Know your body through intrinsic goals: a computational model

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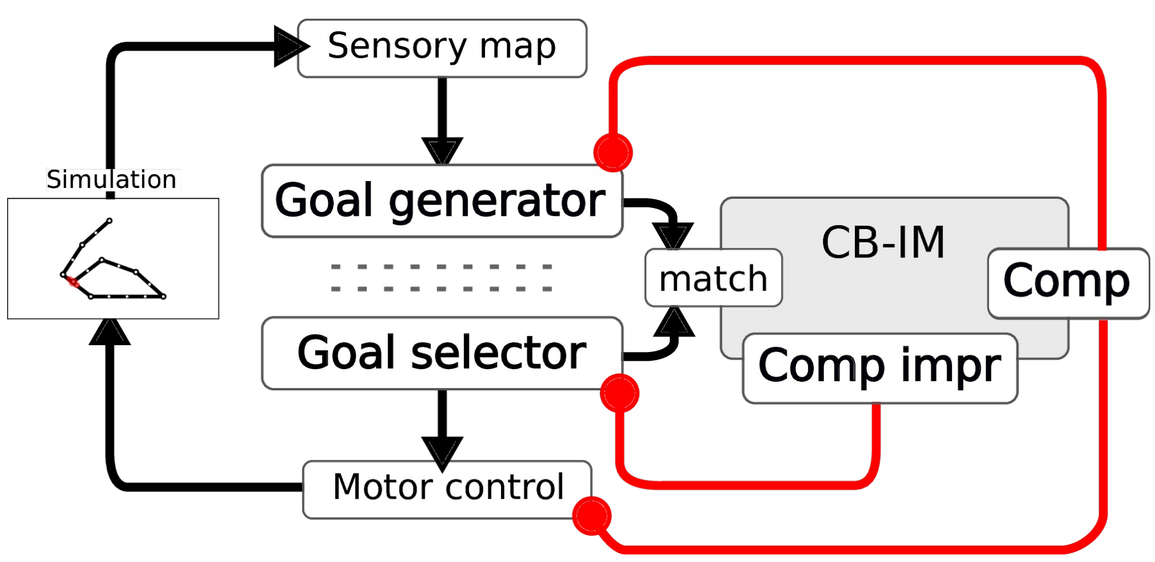
Hypothesis

Newborn children immediately start to play with their own body. Thus they autonomously form a sensorimotor map and a repertoire of actions that constitutes the core of future cognitive and motor development. We propose the computational hypothesis that this **acquisition of early knowledge is guided by goals autonomously generated and set** on the basis of **intrinsic motivations**.

Model

In the model two internal layers share the same topological structure. The first computes the clustering of sensory inputs (**Goal generator**) and the second implements the selection of goals (**Goal selector**). When the activities of the two layers overlap (**match**) the given sensory state is contingent to the selected goal. These match events are used to compute a **competence-based motivational signal for the learning of both the sensory clustering and the motor behaiours**.



Model components:

1) a **SOM** for the acquisition of abstract representations based on the sensory input (touch); 2) a **SoftMax** selection for choosing goals on the basis of competence-based intrinsic motivations; 3) an **ESN** controlling the movements of the robot; 4) a **predictor** of goal reaching to measure competence; 5) a generator of the **competence-based signal** biasing the activity of the other components.

References

Santucci, V. G., Baldassarre, G., and Mirolli, M. (2016). GRAIL: a Goal-discovering Robotic Architecture for Intrinsically-motivated Learning. IEEE Transactions on Cognitive and Developmental Systems 8, 214–231

