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Simulating the integration of newborn neurons into brain networks

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The large-scale structural organisation of the adult brain is relatively stable and unchanging. However, in some animal species, including humans, new neurons are born and integrated into the hippocampal network throughout lifetime. The hippocampus is involved in functions such as memory formation, pattern separation, pattern completion, and spatial navigation, among others. However, how the integration of newborn neurons in the hippocampus affects its function is not clear. Most neurons in the hippocampus are born early in development and have functional properties that are distinct from the newborn cells. We suspect that this age-dependent functional distinction is responsible for the integration of the newborn cells in the existing brain networks. To assay the process of integration we have simulated models of the hippocampus where, following a maturation process, newborn neurons form plastic connections and interact with other neurons in the network. Furthermore, we aim to explore how the integration of newborn neurons contributes to hippocampal function.

We have employed the bwForCluster NEMO to run simulations in a computational neuroscience project where the integration of newborn neurons into mature brain networks is analysed. Neurogenesis in the adult brain is reported for certain parts of the brain, however, it is not known how newborn neurons affect brain function. Our simulations enable us to monitor the dynamics of activity and connectivity of newborn neurons at a level of detail which is currently not possible in real brains. First, I will briefly describe the biological background and motivation behind our work, this will be followed by a short discussion of the MPI-based simulation protocol. Finally, I will outline the results and prospects of our work.

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