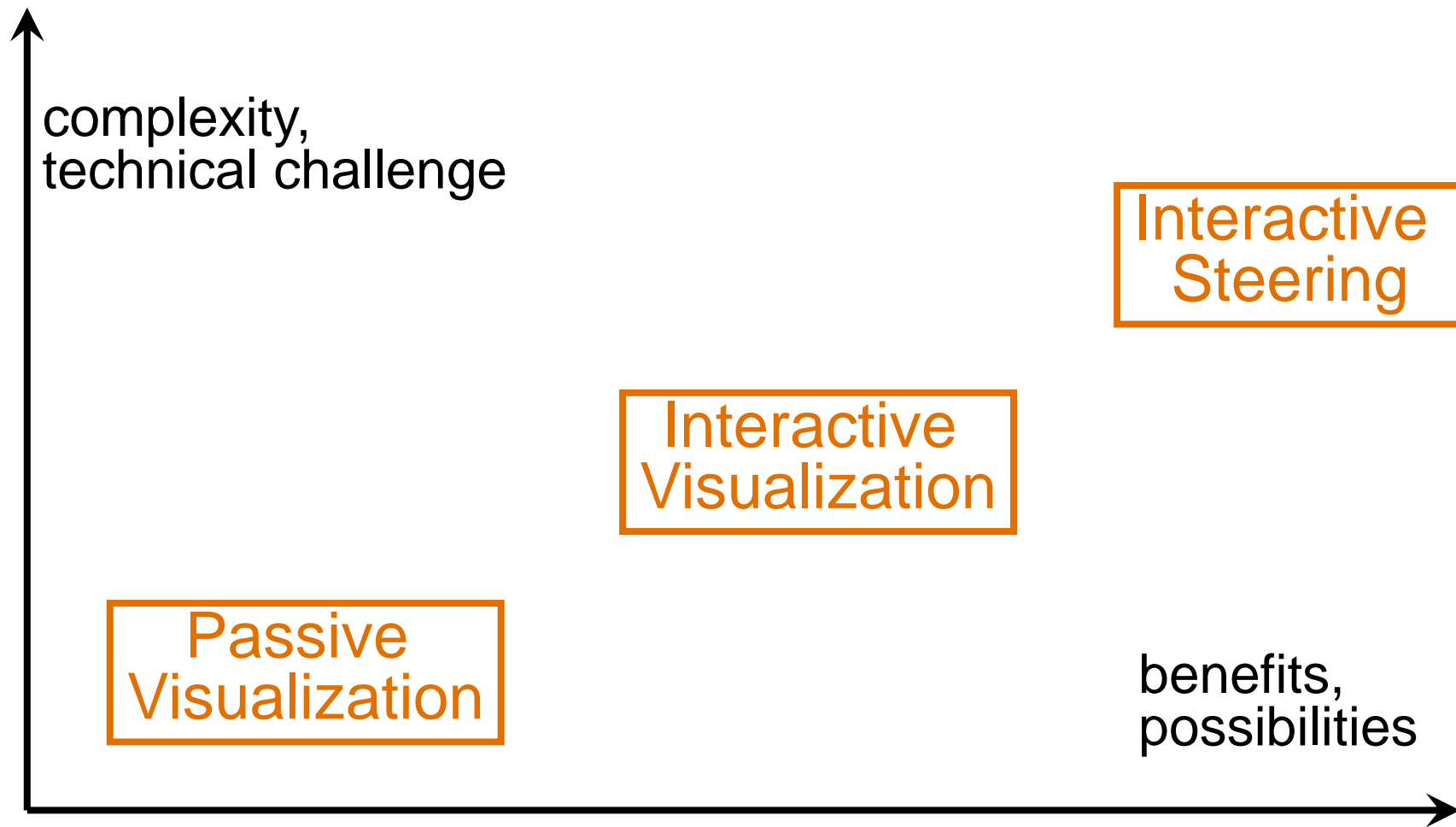
- Interactive visualization allows “real-time” insight into the data

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- Extended possibilities:  
user can interfere with the simulation and/or the modeling, change the design, ...
- Often requires lots of effort, very costly



# Visualization Scenarios



# Thank you.

Thanks for material

- Helwig Hauser
- Eduard Gröller
- Daniel Weiskopf
- Torsten Möller
- Ronny Peikert
- Philipp Muigg
- Christof Rezk-Salama