Know your body through intrinsic goals: a computational model

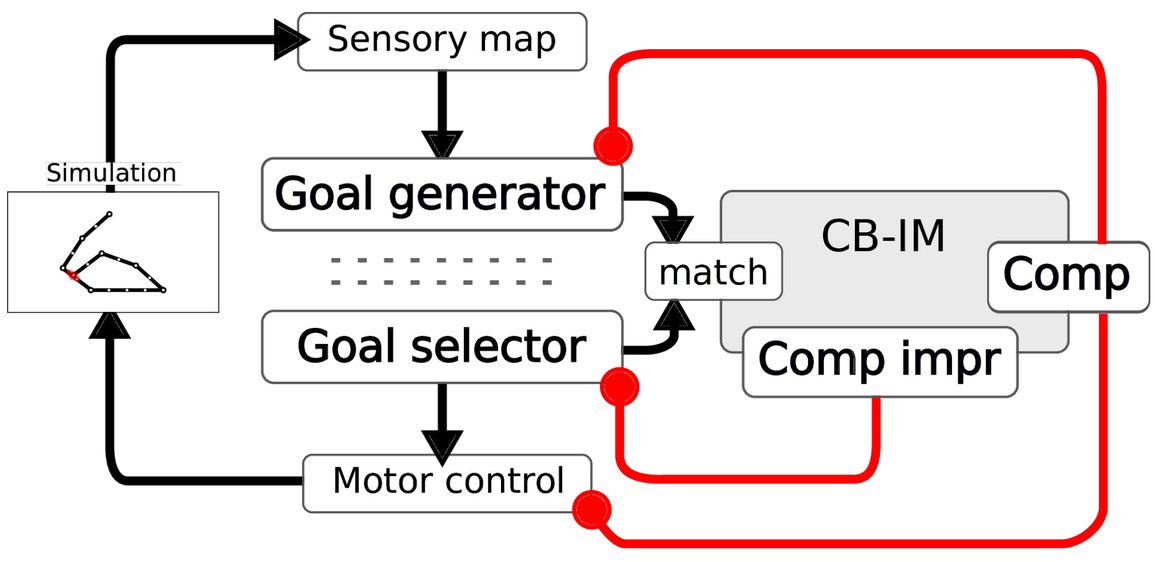
Francesco Mannella, Vieri Giuliano Santucci,
Eszter Somogyi, Lisa Jacquey ,Kevin J. O'Regan,
Gianluca Baldassarre

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:

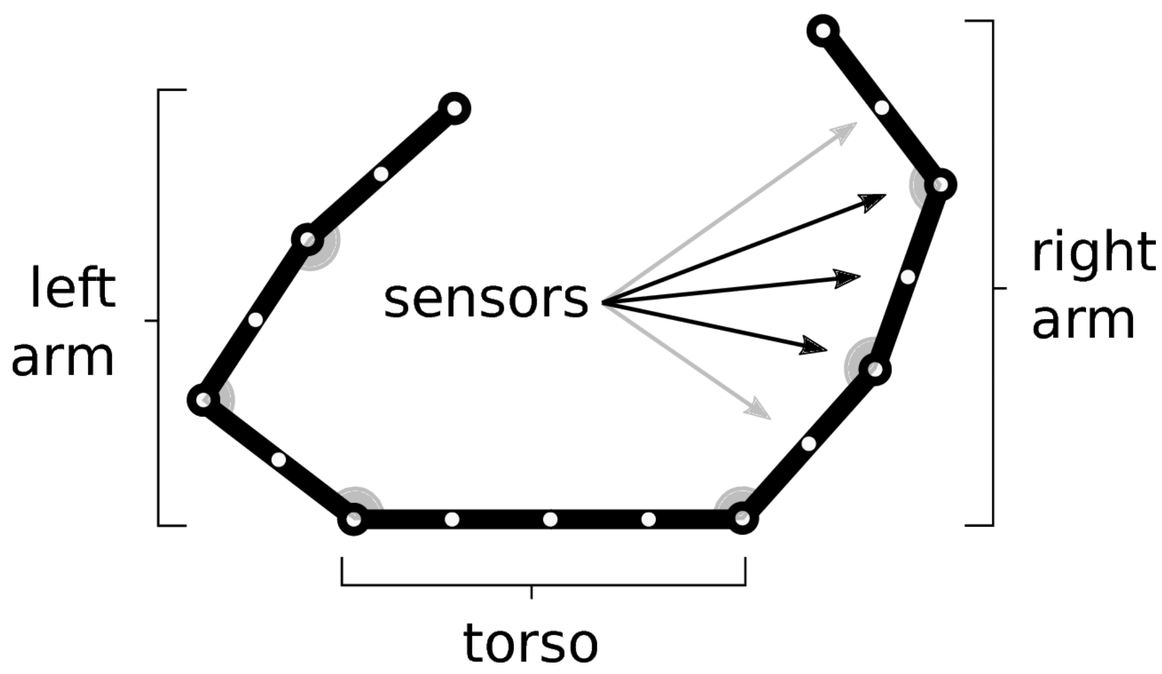
1) a **SOM** for the acquisition of abstract representations based on the sensory input (touch); 2) a **SoftMax** selection for choosing goals on the basis of competence-based intrinsic motivations; 3) an **ESN** controlling the movements of the robot; 4) a **predictor** of goal reaching to measure competence;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

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: