

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

## **Lecture 16: Volume Visualization, Pt. 5**

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# Reading Assignment #8 (until Oct 20)



Read (required):

- Real-Time Volume Graphics, remainder of Chapter 4 (Sec. 4.5-)
- Real-Time Volume Graphics, parts of Chapter 10:  
Secs. 10.1, 10.2, 10.3, 10.6

# Quiz #2: Oct 20



## Organization

- First 30 min of lecture
- No material (book, notes, ...) allowed

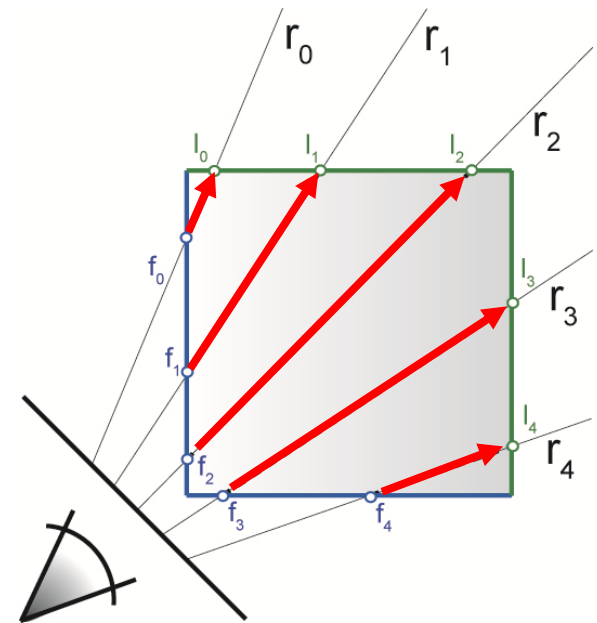
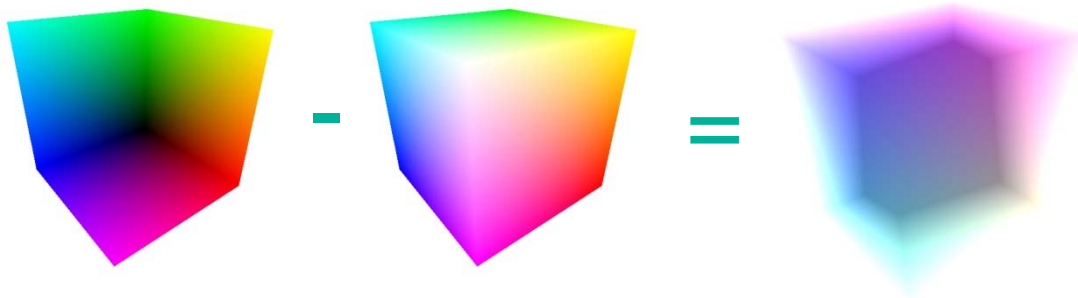
## Content of questions

- Lectures (both actual lectures and slides)
- Reading assignments (except optional ones)
- Programming assignments (algorithms, methods)
- Solve short practical examples

# Rasterization-Based Ray Setup



- Fragment == ray
- Need ray start pos, direction vector
- Rasterize bounding box

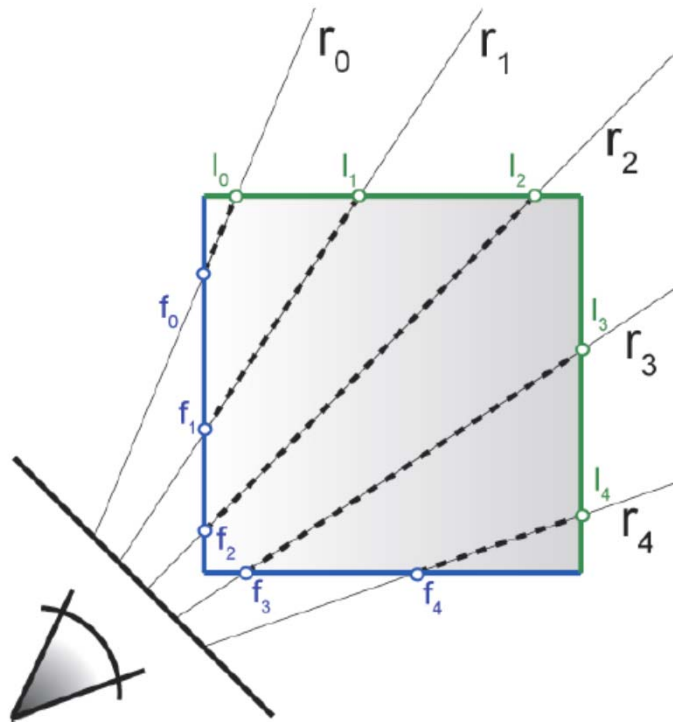


- Identical for orthogonal and perspective projection!

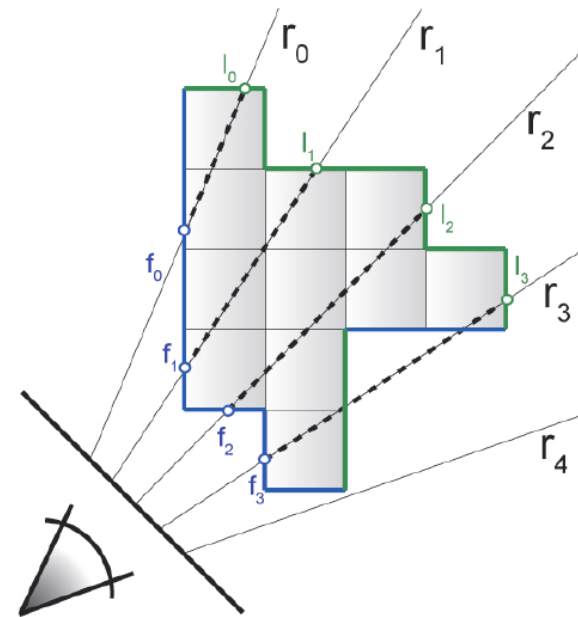
# Object-Order Empty Space Skipping



- Modify initial rasterization step



rasterize bounding box

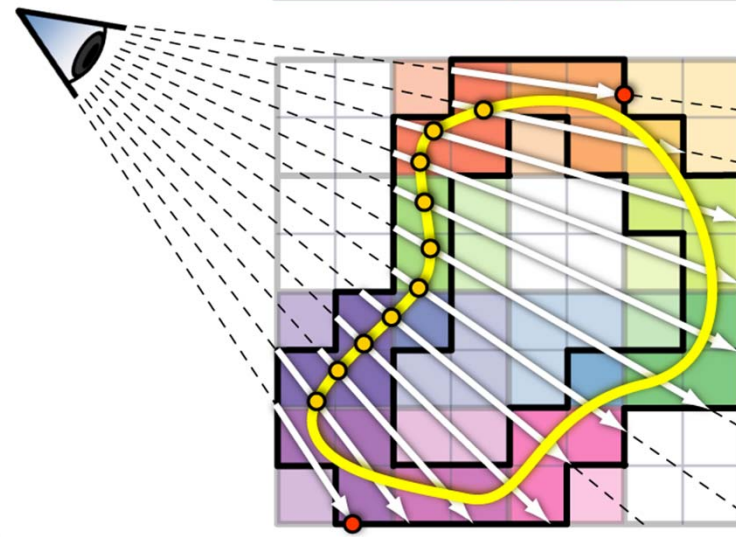
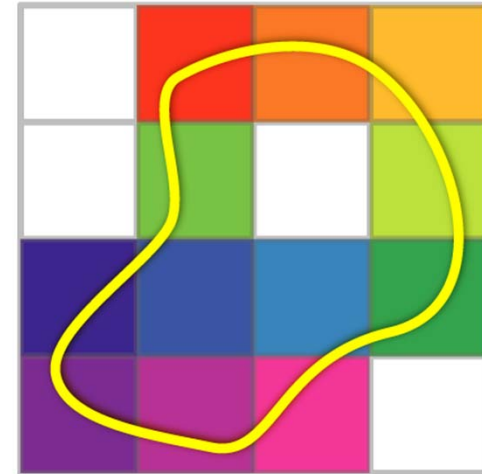


rasterize "tight" bounding geometry

# Object-Order Empty Space Skipping



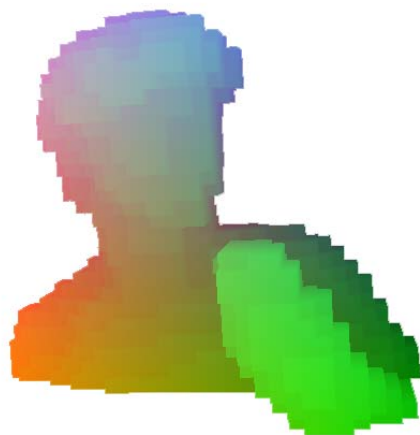
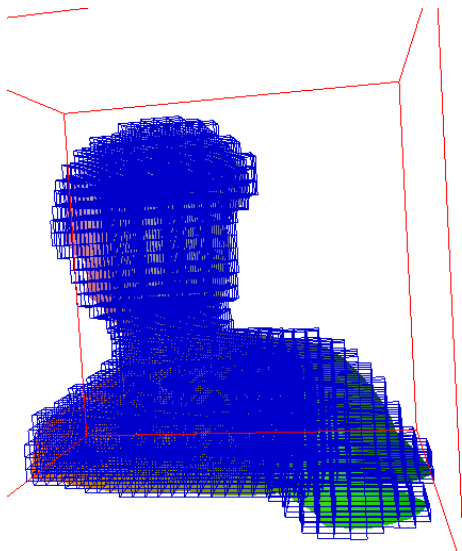
- Rasterize front and back faces of active min-max bricks
- Start rays on brick front faces
- Terminate when
  - Full opacity reached, or
  - Back face reached



# Object-Order Empty Space Skipping



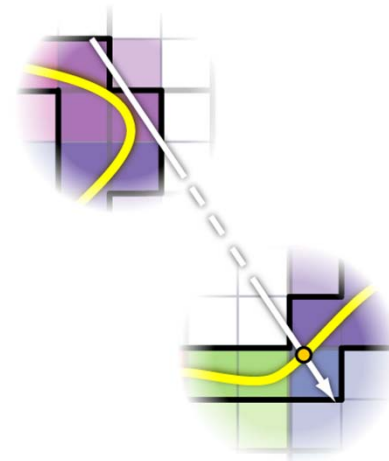
- Store min-max values of volume blocks
- Cull blocks against transfer function or iso value
- Rasterize front and back faces of active blocks



# Object-Order Empty Space Skipping



- Not all empty space skipped
  - Holes in the volume
  - Wrong active bricks





# Combination with Geometry



## 1. Render polygonal geometry

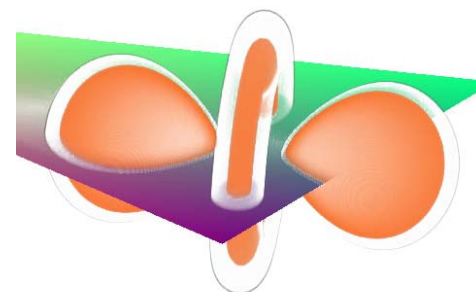
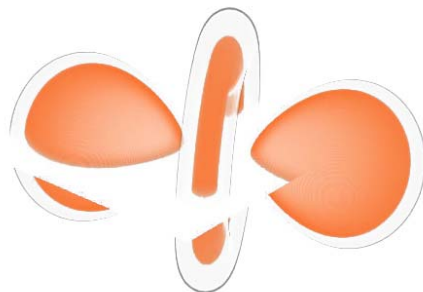
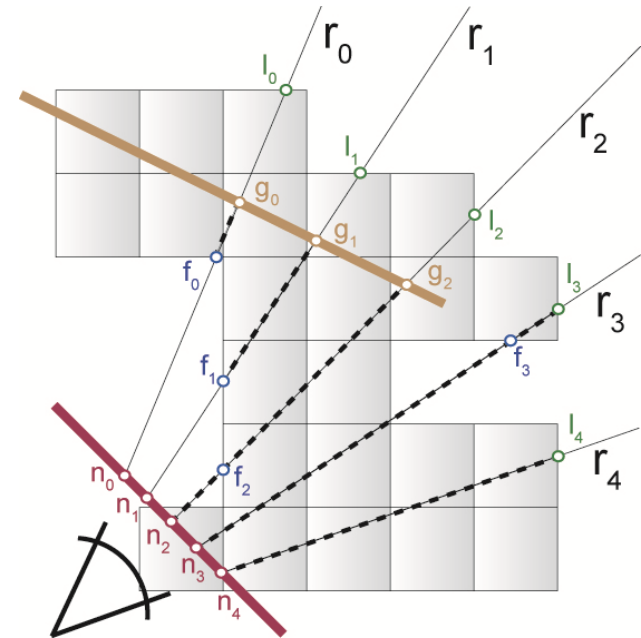
⇒ Modified ray setup

