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Task driven saliency detection for image retargeting

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ABSTRACT

Importance map plays a crucial role in the seam-carving process, a well known image retargeting method. Usually a saliency map (with central bias or single Gaussian priority) is chosen as the importance map. However, we find that direct use of saliency map for seam-carving may cause some unsatisfactory visual effects such as trivial solution or distortion. In this paper, we analyze the reasons and give improved importance map by fusing a multi-Gaussian saliency map (MG-SM) and a revised slant edge saliency map (SE-SM). Specifically for the multi-Gaussian saliency map, we assume that the priori saliency distribution of an image is multi-Gaussian centered at some object centers rather than single Gaussian. Super pixels and sparse representation are used to measure the saliency. For the revised slant edge saliency map, we use wavelet transform to find the slant edges and design to carve seams on the slant edges uniformly. The present method has been extensively tested and more satisfactory experimental results, especially for the slant edge distortion, are obtained than the other methods compared.

1. Introduction

Nowadays our daily life is teeming with various visual display units (e.g. cell phones, TV, PAD or computer monitor) which have different display capabilities; therefore, we need to share or exchange image content among them, specifically adapting the image size to fit the displays which has been called image retargeting. With the development of computer vision image retargeting becomes increasingly important.

Standard image scaling works well on proportional resizing, but it loses effects when an image is resized disproportionately, it makes the salient parts twist or out of proportion. To address this problem, adaptively and optimally resize the image to fit the displays, namely content aware image retargeting comes to our mind. In recent years, large amounts of adaptive methods are raised and cause wide public interests, simple method as cropping. Cropping simply cuts the borders of an image and changes the size. However, this trivial solution has its inherent flaw; it often discards too much information of interests, especially when it is at the borders. For more works on adaptive image retargeting refer to [1–10,15–19]. Among all these methods seam-carving stands out for its wise design and good performance as shown in Fig. 1. It is designed to dynamically carve seams that are of less importance, while the image size changed the visual sense stays. Being a prominent and effective method for image retargeting, seam carving, first proposed by Avidan and Shamir [2], has caused wide public interests. A lot of works have been proposed [3,8–10,27,33].

Seam-carving method is divided into three steps (as in Fig. 2(a)): Firstly, define an energy function to measure the importance of pixels and generate the importance map; Secondly, according to the importance map using dynamic programming

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Fig. 1. Indication of seam-carving.

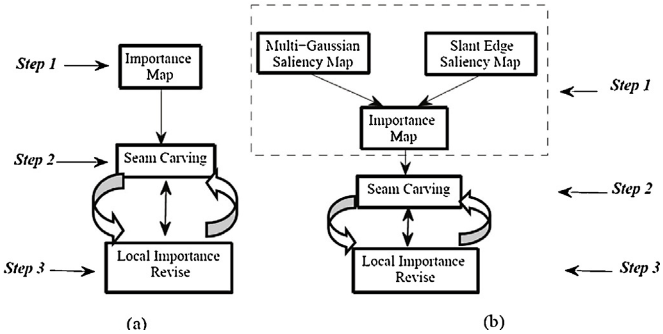

Fig. 2. Flow chart of seam-carving.

find a seam and carve it; Thirdly, diffuse the importance value of the seam carved to their neighbor pixels, and update the importance map for finding the next seam.

In the above steps, the importance map plays a crucial role and even directly affect the seam-carving results. To evaluate the importance gradient information is used in the original seam carving. The gradient information describes the saliency of a pixel in local level and is sensitive to noise or cluttered backgrounds, which to some extent is deeply flawed. Considering local and non-local information Goferman et al. [11] uses the saliency map as importance map for seam-carving; it improves the results and indicates that saliency map is a good surrogate for importance map.

Compared to seam carving, saliency detection is an old and well developed topic, and large amount of great works on saliency detection have been proposed in recent years, and they achieve good results in both quantity value and quality assessment. Liu et al. [12] designed a sliding window to locate the salient object, Goferman et al. [11] measure saliency according to the distance of similar image patches, and detect the region that represents the context, and Hou and Zhang [14] used spectral residual for saliency detection. Another interesting work is [20] in which the author takes the boundary as background to sparse represent the whole image; sparse representation error is used as saliency measure. More saliency detection methods can be found in [11–14,20,23,24,28–32].

Although the above mentioned methods work well for saliency detection, we find that using desired saliency map as importance map does not always work well for image retargeting as shown in Fig. 3. In a deeper analysis we find that there are mainly two reasons for this: (1) many saliency maps are provided with central bias or single Gaussian prior, which means it pays more attention to the central part of an image. For example, Lu et al. [20] use the boundary parts as dictionary atoms to sparse represent the whole image. Obviously the boundary parts are considered less salient, which is not appropriate for seam-carving (in this way seam-carving becomes boundary cropping). (2) Generally, saliency detection aims to detect the salient objects rather than retargeting the image; for example, it treats horizontal line and slant line equally as Fig. 3(a) and

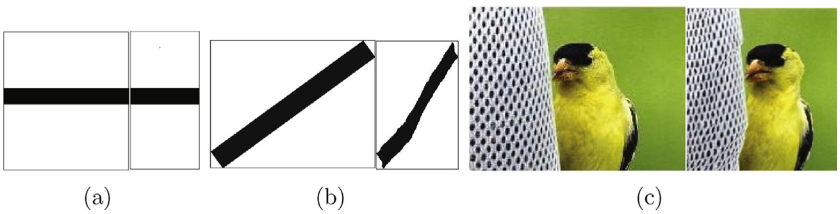

Fig. 3. Seam-carving results using saliency map in [11].