29 Real-world motion that the body sees

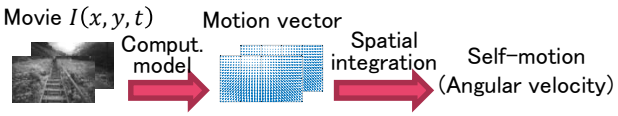
- Distinct visuomotor control revealed by natural statistics -

Abstract

Visual motion has critical roles for quickly adjusting posture, eyes, and limbs in dynamic interactions with environments. By behavioral experiments and synthetic model simulations, we have tried to reveal fundamental mechanisms of implicit visuomotor processing. It is difficult to retrieve detailed information about the scene from highly blurred image. However, we found that blurred image sequence can provide higher estimation accuracy of rapid self-motion than the original image sequence. Interestingly, implicit motor responses of hands and eyes are highly sensitive for low-spatial frequency stimuli. These results suggest that the brain knows the importance of low-spatial frequency component to code the high-speed self-motion from the statistical relationship between visual motion and head/posture fluctuation. This type of visuomotor control would be helpful to realize a novel visual processing for moving robot.

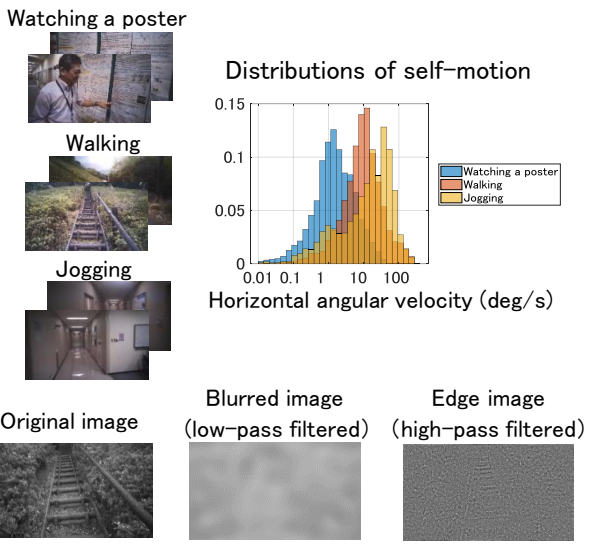
Procedure of self-motion estimation

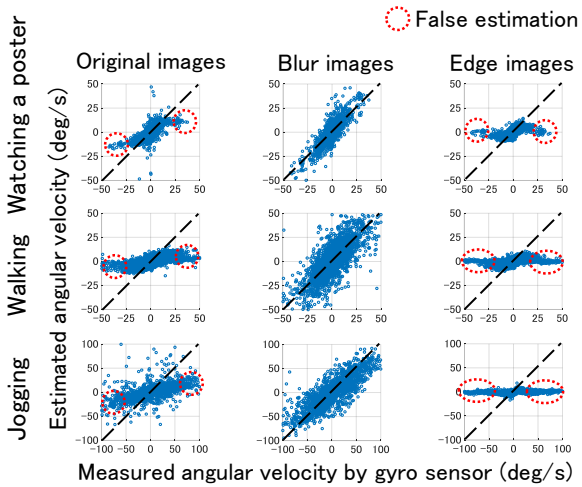
- We employed a computational model which reproduced human visual processing properties[1]



Natural statistics of self-motion & estimation accuracy of proposed model

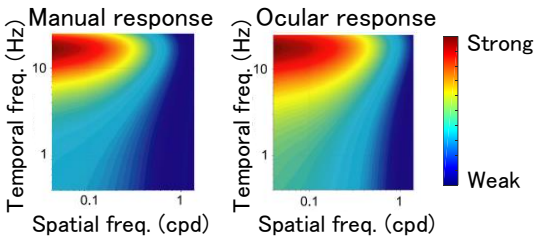
- Blurred images provided highest estimation accuracy (center column of scatter plots)
- Motion signals in low-spatial frequency are important to estimate self-motion





Human studies: implicit motor responses induced by visual motion[2]

- Spatiotemporal tunings of implicit motor responses are highly sensitive to low-spatial frequency stimulus



The body sees blurred images to estimate rapid self-motion information

References

[1] 中村大樹, 佐藤俊治, “計算論的に最適な速度推定器によってMT野細胞の複雑な反応特性を説明する,” in *第27回日本神経回路学会全国大会*, 2017.

[2] H. Gomi, N. Abekawa, S. Nishida, “Spatiotemporal tuning of rapid interactions between visual-motion analysis and reaching movement,” *The Journal of Neuroscience*, vol. 26, No. 20, pp. 5301-5308, 2006.

[3] D. Nakamura, H. Gomi, “Statistical analysis of optic flow induced by body motion characterizing OFR and MFR,” in *JNNS satellite meeting*, 2018.

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