## 2. Raycasting

⇒ Compositing buffer

## 3. Blending

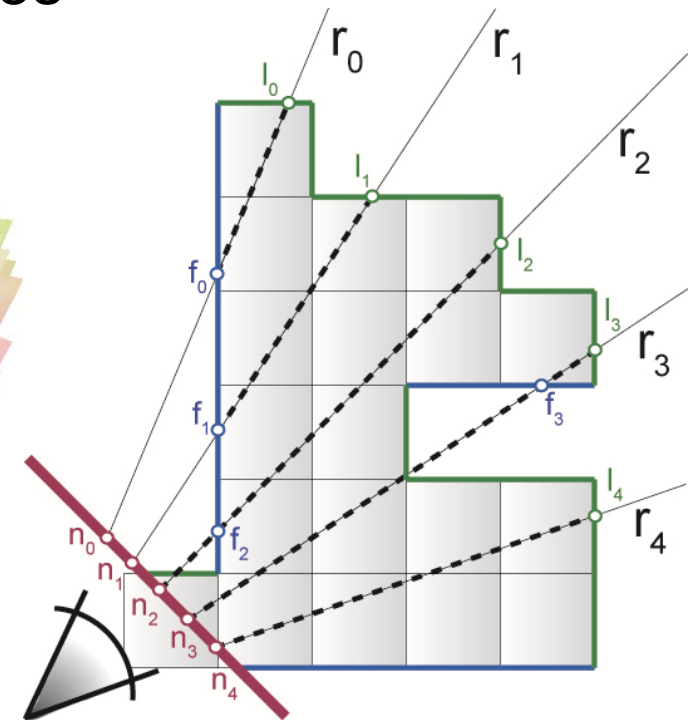
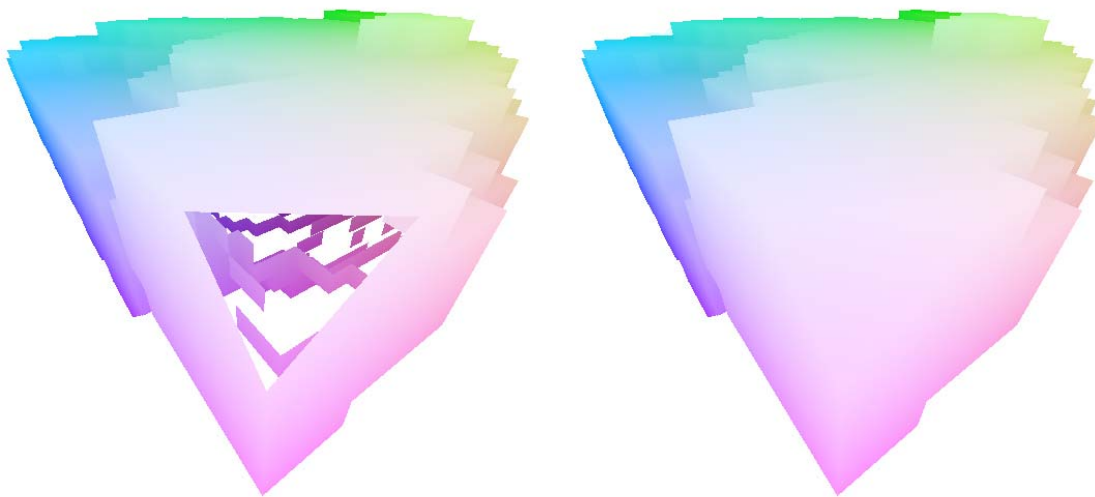
⇒ Final image



# Moving Into The Volume (1)



Near clipping plane clips into front faces



Fill in holes with near clipping plane

Can use depth buffer [Scharsach et al., 2006]

# Moving Into The Volume (2)



## 1. Rasterize near clipping plane

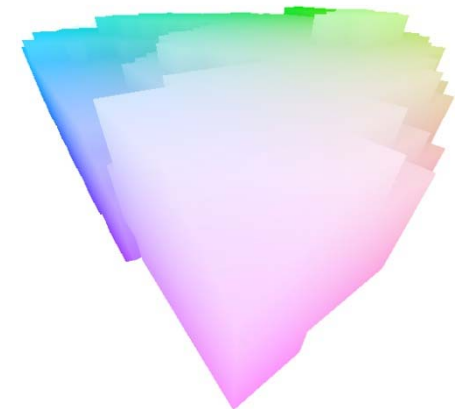
- Disable depth buffer + test, enable color buffer
- Rasterize entire near clipping plane

