

Thesis:
Bio-Inspired Vision Model Implementation
In Compressed Surveillance Videos

by

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Abstract

In this thesis, the application of biomimetic vision models is proposed and evaluated in the field of surveillance video enhancement. It is argued that conventional video compression and representation, even that which is used in surveillance applications, is optimised for entertainment purposes and is demonstrably compromised when it comes to retention of details of relevance to recognition of surveillance-relevant objects such as faces and car licence plates.

Four sets of investigations with experimental results are presented. These are the application of three stages of biomimetic modelling of the blowfly eye and psychovisual system:

1. The Photoreceptor Model as a non-linear temporal enhancement method. It is demonstrated that the contrast enhancement introduced by this process improves object recognition under real-world lighting conditions, with specific application to the recognition of shapes (i.e. playing card suits in our experiments).
2. The Laminar Monopolar Cell (LMC) model as a non-linear spatio-temporal information compression stage. This stage retains, in particular, the details of moving objects in the field of view. The application of this stage to car licence plate alpha-numeral characters is demonstrated as a pre-processing stage before conventional MPEG-like video compression is applied. It is shown that under low to moderate levels of video compression and under realistic lighting conditions, that distinguishing features between similar characters are retained, hence improving the performance of subsequent character recognition.
3. Elementary Motion Detection (EMD) as a subsequent biomimetic stage which measures velocity in the field of view. The EMD is applied as a detector of moving objects in the field of view, which are subsequently investigated as a Region of Interest in surveillance applications. It is demonstrated under complex lighting conditions that car licence plate details can be retained at high compression rates using this approach, especially when combined with LMC enhancement, compared with conventional approaches with the same data bandwidth constraints.
4. The LMC and EMD models are also considered in a preliminary study of facial feature enhancement and recognition. It is demonstrated that facial features are retained at lower data rates than conventional signal processing approaches would support.

Results are compared with conventional signal-processing based enhancement approaches, and computational complexity is also considered. It is argued and demonstrated that the biomimetic approach is not only effective in improving recognition rates through the retention of structural details in enhanced video sequences, but that the enhancement is of relatively low computational complexity, and is highly suited to contemporary parallel graphics processing.



Statement of Originality

This work contains no material that has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and believes, contains no material previously published or written by another person , except where due reference has been made in the text.

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Publications

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2. Poursoltan , S. Brinkworth , R. Sorell , M “Biologically-inspired Video Enhancement Method For Robust Shape Recognition” Intl Conference on Communications, Signal Processing, and Their Applications (ICCSPA), February , 2013



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