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Neurobiologically-constrained neural network implementation of cognitive function processing in NEST –the MatCo12 model

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In the project 'MatCo: Material constraints enabling human cognition', we use neurobiologically informed network models of cognition and language. These networks implement macroscopic cortical areas and their connectivity along with microscopic ones addressing the connectivity, functionality and plasticity of neurons[1]. Such brain constrained models enable studying cognition, natural language and their relationship to basic neuroscience principles and non-cognitive sensorimotor processes. The version discussed here, called 'MatCo12', implements 12 fronto-temporo-occipital areas relevant for language and cognition, and offers neurobiological accounts for example for neural changes following sensory deprivation[2] and for the learning of concrete and abstract concepts[3].

The MatCo12 model was built with the FELIX simulator[4,5]. To make MatCo12 accessible to a wider audience and allow for faster and larger simulations, we implemented its core building blocks in NEST[6]. The neuron model is a point neuron with an internal adaption. The Hebbian synaptic learning rule[7] determines weight changes based on low-pass filtered activity of the presynaptic neuron and the membrane potential of the postsynaptic neuron at every time step. Consequently, long-term potentiation or long-term heterosynaptic or homosynaptic depression take place. We present results showing the functionality of Hebbian learning in the NEST implementation and show first results of large-scale network simulations.

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Preferred form of presentation

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Topic area

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