## 2. Rasterize nearest back faces

- Enable depth buffer + test, disable color buffer
- Rasterize (*nearest*) *back faces* of active bricks

## 3. Rasterize nearest front faces

- Enable depth buffer + test, enable color buffer
- Rasterize (*nearest*) *front faces* of active bricks



# Virtual Endoscopy



Viewpoint inside the volume  
with wide field of view

E.g.: virtual colonoscopy

Hybrid isosurface rendering /  
direct volume rendering

E.g.: colon wall and structures behind

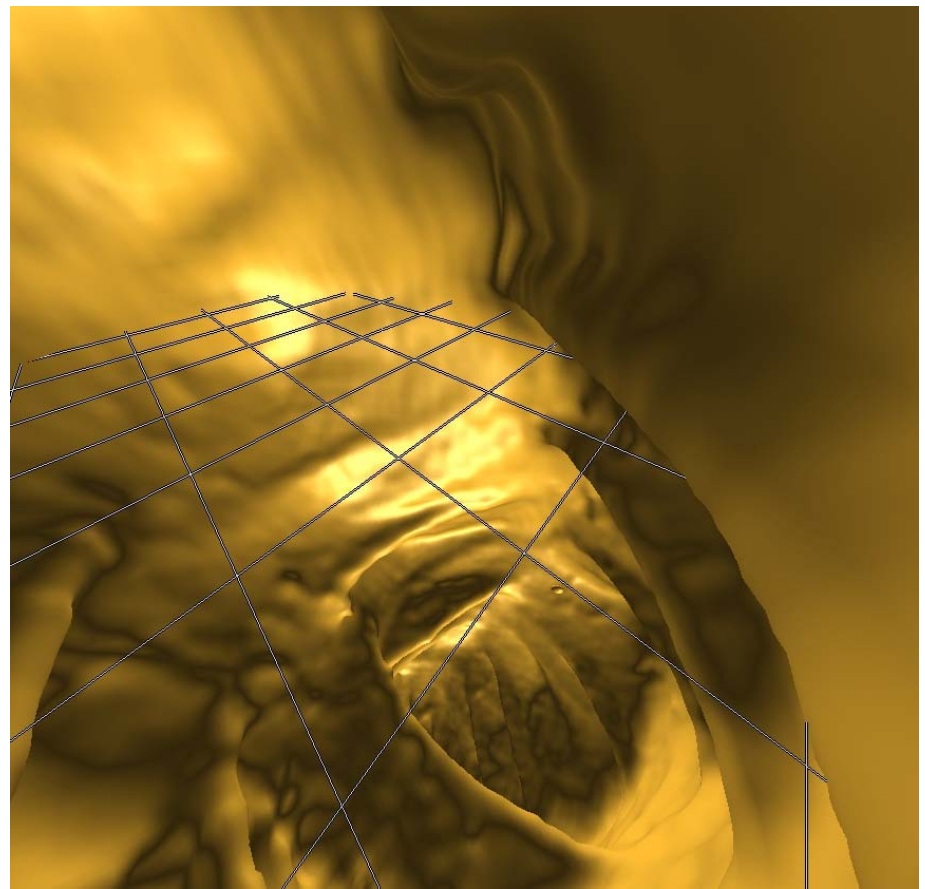
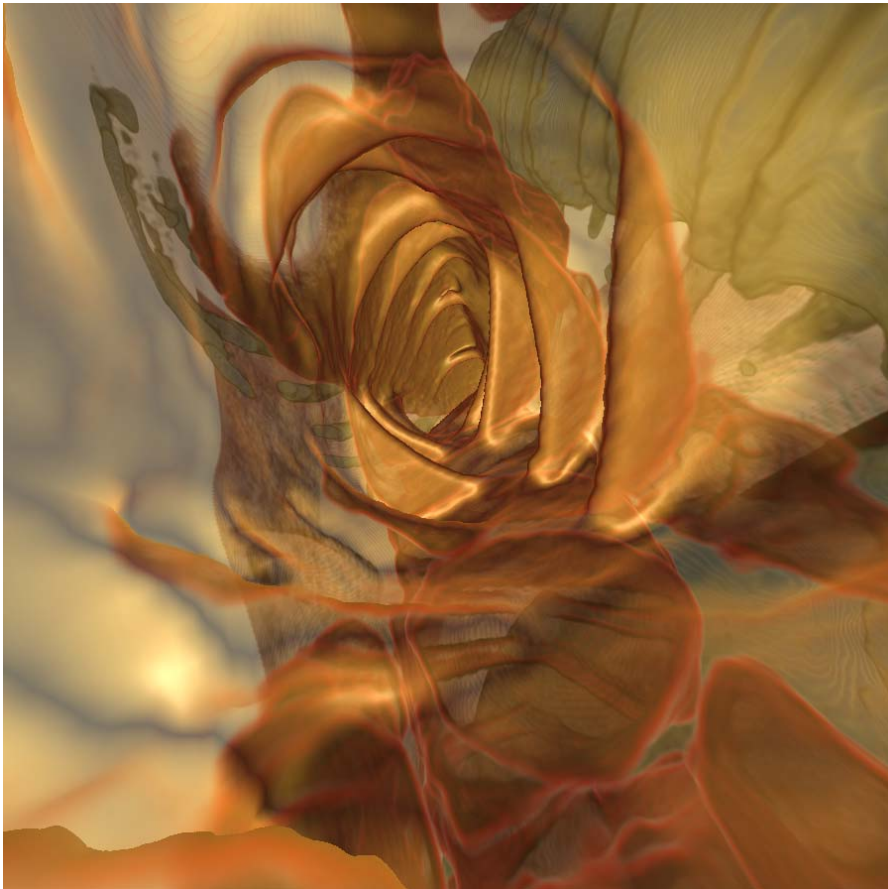




# Virtual Endoscopy



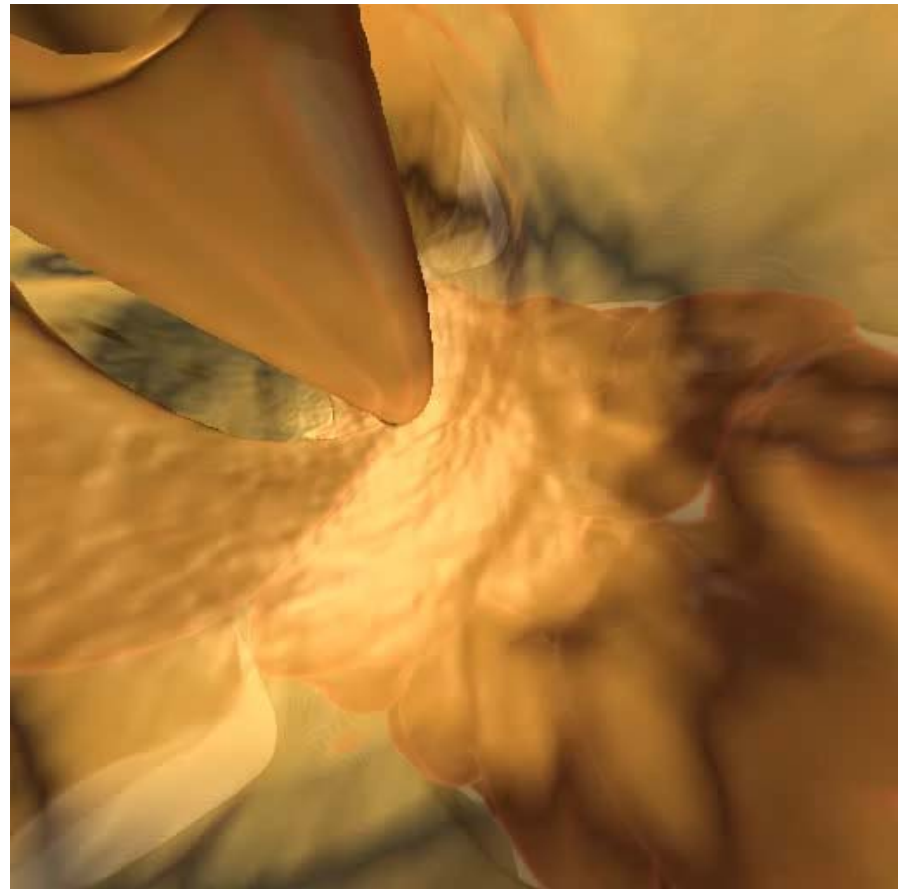
First find isosurface; then continue with DVR



# Virtual Endoscopy



First find isosurface; then continue with DVR



# Thank you.

## Thanks for material

- Helwig Hauser
- Eduard Gröller
- Daniel Weiskopf
- Torsten Möller
- Ronny Peikert
- Philipp Muigg
- Christof Rezk-Salama
- Joe Kniss, Gordon Kindlmann