

Content-aware seam carving for accurate image upscaling

Zhongjie Li (jay2015@stanford.edu)
Liam John Kelly (kellylj@stanford.edu)

Goals:

Our goal is to make low resolution contents, especially images, look better in high resolution display.

There are many existing algorithms to interpolate low resolution images into high resolution. We want to explore content-aware enlarging, however, in order to improve the appearance of low resolution images at higher resolutions beyond just simple scaling and sharpening.

In particular, we are interested in exploring Seam Carving, a method by which images can be resized by growing/shrinking using the minimum energy “seam” and interpolating around that. While image enlarging for seam carving has been implemented before, we are interested in looking at how to be even more cognizant of the image content when doing the enlarging step. Seam carving can result in some tearing along edges or shearing along seams that may reduce image quality. By being aware of these behaviors, we hope to design and implement an algorithm that reduces the amount of shear and tear from seam carving methods.

Work to be carried out:

First, we need to implement a seam carving enlargement algorithm to scale an image for larger display. Once we have the base seam enlargement implementation, we will try various methods to reduce subject shearing. These methods include: changing the energy calculation algorithm, manual subject matter indication, and automatic edge detection. We plan on contrasting these method results to find the algorithm that produces the best images. We also plan to contrast these images with other upscaling interpolation algorithms, to see the trade offs of each kind of algorithm. From these comparisons, we hope to discover trade offs based on processing time, image accuracy, sharpness, and other qualitative features that might depend on the type of application.

The work would be done on desktop computers, not mobile devices.



Figure 1. Source image at 144p



Figure 2. 144p image upscaled through direct resizing



Figure 3. Seam carving example showing a minimum energy vertical seam

Reference:

1. <https://www.cambridgeincolour.com/tutorials/image-interpolation.htm>
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3. Aiazzi, Bruno, et al. "Bi-cubic interpolation for shift-free pan-sharpening." *ISPRS journal of photogrammetry and remote sensing* 86 (2013): 65-76.
4. Shai Avidan and Ariel Shamir. 2007. Seam carving for content-aware image resizing. *ACM Trans. Graph.* 26, 3, Article 10 (July 2007). DOI: <https://doi-org.stanford.idm.oclc.org/10.1145/1276377.1276390>