Motion Visualization using an Impulse Response Model in Human Vision

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Introduction and purpose

Purpose

- Several researches investigated motion sharpening effect in human vision.
- When objects move fast they look sharper than when they are stationary[1]-[5].
- We proposed a method for image enhancement based on the motion-sharpening effect [6].
- This method can enhance only moving objects in image sequence.
- We may represent motion into a still image by using the motion sharpening effect of human.
- We propose a method for motion visualization using the motion-sharpening effect.
- We show the possibility of motion perception into a still image.

A method of motion visualization

Method

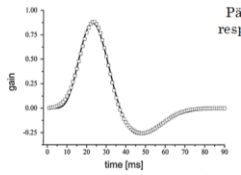


Figure1.Difference-of-Gaussians fit (open squares) to the temporal impulse response function of McKee and Taylor (1984) (continuousline)[5].

Pääkkönen & Morgan [5] offered an idea based on that the visual response to a briefly flashed image is biphasic.

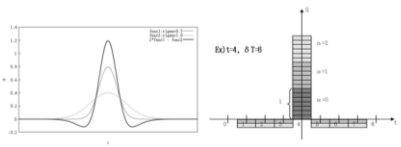
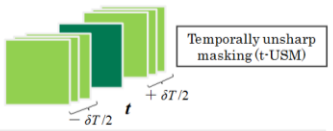
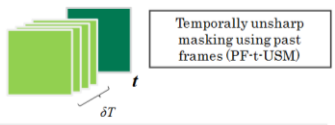


Figure2. Summary of t-USM filter





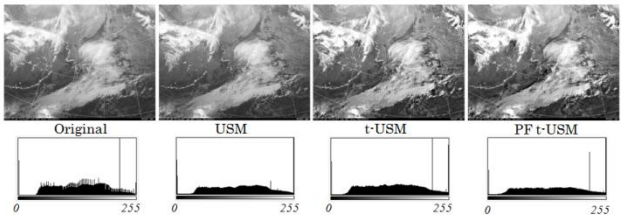
$$f_{tAV}(x,y,t)=\frac{1}{\delta T+1}\sum_{j=-\delta T/2}^{\delta T/2} f(x,y,t+j) \quad (1)$$

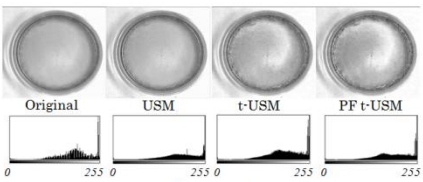
$$f_{tUSM}(x,y,t)=(1+\alpha)f(x,y,t)-\alpha f_{tAV}(x,y,t) \quad (2)$$

$$f_{tAV}(x,y,t)=\frac{1}{\delta T+1}\sum_{j=-\delta T}^{0} f(x,y,t+j) \quad (1')$$

$$f_{tUSM}(x,y,t)=(1+\alpha)f(x,y,t)-\alpha f_{tAV}(x,y,t) \quad (2')$$

f: image intensity, f_{av} : locally averaged image sequence, f_{esw} : filtered image sequence, δT: local temporal domain, α: gain factor





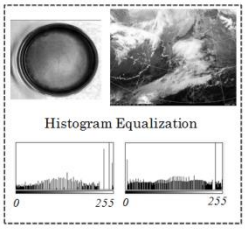
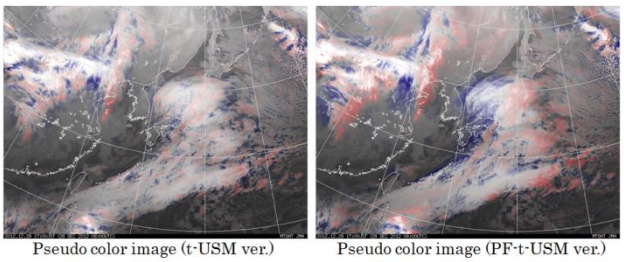
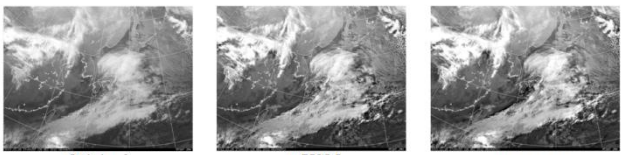


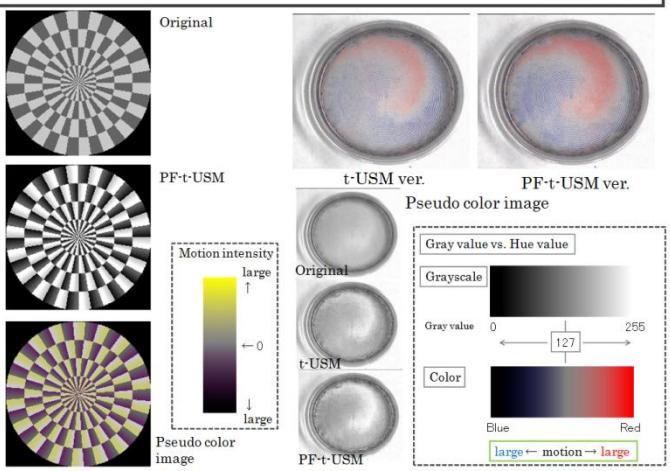
Figure3. Enhanced images
(Sharpness and brightness contrast are enhanced)

Results

Results







References

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[3] Georgeson, M. A., and Hammett, S. T.: Seeing blur: 'motion sharpening' without motion, Proc Biol Sci, 269(1499), pp.1429-1434 (2002).

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[5] Pääkkönen, A.K., and Morgan, M.J.: Linear mechanisms can produce motion sharpening, Vision Res., 41, pp.2771-2777 (2001).

[6] Osa, A., Miura, K., Sugimura, A., Nishibashi, K, Miike, H., "Image enhancement using a motion sharpening model of human vision," Reports of the Technical Conference of the Institute of Image Electronics Engineers of Japan, 09-02-09, pp.49-54, 2009. (in Japanese)

Conclusions

- PF-t-USM can represent motion information into a still image.
  - Motion intensity was represented into a target frame.
  - Rough motion direction was represented into a target frame.
  - This method can makes motion illusion in a target frame in some cases.