Gain-Fields Neural Networks for Body Image and Embodied Simulation in Robots

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The so-called self-other correspondence problem in imitation demands to find the transformation that maps the motor dynamics of one partner to our owns. This requires a general purpose sensorimotor mechanism that transforms an external fixation-point (partner's shoulder) reference frame to one's own body-centered reference frame. We propose that the mechanism of gain-modulation observed in parietal neurons may generally serve these types of transformations by binding the sensory signals across the modalities with radial basis functions on the one hand and by permitting the learning of contextual reference frames on the other hand.

In a shoulder-elbow robotic experiment, gain-field neurons (GF) intertwine the visuo-motor variables so that their amplitude depends on them all. In situations of modification of the body-centered reference frame, the error detected in the visuo-motor mapping can serve then to learn the transformation between the robot's current sensorimotor space and the new one. These situations occur for instance when we turn the head on its axis (visual transformation), when we use a tool (body modification), or when we interact with a partner (embodied simulation).
Our results defend the idea that the biologically-inspired mechanism of gain modulation found in parietal neurons can serve as a basic structure for achieving nonlinear mapping in spatial tasks as well as in cooperative and social functions.

Mahé, et al. *"Exploiting the Gain-Modulation Mechanism in Parieto-Motor Neurons: Application to Visuomotor Transformations and Embodied Simulation"*, (accepted, *Neural Networks*)

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