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Generic Bio-inspired Chip Model-Based on Spatio-temporal Histogram Computation: Application to Car Driving by Gaze-Like Control

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Abstract. A neuromorphic generic chip has been developed for human-like perception, from 1986 onwards. Similarly to the brain, the chip intertwines three aspects of visual perception, respectively related to color vision, to movement detection and to border identification. These so-called *Global*, *Dynamic* and *Structural* perceptions are processed on-line by a family of spatio-temporal histogram computations. The interconnected histograms mimic the brain's "What and Where" mode of visual processing. The chip's capabilities are demonstrated here with an automatic car driving simulation that mimics the human gaze control on the steering wheel.

Keywords: generic chip, spatio-temporal histogram, model-based processing, bio-inspired, neuromimetic, perception, vision, gaze control, car driving, GVPP, BIPS.

1 Introduction

Long ago, we observed that histogram computation is an efficient solution to conventional imaging processing, provided that a correct choice of input signals is made. In such case, it provides good results with little software development.

The goal is to emulate the human perception by a silicon chip. Opposing characteristics between human and silicon computations are the number of connections and speed of computation. With a product of the two latter values, i.e. the number of connections by the speed, is an index of the computational complexity of a perceptual task. By contrast with the brain, the silicon chip can easily sample in time at high speed the sensory signals in accordance with the Shannon's law.

The design of our chip is similar to the brain in that the sensor input is filtered in modalities, themselves divided in criteria. Modalities are defined as *Global* with the three criteria of luminance, hue and saturation, *Dynamic* with the three criteria of temporal variation, direction and velocity of motion, and *Structural* with the three criteria of oriented edges, curvature and texture.

The brain's cerebral cortex simultaneously processes temporal and spatial information at multiple levels of scale. At the higher level, a parietal magnocellular

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