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Contrast Saturation in First- and Second-Order Motion Perception
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A novel pedestal-plus-test paradigm is used to determine the nonlinear saturation properties of the first-order (luminance) and second-order (texture-contrast) motion systems, that is, how these systems' responses to motion stimuli are reduced by pedestals and other masking stimuli and how these systems' responses fail to remain proportional to stimulus contrast even for motion stimuli themselves. Motion direction thresholds were measured for test stimuli consisting of drifting luminance and texture-contrast modulation stimuli superimposed on pedestals of various amplitudes. (A pedestal is a static sinewave grating of the same type and same spatial frequency as the moving test grating.) Results. First-order motion-direction thresholds are unaffected by small pedestals, but at pedestal contrasts above 1 to 2% (5 to 10x pedestal threshold), motion thresholds increase proportionally to pedestal amplitude (a Weber law). For first-order stimuli, pedestal masking is specific to the spatial frequency of the test. On the other hand, motion-direction thresholds for texture-contrast stimuli are independent of pedestal amplitude (no saturation whatever!) throughout the accessible pedestal amplitude range from 0% to 40%). However, when baseline contrast increases (with constant pedestal amplitude), motion thresholds increase. Note that baseline (carrier) contrast is inherently independent of spatial frequency of the test (modulator). the drastically different saturation properties of the two motion systems and many related results are encompassed in a functional theory. The stimulus inputs to both first- and second-order motion process are normalized by similar contrast gain-control mechanisms. The different saturation properties arise from different inputs and controlling signals to the gain-control mechanisms.