A Biologically-Motivated Approach to Online Learning of a Dictionary of Features from Natural Images for Computational Object Recognition

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Ongoing neuroscientific researches on information processing in the brain have gained sufficient knowledge to build simple computational models, which simulate the neuronal behaviour. However, there are still only a few applications that make use of the potential of neurobiological findings, although this could lead to a new generation of technical systems, which can exceed the capabilities of state-of-the-art systems.

With our research we aim to pursue the integration of neural information processing functionality into technical systems like humanoid robots. Our system is based on HMAX, initially proposed by Serre, Wolf and Poggio, which models the ventral pathway in the areas of the visual cortex. It uses a set of patches as a so-called dictionary for the generation of feature vectors for classification. These patches can be seen as fixed and tuned artificial neurons, which react to certain stimuli. In the standard HMAX model, this set is created randomly over a set of images. Naturally this results in a non-optimal set with overrepresented and redundant features.

Our method is motivated by the functionality of lateral-inhibition in neurons. We imitate this behaviour by allowing only one feature in our set to react to certain stimuli, while the other features remain under a certain response. With this method we gain a greater representation in form of redundancy and a more distinct response to visual input, which enhance the training of a classifier. This gives us the advantage to choose any setting between a.) speeding up the computation by reducing the size of the dictionary while keeping the classification accuracy at the same level; and b.) keep the size of the dictionary gaining better classification accuracy when needed. The learning procedure is performed online by feeding the system with a continuing stream of natural images of positive and negative training examples until the dictionary is fully trained.

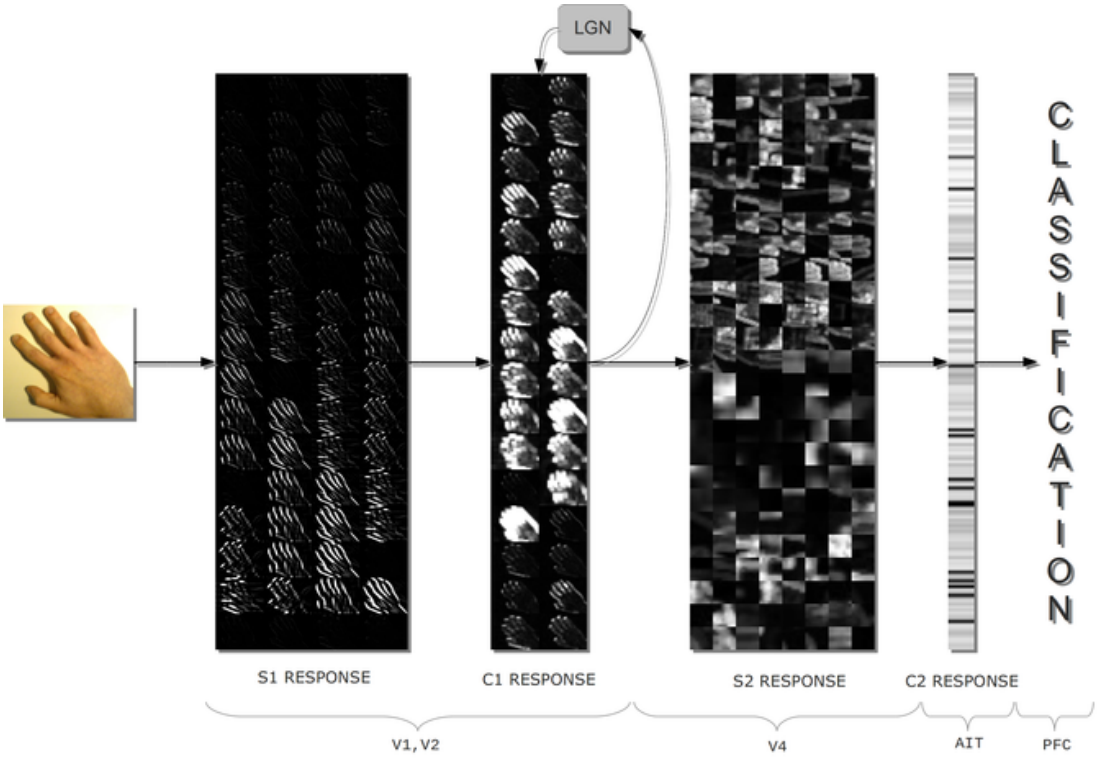

Figure 1: Object Classification System

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References

[1] T. Serre, L. Wolf, S. Bileschi, M. Riesenhuber, and T. Poggio, "Robust object recognition with cortex-like mechanisms." IEEE transactions on pattern analysis and machine intelligence, vol. 29, no. 3, pp. 411–26, 2007.

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