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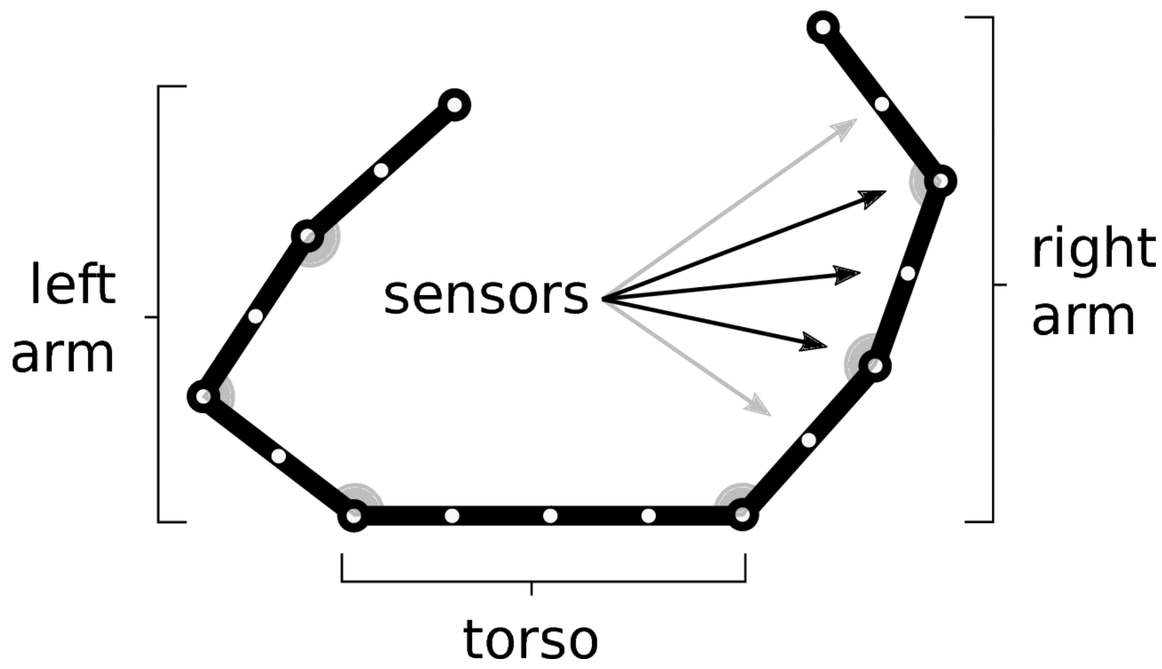
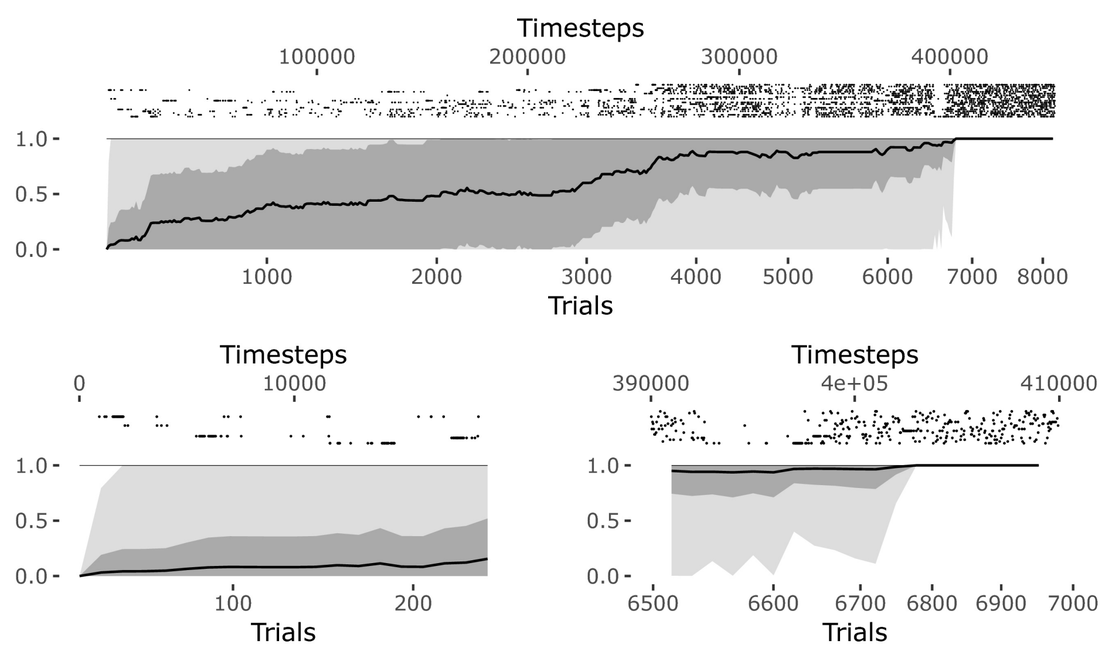
Simulation

The model is tested as the controller of a simulated simple planar robot composed of two kinematic 3DoF arms exploring own body in a 2D environment.



Results

Stability:



Performance: