Bayesian modeling of binocular vision

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The PERCEPTION team at INRIA investigates stereoscopic vision. Over years we have studied the geometry of binocular vision, e.g., [1] and developed several stereo matching algorithms based on seed-growing [2,3,4]: The seed-growing principle is very simple: the matching that starts from a small number of control points which are then propagated to yield a dense disparity map. This yields a maximum a posteriori (MAP) formulation that leads to a series of local minimization problems that are solved hierarchically by a range growing process. While this method is sub-optimal, it allowed us to devise an intrinsically efficient methodology that bridges the gap between MRF-based global optimizers and locally optimal winner-take-all strategies. These developments formed the basis of a fast stereo implementation that runs on the NAO humanoid at 10 frames/second.

In this master project we propose to study the seed-growing stereo matching algorithm from the perspective of human stereopsis: Recently, it has been postulated that the visual cortex implements Bayesian inference [8] and that MRF could form the basis of a biological model of stereopsis [9]. We propose to investigate the biological plausibility of seed growing, the link between stereopsis and the perception of texture [10], the role played by the complex cells for representing local image structure [11,12], and the importance of the top-down data that is fed into visual areas V1 and V2 from other "higher-level" cortical areas.

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