I know what you are doing: A spiking neural architecture for action understanding

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【Background & purpose】 Infants are able to early develop cooperative behaviors toward others without explicit rewards. Such behaviors show that even young infants have the ability to understand other's intentions. Some researchers suggest that the ability to understand others is supported by the mirror neuron systems, which fire both when executing and observing similar goal directed actions. This paper presents our computational model to reproduce the emergence of an action understanding function in a robot interacting with its environment.

【Method】 We developed an artificial neural network named adaptive Liquid State Machine* (aLSM). The aLSM is made of an input and an output layer with a reservoir in between (randomly connected neurons). Each neuron of the reservoir spikes if it is activated and has a residual activation charge. The particular importance is that adapts the network adapts its internal parameters to the environmental ambiguity. First the learning rate (LR), how fast the output connection weights are updated. Then the charge decreases (CL), how quickly the activation charge decreases.

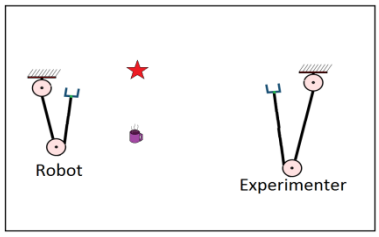

Fig. 1: Experiment setting for 2 objects.

Fig. 1 shows the experiment setting, the robot arm on the left and the experimenter's arm on the right. During the learning phase, the robot tries to reach for each object and learns the correspondence between the visual information and the goal of the action. During the testing phase, the robot predicts the goal of the other's action toward one of the objects.

【Results and discussions】 As shown in Fig. 2 B., the success rate more important when the environment is taken into account compare to the other case. The experiments have been conducted in several environment setting (object position and CL and LR that depend, or not, on the environmental ambiguity) and each time best performances appear for the environmental dependent settings.

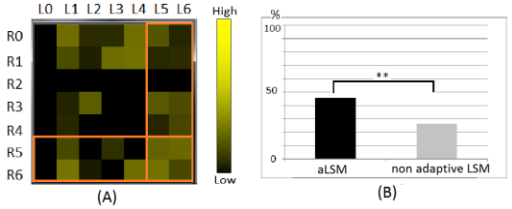

Fig. 2: Statistical results. (A): Effect of the variation of 2 parameters (L & R) of success rate. Orange parameters are environment dependent. (B). Average success rate with and without environmental dependency.

These results demonstrate the importance of including the environmental information into the learning loop in order to acquire better emergence of new functions such as action understanding. Future experiments will be conducted with a real kids sized robot.

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* Liquid State Machine: Neural network made of spiking neurons. The network is divided into 3 layers: Inputs, outputs and a middle reservoir composed by a large number of randomly connected neurons.