The Interaction of Low-Level Computation and High-Level Modulation in Human Stereopsis

Jong-Tsun Huang,[1] Da-Lun Tang,[2] Jy-Chyi Yuan,[3] Shwu-Lih Huang,[4] and Shojiro Sakurai[5]

[1]Graduate Institute of Neural and Cognitive Sciences, China Medical University

[2]Department of Mass Communication, Tamkang University

[3]Department of Psychology, Fu-Jen Catholic University

[4]Department of Psychology & Research Center for Mind, Brain and Learning, National Chengchi University

[5]Department of Psychology, Kaohsiung Medical University

The present article reviews a set of studies that were conducted in the period of 1983-2000 for a test of the evolving computational vision theory after the posthumous publication of Marr's (1982) classic on vision. Two pillars of the main architecture, namely, the spatial correspondence assumption and the fundamental assumption of stereopsis, with their realization into a successful implementation of cooperative algorithm were briefly described and put into a series of critical tests. A summary evaluation was suggested to highlight the plausibility and inadequacies concerning an application of retinal matching constraints (especially, the constraint of compatibility) in human stereoscopic processing. An alternative approach based on the operation of conjunctive and vergent eye movements in finding hidden disparities has been simulated to show its successful resolution of visual recovery, and henceforth, inverse optics. Further experimental evidence were provided to show the operational precedence of disparity and contour information with a compromise to the modulation of high-level factors in human stereoscopic processing. High-level influence could be brought into effect to resist the stereo capture to a positive disparity plane where residing the illusory contour while a Chinese character was resting on a zero-disparity background. A similar result was also observed in a stereoscopic experiment on bistable figure. Monocular cues were shown to be effectively modulating the disparity computation. The study also maintains that a cognitive interpretation can not be excluded in the discussion of disparity interpolation in the blind-spot area. The study therefore proposes that an evolving computational vision theory should better take feedback mechanism into account to deal with the intricate interaction of low-level computation and high-level modulation.

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