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Computational Modeling of Depth-Ordering in Occlusion through Accretion or Deletion of Texture

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Abstract

Understanding the depth-ordering of surfaces in the natural world is one of the most fundamental operations of the primate visual system. Surfaces that undergo accretion or deletion (AD) of texture are always perceived to behind an adjacent surface.

An updated ForMotionOcclusion (FMO) model (Barnes & Mingolla, 2013) includes two streams for computing motion signals and boundary signals. The two streams generate depth percepts such that AD signals *together* with boundary signals generate a farther depth on the occluded side of the boundary. The model fits the classical data (Kaplan, 1969) as well as the observation that moving surfaces tend to appear closer in depth (Royden *et al.,* 1988), for both binary and grayscale stimuli.

The recent 'Moonwalk illusion' described by Kromrey *et al.* (2011) upends the classical view that the surface undergoing AD always becomes the background. Here surface that undergoes AD appears to be *in front* of the surrounding surface; a result of the random flickering noise in the surround. As an additional challenge, we developed an AD display with dynamic depth ordering. A new texture version of the Michotte rabbit hole phenomenon (Michotte, Thinès, & Crabbé, 1964/1991) generates depth that changes in part of the display area.

We will show simulations that explain the workings of the new version of the model. The model now uses a simplified push-pull mechanism to generate depth-order signals. Because the FMO model separates the computation of boundaries from the computation of AD signals, it is able to explain the counter-intuitive Moonwalk stimulus. We will show detailed simulations explaining the Moonwalk illusion as well as the textured Michotte rabbit hole phenomena.

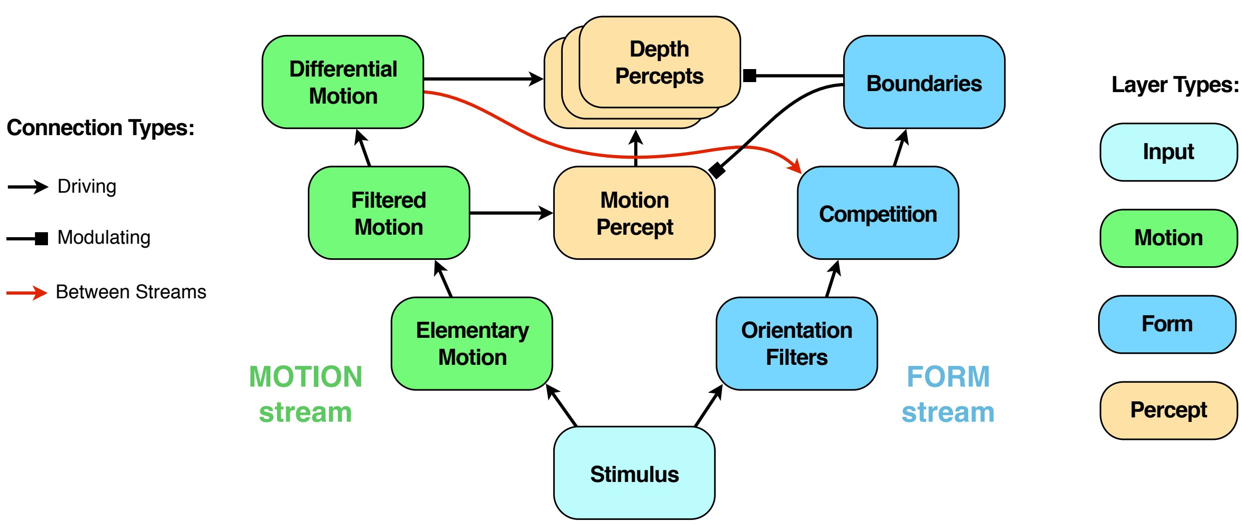

Figure: The structure of the ForMotionOcclusion model.