

Content-Aware Image and Video Resizing by Anchor Point Sampling and Mapping



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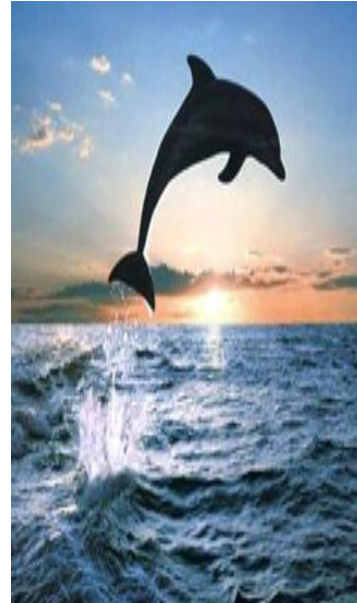
August, 2008

Motivation: Image Resizing

- **Preserve the properties of important contents when resizing.**



Original Image



Uniform Scaling



Content-Aware Resizing

Motivation: Video Resizing (1)

- Preserve important contents consistently across the video when resizing.

Time 1



Time 2



Time 3



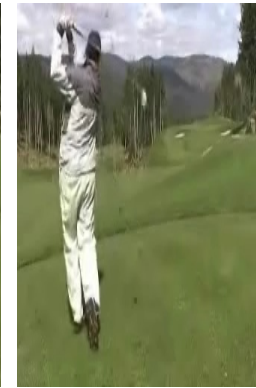
Content-Aware
Resizing

Uniform
Scaling



Content-Aware
Resizing

Uniform
Scaling



Content-Aware
Resizing

Uniform
Scaling

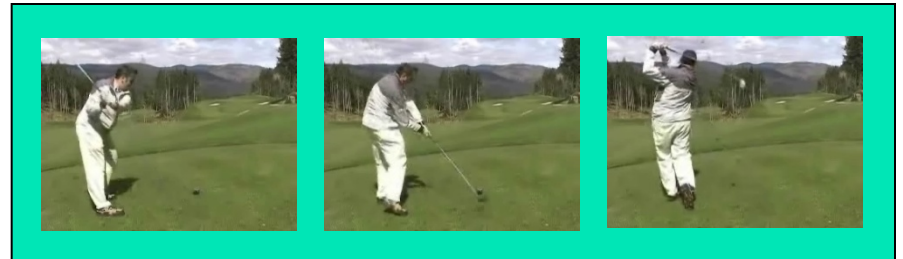
Motivation: Video Resizing (2)

- Preserve important temporal events when shortening/stretching the video.

Original
Video

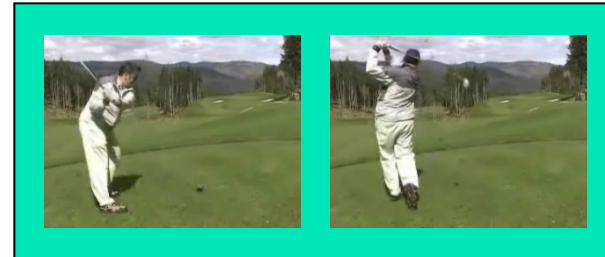


Nearly static frames (no event)

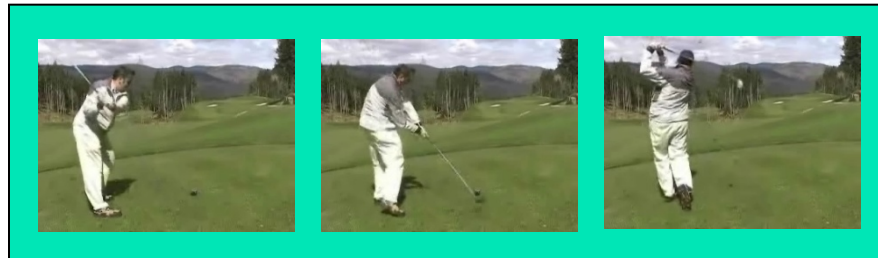


Swing event

Uniform
Shortening



Content-Aware
Shortening



Our Method (Image)

- **Compute the importance (saliency) of image/video pixels.**
- **Important features such as faces and strong edges lead to high saliency value.**



