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Vestibular contributions to optic flow processing

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ABSTRACT OF THE TALK

The visual system is specialized to extract behaviorally relevant information from optic flow, which is the characteristic pattern of visual motion produced on the retina during self-motion and object motion. Signals from the vestibular system can facilitate this processing. The vestibular system is composed of tiny biomechanical linear and angular accelerometers in the inner ear. We examined vestibular contributions to optic flow processing in two separate psychophysical experiments. Both experiments were conducted using a virtual reality motion simulator consisting of a hexapod motion platform and attached stereo visual display. The first experiment measured discrimination of object motion during self-motion. Local motion signals inconsistent with the global flow are generated by objects moving relative to the scene, so the nervous system must 'parse' retinal image motion in order to estimate object motion and self-motion separately. We hypothesized that simultaneous vestibular self-motion would facilitate this parsing process. In support of this hypothesis, we observed that thresholds for discriminating object motion were reduced in the Visual-vestibular condition relative to Visual-only. The second experiment measured and compared visual, vestibular, and combined visual-

vestibular thresholds for discriminating the direction of linear self-motion, i.e. heading, in the horizontal plane. Both visual and vestibular estimates of heading were less reliable when the direction of self-motion was eccentric, i.e. away from straight ahead. Single-cue reliability measures were used to predict 1) the maximum-likelihood (ML) increase in reliability during combined visual-vestibular heading estimation and 2) the visual and vestibular ML weights. On average, combined visual-vestibular estimates were more reliable than single-cue, and close to the ML predictions. Observed weights were also close to the ML predictions, with one notable exception: visual weights were much lower than predicted for discrimination around straight ahead.