Image Resizing Using Seam Carving

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Outline

1. Introduction
   - Background

2. Seam Carving

3. Object Carving

4. Video Retargeting

5. Conclusion
The Problem Space


http://twd3.com/responsive-web.cms
Traditional Resizing

http://jeremykun.com/2013/03/04/seam-carving-for-content-aware-image-scaling/
Seam Carving

http://jeremykun.com/2013/03/04/seam-carving-for-content-aware-image-scaling/
Outline

1. Introduction

2. Seam Carving
   - Seams
     - Energy Function
     - Computing Seams
     - Results

3. Object Carving

4. Video Retargeting

5. Conclusion
### Seams

#### Defining a Seam

- **One pixel wide path**
- **Traverses the image’s width or height**

Let image $I$ be a $n \times m$ image

$$s^x = \{(x(i), i)\}_{i=1}^{n}$$

$$\forall i, |x(i) - x(i-1)| \leq 1$$

Seams

Defining a Seam

- One pixel wide path
- Traverses the image’s width or height
- Let image \( I \) be a \( n \times m \) image
- \( s^x = \{ (x(i), i) \}_{i=1}^n \)
- \( \forall i, |x(i) - x(i - 1)| \leq 1 \)

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A pixel’s energy is high if its color value is very different from its neighbors.

A pixel’s energy is low if it is similar to its neighbors.

\[
dx = \frac{|I(x + 1, y) - I(x - 1, y)|}{2} \\
dy = \frac{|I(x, y - 1) - I(x, y + 1)|}{2} \\
e(x, y) = dx + dy
\]
A pixel’s energy is high if its color value is very different from its neighbors.

A pixel’s energy is low if it is similar to its neighbors.

\[ dx = \frac{|I(x+1, y) - I(x-1, y)|}{2} \]

\[ dy = \frac{|I(x, y-1) - I(x, y+1)|}{2} \]

\[ e(x, y) = dx + dy \]
Computing Seams

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### Computing Seams

Energy Values: Each pixel gets a value

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Computing Seams

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Find smallest energy value on bottom row.
### Computing Seams

Find smallest energy value on bottom row.

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### Computing Seams

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Trace seam back up the image.
Remove seam and shift everything else to the left.

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Reset energy values and repeat.
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4. Video Retargeting
5. Conclusion
Results

Results

Image Enlarging

http://www.ulfdittmer.com/imagej/seam-carving.html
Results

Limitations

(a) Original  (b) Cropping  (c) SC  (d) Multi-Op

Reference [4]
Outline

1. Introduction
2. Seam Carving
3. Object Carving
   - Object Detection
   - Object Removal
4. Video Retargeting
5. Conclusion
Object Carving: Removing repeated objects in an image to help avoid distortion while shrinking.

Reference [2]
Object Carving

(a) Paint Selection  (b) Shape Information  (c) Detection Result

Reference [2]
Outline

1 Introduction

2 Seam Carving

3 Object Carving
   - Object Detection
   - Object Removal

4 Video Retargeting

5 Conclusion
Visual Importance: The algorithm measures the layering relation between the different objects and assigns higher importance to images in the foreground.
How to Remove Objects

This displays the importance of evaluating the energy that the seam will carve out as well as the object’s energy.
The Need to Resize Videos

Outline

1. Introduction
2. Seam Carving
3. Object Carving
4. Video Retargeting
   - The Need to Resize Videos
   - Algorithm
5. Conclusion
The Need to Resize Videos

Video Resizing


Outline

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3. Object Carving
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   - The Need to Resize Videos
   - Algorithm
5. Conclusion
Each column’s energy is summed in a value $C_i$. Then each of these values are summed into a value $W_j$ for each cropped window. Finally the values for the positions of all frames are combined to a 2D array.
Seam Carving in Frame

Reference [3]
In Summary

- Image/Video resizing is becoming more necessary as the number of different screen sizes.
- Seam carving works well on landscapes.
- Object carving works well on images with repeated objects or patterns.
- Videos can also effectively be resized using seam carving.
Questions?

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References I

S. Avidan and A. Shamir.
Seam carving for content-aware image resizing.  

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In *Proceedings of the 4th Workshop on Mobile Video, MoVid '12*, pages 13–18, New York, NY, USA, 2012. ACM.

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