Original Image



Saliency Map (brighter color refers to higher importance)

Our Method (Video)

- **Compute the importance (saliency) of image/video pixels.**
- **Important features such as faces and strong edges lead to high saliency values.**
- **For videos, pixels with high spatio-temporal gradient have high saliency values.**



Original Video



Saliency Map (brighter color refers to higher importance)

Our Method (Image)

- **Select representative anchor points by sampling.**
- **Pixels with higher saliency have higher probability to be sampled.**



Saliency Map (brighter color refers to higher importance)



Selected anchor points (blue dots)

Our Method (Video)

- **Select representative anchor points by sampling.**
- **Pixels with higher saliency have higher probability to be sampled.**
- **To save computational cost, only a small number of anchor points are selected for video resizing.**



Saliency Map (brighter color refers to higher importance)

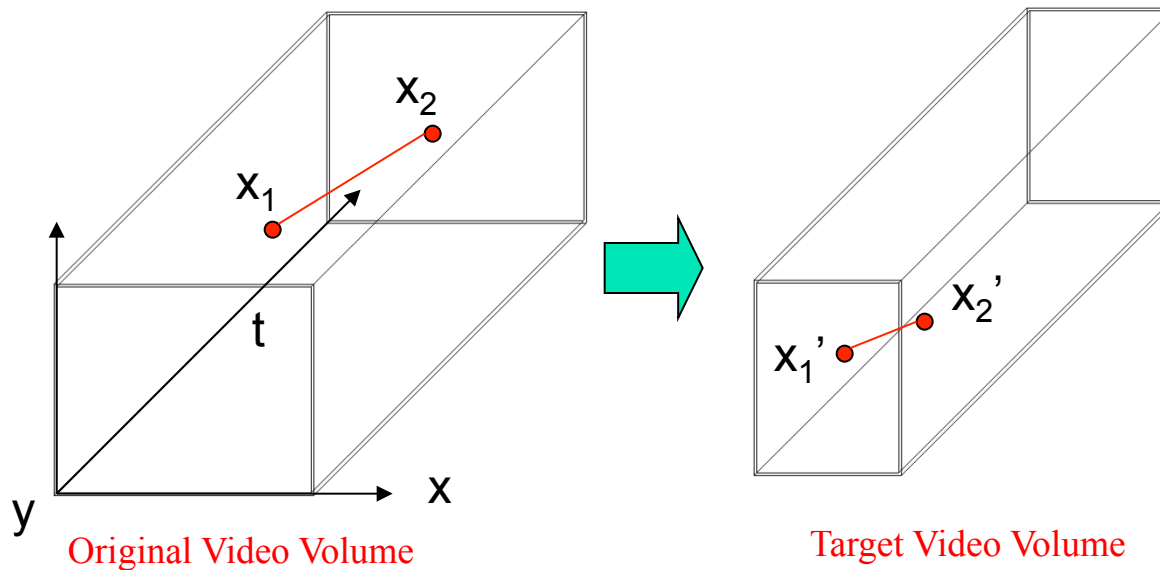


Selected anchor points (blue dots)

Our Method (Image/Video)

- Compute mapping of the anchor points from original size to target size.
- **Criterion: Preserve high-saliency pixel properties more than others.**
- **Linear constraints on anchor points x_1 and x_2 with saliency s_{12} :**

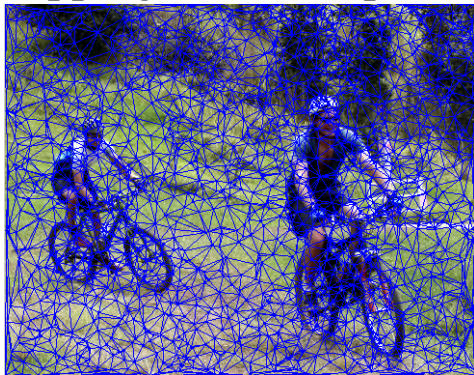
$$s_{12}(x_1' - x_2') = s_{12}(x_1 - x_2)$$



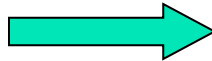
Mapping illustration for video resizing. Image resizing is similar.

