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Second-Order Illusions: Mach Bands, Chevreul, and Craik-O'Brien-Cornsweet
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Mach bands, which normally occur at the edges of ramp modulations of luminance, are demonstrated to occur in fullwave stimuli that have ramp modulations of contrast while maintaining constant expected luminance. {The fullwave stimuli are random textures that (1) have a ramp contrast modulation that is exposed by fullwave rectification (e.g., absolute value or square) or by halfwave rectification but (2) have a uniform expected luminance throughout, so the modulation remains hidden without rectification.} Two different textures were used: random pixels and "Mexican hats". Stimuli were presented dynamically, with a new instantiation of the texture every 67 msec (this enhances the magnitude of the illusion). Both fullwave Mach-band stimuli exhibit perceptual Mach bands that are decreases or increases in apparent texture contrast with no concommitant change in apparent brightness. The perceived contrast bands in fullwave Mach stimuli and the brightness bands in a conventional luminance Mach-band stimulus have approximately the same magnitude. Chevreul (staircase) illusions in luminance and in fullwave patterns also are found to have approximately similar magnitudes, as do luminance and fullwave Craik-O'Brien-Cornsweet illusions. None of these illusions can be perceived with halfwave textures. These results indicate that second-order (texture) illusions result from fullwave, not halfwave, rectification and involve spatial interactions that are remarkably similar to those in first-order (luminance) processing.