Brain Research Association Abstracts, 12 (1995), p. 68.

MODELLING VISUAL LATENCIES, MASKING AND SYNCHRONIZATION G. Bugmann and J.G. Taylor*. Neurodynamics Research Group, School of Computing, University Plymouth, Plymouth PL4 8AA, UK. * Department of Mathematics, Kings College London, London WC2R 2LS, UK.

Why does visual information take approximately 10 ms to propagate from one neuronal relay to another, while single spikes take only 1 ms ? In masking experiments, how can visual information presented later in time affect the processing of earlier information ? About synchronisation of neuronal firing, how can neurons in earlier stages of visual information processing "know" that they code for the same complex object and bind together its features by synchronising their firing ?

Responses to these questions are suggested from the study of simple pyramidal multilayer neural network representing the subset of visual neurons causing one neuron in a higher layer to fire. The network is made of coincidence detecting spiking neurons. These are provided with short-term memory properties in the form of sustained firing induced by a local cluster of excitatory neurons. Thereby, information on detected coincidences is retained locally until target neurons in the next layer are able to process it. The sustained firing is then interrupted, or reset, by a feedback signal from these target neurons. This model has been simulated, analysed theoretically and exploited to fit physiological latency data in monkey and psychophysical masking data in human.

We suggest that a possible cause of long visual latencies is the retinal jitter which causes a temporal fragmentation of visual inputs. This causes also a spatial spread of visual information over several layers and allows interferences between visual inputs occurring at different times. Finally, the resetting feedback has the effect of synchronising input neurons coding for the pattern recognised in higher areas, once recognition has occurred.

To conclude, this model is obviously too simple but it is intriguing that it allows to describe a number of apparently unrelated phenomena. It predicts also several observations. For instance: - manipulating the retinal jitter should have a considerable effect on visual latencies; - masking experiments should result in a fraction of visual neurons showing prolonged sustained firing; - synchronisation of distant neurons in a visual area can be caused by top-down feedback projections.