23 Make natural-looking illusions by perceptual model

Adaptive motion retargeting for illusion-based projection AR
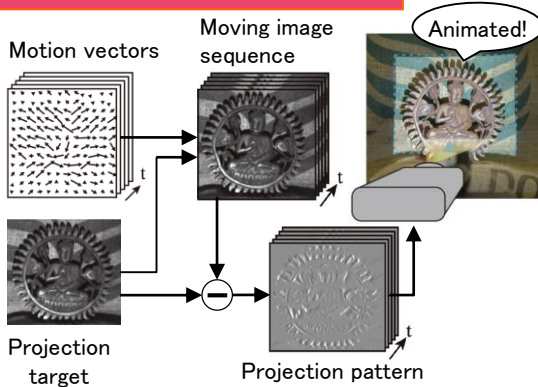
Abstract

Hen-Gen-Tou, invented by CS Labs, is an illusion-based projection mapping that adds motion impressions to real static objects. It produces illusory motion impressions in the projection target by projecting luminance motion signals that selectively drive the motion detectors in the human visual system. However, in order to successfully "fool" human vision, the amount of movements must be properly adjusted because there is a limit in shift size that can create the illusion. Here, to automate this laborious adjustment task, we propose an optimization framework that adaptively retargets the motion information in real time based on a perceptual model. The perceptual model predicts the perceived deviation of a projected pattern from an original surface pattern using a computational model of human visual information processing. This technique will broaden the range of applications of Hen-Gen-Tou, including interactive applications.
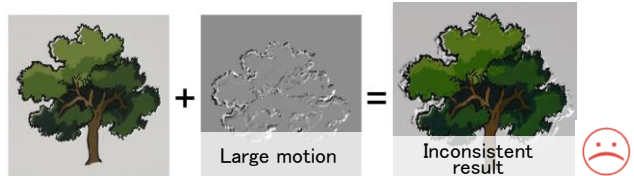
Mechanism of "Hen-Gen-Tou"

Motion vectors
Moving image sequence
Animated!
Projection target
Projection pattern

The human visual system separately analyzes color, pattern, and motion information and later integrates them. Taking advantage of this characteristic, HenGenTou adds illusory motion impressions on static objects by projecting only luminance motion signals.
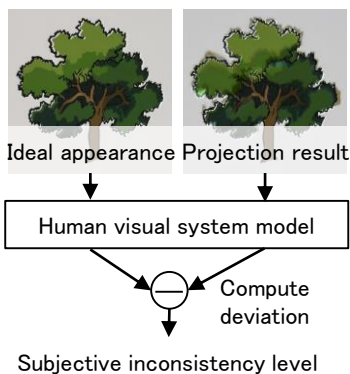
Problem: shift limit

Trying to add too large motion leads to **subjective inconsistency** between original appearance and projected patterns.

Large motion · Inconsistent result

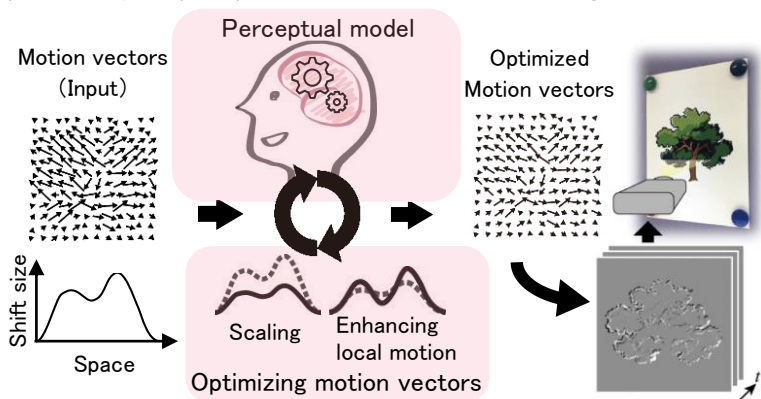Manual adjustments? ➡ Impossible for interactive applications

Perceptual model to predict subjective inconsistency level

Predict subjective inconsistency level of the projection result as a deviation from the ideal appearance in representation space of the human visual system.

Ideal appearance · Projection result

Human visual system model

Compute deviation

Subjective inconsistency level

Optimizing motion vectors based on the perceptual model

Maximize motion impressions while keeping the subjective inconsistency level predicted by the perceptual model within the tolerable range.

Motion vectors (Input)
Perceptual model
Optimized Motion vectors
Shift size
Space
Scaling · Enhancing local motion
Optimizing motion vectors

Automatically generates results in real time, comparable to conventional methods that require manual fine-tuning

References

[1] T. Fukiage, T. Kawabe, S. Nishida, "Perceptually based adaptive motion retargeting to animate real objects by light projection," *IEEE Transaction on Visualization and Computer Graphics*, Vol. 25, No. 5, pp. 2061-2071, 2019.

[2] T. Kawabe, T. Fukiage, M. Sawayama, S. Nishida, "Deformation Lamps: A projection technique to make static objects perceptually dynamic," *ACM Transactions on Applied Perception,* Vol, 13, No. 2, pp. 1-17, 2016.

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