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Programmable Opto-electronic CNN implementation provides a new and powerful tool for image processing applications

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Abstract. An opto-electronic CNN implementation, as it combines the huge inherent computational capabilities of a massively parallel optical system with programmability of the CNN-UM systems, provides an efficient frame for diverse image processing applications. Our optical CNN implementation is based on a new, semi incoherent optical correlator architecture that is superior from several points of view to any alternative optical correlator. This architecture provides the possibility of real time reprogramming of the correlator like in the joint Fourier transform correlators, but preserves the speed of VanderLugt type of systems. Programming is done through fast holographic read-out by B-templates. With combination of a high speed CNN-UM sensor chip it forms a programmable opto-electronic analogic computer (POAC) architecture. This device is especially useful in those image-processing algorithms, which requires a great number of pattern matching tasks.

1 Introduction

Image understanding (pattern recognition, classification etc.) is important task in image processing applications. Moreover, its realization requires several image-processing steps. Optical correlators can fulfill these tasks efficiently because the computation is accomplished by physics in a vastly parallel way. Our optical correlator with an embedded visual CNN-UM chip forms a programmable opto-electronic analogic computer (POAC) architecture what is intended to compare and process images with several TeraOps speed.

Demands for fast identification and tracking of targets in surveillance systems has been increasing dramatically during the last years [1], [2]. Although the known optical processors can fulfil these task with the required speed, they are usually not flexibly programmable [3], [4], [5]. Another problem of optical processors is that they require considerable pre- and post-processing (spatial filtering, adaptive thresholding, analog storage, further nonlinear processing). As these computations are usually accomplished by a DSP system, the serial download (upload) of the gained results restricts overall performance. An optical processing systems is

1

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