Fundamentos de Processamento de Imagens

Aula 21

Restauração de Imagens:

Image Inpainting

Image Inpainting

- Reconstruction of missing or damaged portions of images


Image Inpainting

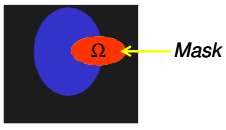
- Ancient practice
- Performed manually by skilled artists
- Extensively used in artwork restoration

Applications of Inpainting

- Restoration of photographs, films and paintings
- Removal of text, subtitles and publicity from images
- Special effects
- Desirable feature for image tools such as PhotoShop!!

Bertalmio's Algorithm

- User-provided mask specifies the inpainting region



- Input image split into R, G and B channels
- For each channel, propagate information from the outside of the masked region along level lines (*isophotes*)

Fast Image Inpainting

- **Observations**
  - One can only hope to get a plausible rather than an exact reconstruction
    - Inpainting regions must be locally small
    - Simple model approximates the result produced by more sophisticated ones
  - Human visual system can tolerate some blurring in areas not associated with high contrast edges [Kanizsa 79]

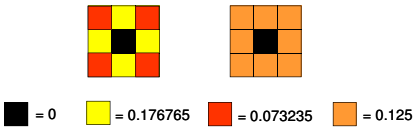
The Algorithm [Oliveira et al 01]

- Initialize (clear) Ω
- Inpainting by isotropic diffusion from the boundary into Ω
- Stop if
  - no significant change in pixel color
  - a maximum number of iterations is reached
- R, G and B channels handled at once

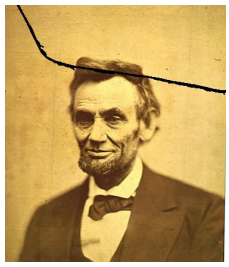
Pseudocode

```
initialize Ω;
for (iter =0; iter < num_iteration; iter++)
    convolve inpainting domain with diffusion kernel;
```

- Kernel: weighted average of pixel neighborhood

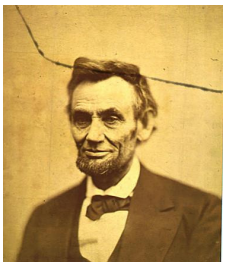


Example



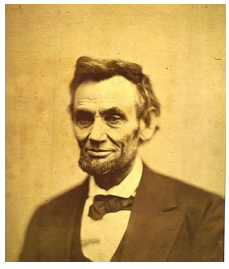
Initialize Ω

Example



After 5 Iterations

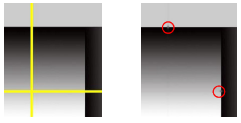
Example



After 100 Iterations

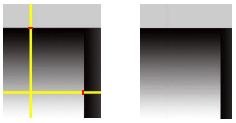
Artifacts

- Noticeable artifacts at high contrast edges



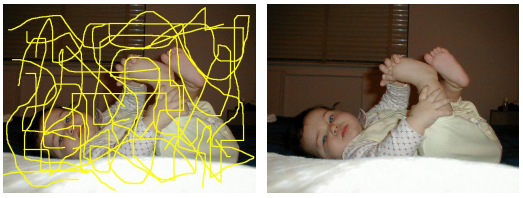
Preserving Edges

- Masking
  - most time consuming operation (human intervention)
- "Diffusion Barriers" (two-pixel wide segments)
  - Stop the diffusion process
  - replicate color of nearest pixel



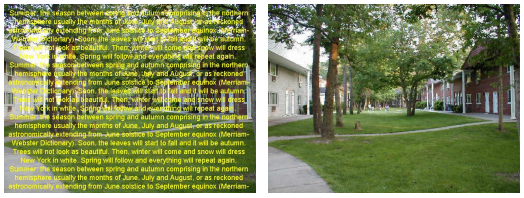
Results

- Baby Lu (640 x 480 pixels)
  - few high contrast edges
  - mask covers 14.54% of the total area



Results

- Yard (640 x 480 pixels)
  - uncorrelated high frequency
  - mask covers 18.77% of the total area



Results

- Underwater (512 x 384 pixels)
  - high contrast edges
  - mask covers 16.19% of the total area