• Region-Filling and Object Removal by Exemplar-Based Inpainting. Criminisi, Pérez, and Toyama. CVPR 2004

• Image Completion with Structure Propagation. Sun, Yuan, Jia and Shum SIGGRAPH 2005
Problem

- Region filling, object removal, image completion, ...
Another Example
Key ideas (1)

- Exemplar-based synthesis

+ execution speed

+ accuracy of propagated structures
Key ideas (2)

- Filling order is critical
Algorithm

1) Computing patch priorities at fill front
   → see next slide

2) Find patch with max priority

3) Find most similar exemplar (source region)
   → SSD in CIE lab color space

4) Copy image data & update confidences
Patch priorities

- \( P(p) = C(p) \times D(p) \)
- Confidence term: amount of reliable information surrounding pixel \( p \)
- Data term: encourages linear structures to be synthesized first

\[ \Phi \]
\[ \delta \Omega \]
\[ \nabla I_p \]
\[ \nabla I_p \]
\[ \nabla I_p \]
\[ \nabla I_p \]
\[ \nabla I_p \]
Limitations

- Need similar patches for synthesis
- Only linear structures (curves?)
- Cannot handle depth ambiguities
Competitive work & Impact

- Diffusion-based techniques [Bertalmio et al., 2000]

- No blur / faster

→ Patch-based approach wide-spread
Previous approaches have difficulties with salient structures in unknown regions

→ Structure propagation along user-specified curves
Key Ideas

- **Synthesis ordering**
  - Salient structures first
  - Then texture propagation into other regions

→ Graph labeling problem
Key Ideas (2)

- Formulate structure propagation as global optimization problem
  - Similar structure
  - Overlapping patches should match

- Solve effectively using
  - Dynamic Programming
  - Belief Propagation
Results & Competitive Work

Criminsi et al., 2003

Sun et al., 2005
Discussion

- Questions?
Discussion

- Differences?
  - Combination structure and textures vs. separation of structure and texture
  - Linear vs. curves
  - Amount of user input
Discussion

- Limitations?
  - Depth
  - Areas for sampling
  - Guidance by user
Discussion

- Solutions?
  - Layers and Bayesian Matting
  - Patch Matching
Discussion

- Future work?
  - Applying Belief Propagation to other graphical work
  - Video/Meshes