# Importance-Driven Expressive Visualization

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# Motivation





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outer and inner structure



# **Traditional Illustration**





### http://www.medigraphics.com/ http://www.khulsey.com/





- Model for Importance-Driven VisualizationValidation of feature visibility
- Thesis based on publications
  - IEEE Visualization 2004
  - ◆ IEEE TVCG 2005
  - SIGGRAPH 2005 Sketch
  - EG Tutorial on Illustrative Visualization



# **Importance-Driven Visualization**



### Model for Importance-Driven Visualization



# [Viola et al. '04 '05]



importance-driven feature enhancement





- Determines the representation
- Automatic specification
  - Feature classification
  - Value range
  - Distance to other feature
  - Distance to focal point



# User-steered assignment to segmented objects



# **Levels of Sparseness**





# Smooth transitions in representation





# **Opacity and Color Modulation**



# High importance: opaque, colorLow importance: transparent, desaturated











High importance: dense, small grid spacingLow importance: big grid spacing





![](_page_10_Picture_5.jpeg)

![](_page_10_Picture_6.jpeg)

![](_page_11_Picture_1.jpeg)

High importance: low gradient magnitudeLow importance: high gradient magnitude

![](_page_11_Picture_3.jpeg)

![](_page_11_Picture_4.jpeg)

![](_page_11_Picture_5.jpeg)

![](_page_11_Picture_6.jpeg)

![](_page_12_Picture_1.jpeg)

![](_page_12_Figure_2.jpeg)

- Using different feature representations
- Using different rendering techniques

![](_page_12_Figure_5.jpeg)

### **Sharp Levels of Sparseness**

![](_page_13_Picture_1.jpeg)

![](_page_13_Picture_2.jpeg)

### contour rendering

![](_page_13_Picture_4.jpeg)

# **Importance Compositing**

![](_page_14_Picture_1.jpeg)

![](_page_15_Picture_1.jpeg)

- Connects importance to levels of sparseness
- Focus features dense representation
- Context features
  - If occluding sparse representation
  - Else dense representation

![](_page_15_Picture_7.jpeg)

![](_page_16_Picture_1.jpeg)

Maximum importance projectionAverage importance compositing

![](_page_16_Figure_3.jpeg)

![](_page_17_Picture_1.jpeg)

Only feature with highest importance along the ray is rendered

![](_page_17_Figure_3.jpeg)

# **Average Importance Compositing**

- Occluding context information is suppressed
- Not entirely removed
- Sum-up importance of intersected features along the ray

![](_page_18_Figure_5.jpeg)

# Improving the Spatial Arrangement

![](_page_19_Picture_1.jpeg)

![](_page_19_Figure_2.jpeg)

![](_page_19_Picture_3.jpeg)

### Examples

![](_page_20_Picture_1.jpeg)

![](_page_20_Picture_2.jpeg)

![](_page_20_Picture_3.jpeg)

maximum importance projection

#### average importance compositing

![](_page_20_Picture_6.jpeg)

# **Visibility Validation**

![](_page_21_Picture_1.jpeg)

# Visibility Validation

![](_page_22_Picture_1.jpeg)

- Avg. imp. compositing preserves thickness
- Visibility of focus is not guaranteed
- Visibility validation useful for partial supression

![](_page_22_Figure_5.jpeg)

![](_page_22_Picture_6.jpeg)

# Local Visibility-Preserving Imp. Compositing

![](_page_23_Figure_1.jpeg)

![](_page_23_Picture_2.jpeg)

# Local Visibility-Preserving Imp. Compositing

![](_page_24_Picture_1.jpeg)

average importance compositing

visibility preserving importance compositing

![](_page_24_Picture_4.jpeg)

### Global Visibility-Preserving Imp. Compositing

![](_page_25_Picture_1.jpeg)

![](_page_25_Picture_2.jpeg)

#### initial transfer function

#### equal visibility

![](_page_25_Picture_5.jpeg)

Ivan Viola

# **Visibility Evaluation**

![](_page_26_Picture_1.jpeg)

![](_page_26_Figure_2.jpeg)

![](_page_26_Picture_3.jpeg)

### Global Visibility-Preserving Imp. Compositing

![](_page_27_Picture_1.jpeg)

![](_page_27_Figure_2.jpeg)

![](_page_27_Picture_3.jpeg)

### Global Visibility-Preserving Imp. Compositing

![](_page_28_Picture_1.jpeg)

![](_page_28_Picture_2.jpeg)

#### initial transfer function

rind = 1.0 pulp = 2.0 seeds = 0.5

![](_page_28_Picture_5.jpeg)

# **Applications**

![](_page_29_Picture_1.jpeg)

۳. 

# Lung Nodules Visualization

![](_page_30_Picture_1.jpeg)

![](_page_30_Picture_2.jpeg)

![](_page_30_Picture_3.jpeg)

# Visualization of MR Mammograms

![](_page_31_Picture_1.jpeg)

![](_page_31_Picture_2.jpeg)

![](_page_31_Picture_3.jpeg)

# VolumeShop: Interactive IDV

![](_page_32_Picture_1.jpeg)

![](_page_32_Picture_2.jpeg)

![](_page_32_Picture_3.jpeg)

![](_page_33_Picture_1.jpeg)

New focus+context visualization technique Importance specification Levels of sparseness Importance compositing Validation of feature visibility High potential of visualization applications New research possibilities

![](_page_33_Picture_3.jpeg)

# Thank you!

![](_page_34_Picture_1.jpeg)

![](_page_34_Picture_2.jpeg)