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Videoshop: A New Framework for Spatio-Temporal Video Editing in Gradient Domain

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DESCRIPTION

Our goal is to develop tools that go beyond frame-constrained manipulation such as resizing, color correction, and simple transitions, and provide object-level operations within frames. Some of our targeted video editing tasks include transferring a motion picture to a new still picture, importing a moving object into a new background, and compositing two video sequences. The challenges behind this kind of complex video editing tasks lie in two constraints:

1) *Spacial consistency*: Imported objects should blend with the background seamlessly. Hence pixel replacement, which creates noticeable seams, is problematic.
2) *Temporal coherency*: Successive frames should display smooth transitions. Hence frame-by-frame editing, which results in visual flicker, is inappropriate.

Our work is aimed at providing an easy-to-use video editing tool that maximally satisfies the spatial and temporal constraints mentioned above and requires minimum user interaction. We propose a new framework for video editing in gradient domain. The spatio-temporal gradient fields of target videos are modified and/or mixed to generate a new gradient field which is usually not integrable. We propose a 3D video integration algorithm, which uses the variational method, to find the potential function whose gradient field is closest to the mixed gradient field in the sense of least squares. The video is reconstructed by solving a 3D Poisson equation. We derive an extension of current 2D gradient technique [2] to 3D space, yielding in a novel video editing framework, which is very different from all current video editing software.

A set of gradient operators is provided to the user for editing purposes. Several new applications are introduced as follows:

1) *Face replacement and painting*: Digital face replacement and painting involves replacing the face of a person in a target image using the face of another person in a source video. The shape, expression and motion of the face in the resulting video will be the same as in the source video, but the color and appearance of the face will be the same as the target face, as shown in Fig. 1.
2) *Graph-cut based video compositing*: To obtain the regions of interest for video compositing, we use a 3D graph cut algorithm to find the minimum cut between two sequences, and then use gradients of one video sequence on one side of the cut and the gradients of the other video sequence on the other side.
3) *High dynamic range (HDR) video compression*: We used the high dynamic range video camera called split aperture camera [3] to capture the HDR video. By attenuating large gradients and magnifying low gradients, the dynamic range of input videos is greatly reduced.

Fig. 1
LEFT: INPUT VIDEO; RIGHT UP: COMPOSITING VIDEO; RIGHT BOTTOM: INPUT IMAGE.

Demo videos are available from `http://vision.ai.uiuc.edu/~wanghc/research/editing.html`, and some preliminary results have been reported in a technical paper [1].

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