MBS 01-02

Sensitive Calibration and Measurement Procedures Based on The Amplification Principle in Motion Perception

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We compare two types of sampled motion stimuli: Ordinary periodic displays with modulation amplitude $m_{o=e}$ that *translate* 90 degrees between successive frames; sandwich displays with even-numbered frames are of one type, odd-numbered frames are of the same or different type, and (1) both types have the same period, (2) translate in a consistent direction 90 deg between frames, and (3) even frames have modulation amplitude m_e, odd frames have modulation amplitude m_o. In both first-order motion (van Santen & Sperling, 1984) and second-order motion (Werkhoven, Sperling, & Chubb, 1993) the motion strength of sandwich stimuli is proportional to the product $m_o m_e$ for a wide range of m_e. By setting m_e to a large value, a sandwich stimulus with a very small value of m_o can still produce visible motion. The amplification factor is is the ratio of two threshold modulation amplitudes: ordinary $\hat{m}_{o=e}$ over amplified $\hat{m}_o$, $\hat{m}_{o=e} / \hat{m}_o$. We find amplification factors of up to about 8x.

Light adaptation and contrast gain control in early visual processing distort the representations of visual stimuli so that inputs to subsequent perceptual processes contain undesired distortion products or "impurities." Motion amplification is used to measure the thence to reduce these unwanted components in a stimulus to a small fraction of their threshold. Such stimuli are certifiably pure in the sense that the residual impurity is less than a specified value. Six applications are considered: (1) Removing (first-order) luminance contamination from (second-order) texture gratings; (2) removing luminance contamination from chromatic gratings to produce pure isoluminant gratings; (3) removing distortion products in luminance-modulated (first-order) gratings--by iterative application, all significant distortion products can be removed; (4) removing second-order texture contamination from third-order motion displays; (5) removing feature bias from third-order motion displays. (6) The same general principles are applied to spatial configurations in which the x,y spatial coordinates replace the x,y motion coordinates. In all applicable domains, the amplification principle provides a powerful assay method for the precise measurement of very weak stimuli, and thereby a means of producing visual displays of certifiable purity.