

Biology inspired pattern recognition system using neural oscillations

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ABSTRACT

We propose an image recognition system based on a two-layered spiking neural network. Each neuron uses integrate-and-fire model. Intra-layer communication is used for image segmentation, and extra-layer communication is used to match similar regions in both images. The algorithm uses temporal correlation, which is thought to be present in visual cortex.

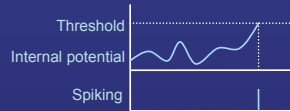
A pattern is presented on the first layer, then a scene is presented on the second layer. If the pattern is found in the scene, a time synchronization of neurons representing the pattern on both layer will occur. If it is not found, neurons will not synchronize. The main advantage of this approach is its robustness to affine transforms and small distortions.

We present here some preliminary results in facial recognition and object recognition contexts.

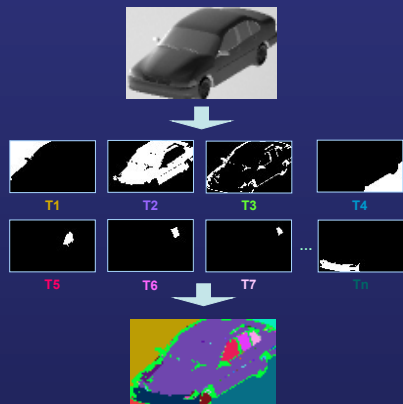
SPIKING NEURON

Biology inspired neuron

- The neuron spikes when internal potential reaches a defined threshold.



SPIKE TIME SYNCHRONIZATION



SIMULATOR

Discrete event-driven simulation

- Discharge phases are considered as events.
- These calculations are made for each event:
 - Neurons update
 - Finding next event

ODLM

Oscillatory Dynamic Link Matcher

PREPROCESSING

(size, color, contrast, ...)

SEGMENTATION

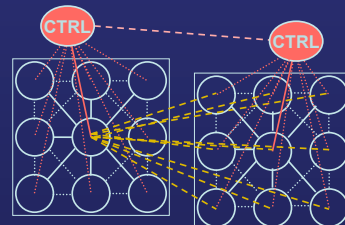
MATCHING

Segmentation through temporal correlation

- Single layered spiking neural network with global controller (**CTRL**)
- A neuron for each pixel
- Intra-layer connection: each neuron is connected with its 8 neighbours

Matching through temporal correlation

- Two-layered spiking neural network with global controller (**CTRL**)
- Extra-layer connection: each neuron is connected to all other layer's neurons
- Matching is not affected by affine transforms (rotation, translation, symmetry, scaling)

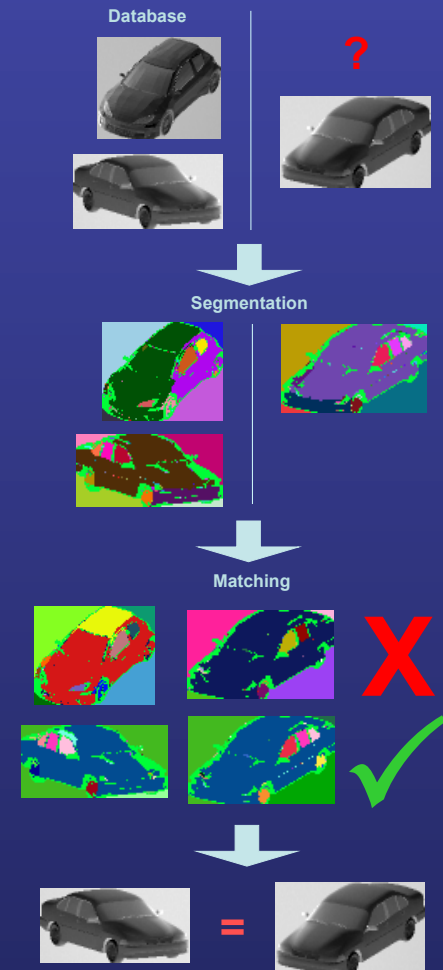


Segmentation : Blue links
Matching : Orange links (for one neuron)

FACE RECOGNITION



OBJECT RECOGNITION



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REFERENCES

- R. Pichevar, J. Rouat and Le Tan Tanh Tai, "The Oscillatory Dynamic Link Matcher for Spiking-Neuron-Based Pattern Recognition", Neurocomputing (Elsevier), Vol. 69, October 2006.