Advantages of bio-inspired frameless vision sensors over frame-based vision systems

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***Abstract*— In this presentation, the advantages of bio-inspired vision sensors over conventional frame-based vision systems will be discussed. Examples of practical applications where bio-inspired vision sensors perform better than frame-based systems will be given and explained. During the exposition, experimental results and videos recorded with bio-inspired frameless vision sensors will be shown.**

I. Introduction

During the last 15 years, the demand of vision sensors has grown significantly. Such demand is mainly due to the success of cell phones and the fast development of Internet and social networks. Nowadays we are accustomed to transmit or receive images and videos when we use our computer or our smart phone.

In parallel, requirements for vision sensors have become more and more restrictive: low power consumption, good fill factor, high dynamic range, high sensitivity, etc. Specific sensors are designed for each particular application: surveillance, photography, traffic monitoring, etc. In general, it is difficult or impossible to design an imager suitable for all these tasks.

Conventional vision sensors are frame-based systems (also known as imagers). A frame is a 2D-dimensional matrix that contains information about the visual scene (typically light intensity or color). Such sensors provide images with excellent quality, but they have same disadvantages that make them not suitable for some applications. They always provide a continuous output data flow (frames are transmitted with a continuous frequency) that can be very redundant if the visual scene does not change. If we compare their performance with the human retina, we can state that they perform worse in the majority of uncontrolled situations and environments: their dynamic range is much lower, their sensitivity to light is also lower, and their power consumption is much higher.

For these reasons, some authors considered the idea of developing bio-inspired vision sensors (also called retinae). These sensors try to mimic the interactions of the cells of the human retina. The retina operates in a very different way than conventional vision sensors. Its cells process the visual information before transmitting it to the brain. Thus, redundant information is not sent to the optical nerve. Retinal cells can compute the spatio-temporal contrast that contains almost all the relevant information about the visual scene. This information is transmitted continuously. There is a massive parallel architecture and cells can send anytime spikes to the brain. Therefore biological systems are inherently faster than classic imagers which bandwidth is limited by the frame rate.

II. Conference presentation

In the conference exposition, the advantages of bio-inspired vision sensors will be discussed. Videos and experimental measurements taken with three different retinae (some of them tested in our laboratories) will be shown: The first one [1] can detect the spatial contrast and reduces significantly the output data flow. The second one [2] can operate a very high speed and can detect, for instance, objects rotating at *600,000 rpm*. The third one [3] has an innovative system to detect color information saving area and provides an output data flow proportional to light intensity.

We will conclude the presentation describing one novel vision sensor that we are currently testing at the University of Oslo. This sensor is targeted for WSN (Wireless Sensor Networks). In such kind of networks, sensors with reduced output data flow, very low power consumption, and high dynamic range are desirable. These constrains make frameless sensors more suitable for their usage in network nodes.

References

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