Deformation Lamps: A Projection Technique to Make a Static Picture Dynamic

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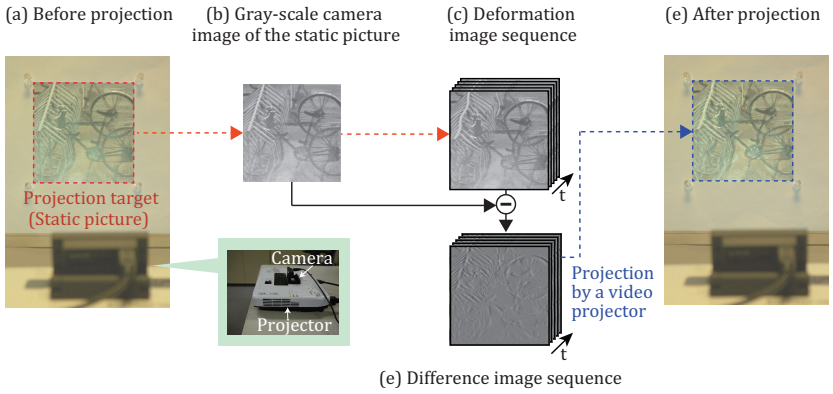

Figure 1: *The processing stream of a representative system of Deformation Lamps, which consists of a video projector and a camera. (a) A static picture is placed on the projection plane (a magnetic white board in this case). (b) A gray-scale camera image of the static picture. (c) A deformation image sequence is generated by deforming the camera image (b) with an arbitrarily defined deformation map. (d) Difference image sequence obtained by subtracting (b) from (c). (e) The difference image sequence is optically projected onto the static picture. Humans perceive an illusory dynamic deformation of the static picture.*

1 Introduction

We propose a new light projection technique named 'Deformation Lamps', which adds a variety of realistic movement impressions to a static projection target. While static pictures are good at expressing spatial information about objects and events, they are not good at expressing temporal information. To overcome the deficit of a static picture, Deformation Lamps superimposes luminance motion signals onto a colorful static picture and produces an illusory, but realistic movement of the picture by fully utilizing the processing characteristics of the human visual system.

2 Principle

Unlike previous attempts to use projection mapping (or shader lamps [Raskar et al. 2001]) to modify the apparent surface reflectance or shading of real objects [Amano 2013] via pointwise control of intensity/color, Deformation Lamps does not significantly change the apparent surface properties of a static picture, but only adds the impression of motion. This technique produces apparent image movements not by shifting the position of the picture image, but by adding luminance motion signals. The motion signals are calculated by subtracting luminance values of a static picture image from those of the warped image (Figure 1). Because the motion signals are added to static color and form signals in a static target, an inconsistency arises between the added motion signals and color-form signals. However, this inconsistency can be perceptually 'corrected' by the brain when it integrates motion, form, and color signals. Adding only luminance motion signals is critical not only for effectively driving motion sensors in the human visual system, but also for minimising the appearance change of the static image. Projecting color components is avoided, since the current purpose was not to synthesize a correct movie on top of a static picture, but to produce an illusory movement of the static picture.

3 Application

Deformation lamps can give various types of dynamic impression to a static picture. For example, taking advantage of knowledge about natural image distortions, Deformation Lamps can make a picture of flames fluttering in the dark, a picture of a stone under moving water, and a picture of a road scene with a waving heat shimmer. Moreover, by using motion signals of an existing or synthesized movie, Deformation Lamps can give a movie-like dynamic impression to a static printed picture of the movie snapshot. It is possible to use Deformation Lamps to deform the surface patterns of 3D targets.

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References

AMANO, T. 2013. Projection based real-time material appearance manipulation. In *Proceedings of 2013 IEEE Conference on Computer Vision and Pattern Recognition Workshops*, 918–923.

RASKAR, R., WELCH, G., AND LOW, K.-L. 2001. Shader lamps: Animating real objects with image-based illumination. In *Proceedings of the 12th Eurographics Workshop on Rendering Techniques*, 89–102.

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