Our Method (Image)

- Construct 2D (images) or 3D (videos) mesh model of the anchor points by Delaunay triangulation.
- Warp each mesh unit to the target images or videos by interpolation based on the mapping of anchor points.



Interpolation



Uniform
Scaling

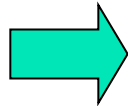


Our Method (Video)

- Construct 2D (images) or 3D (videos) mesh model of the anchor points by Delaunay triangulation.
- Warp each mesh unit to the target images or videos by interpolation based on the mapping of anchor points.



Original Video



Content-Aware
Resizing



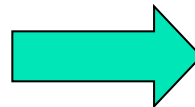
Uniform
Scaling



Examples: Temporal Resizing (Video)



Original Video



Content-aware shortening preserves the swing event.

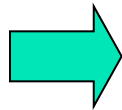


Uniform shortening changes the swing event.

More Examples (Image)



Original

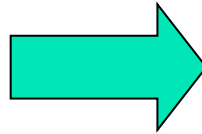


Shrinking



Enlarging

More Examples (Image)



Original

Enlarging

More Examples (Image)

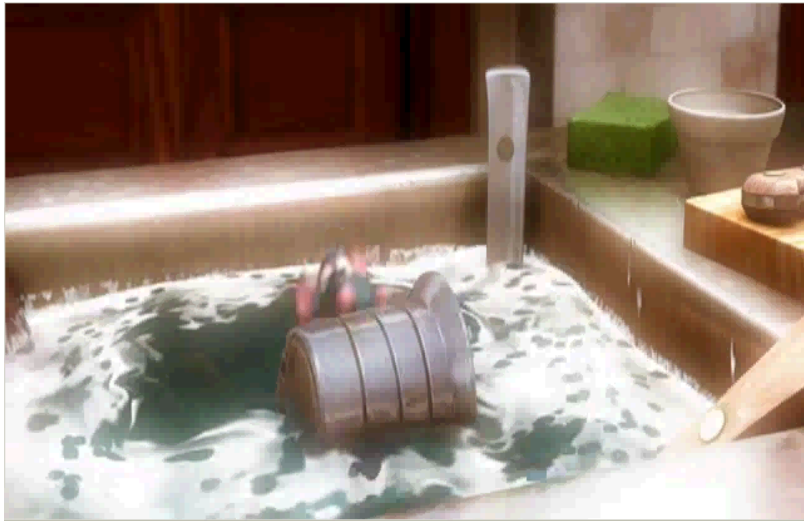
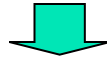


Original

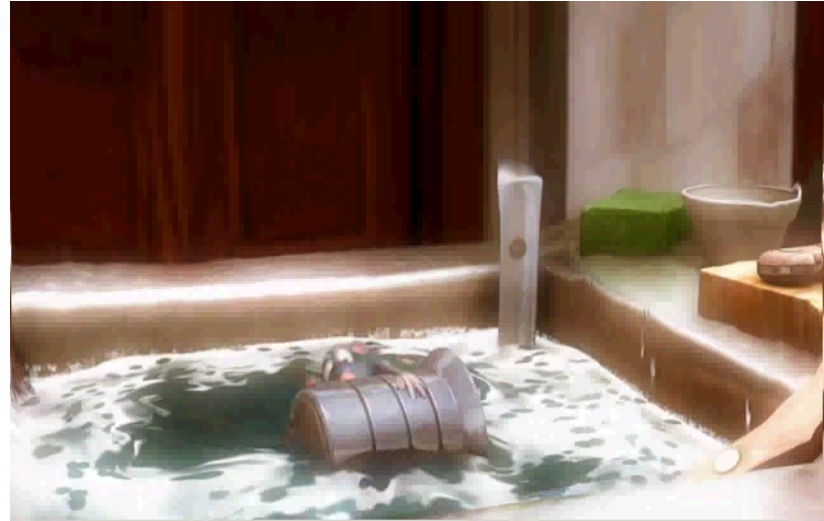
Enlarging

More Examples (Video)

Original



Heightening by Uniform Scaling up



Content-Aware Heightening