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Achieving in-vitro axonal polarization by using micro-patterns
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— Our project is based on the elaboration of in vitro neuron networks as simplified models to explore the relation between neuronal architecture and biological function. Beyond a control of soma and neurite position, our first goal was to achieve in-vitro axonal differentiation of embryonic E18 hippocampal mice neurons by the mean of geometrical growth constraints, i.e. by the use of adhesive micro-patterns on silanized glass substrates. Such a process thus excludes chemical guidance or specific adhesion mechanisms. This study explores two different types of geometrical constraints. The first one, based on the centrosome role and localization, is applied to the soma, and force a choosen neurite to differentiate into an axon with 39% of efficacy (N= 160 cells, 3 different cultures). The second one derives from the suggested relationship between neurite mechanical tension and axonal differentiation, and is based on the design of wavy neurite's shape. Its efficacy reach 0.51% (N= 300 cells, 3 different cultures). The combinaison of these two constraints into a final pattern yields an efficacy of 82% (N= 83 cells, 2 different cultures). These results not only provide an important tool for creating neural model networks but also point out an important role of intrinsic neurite tension during axon differentiation.

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