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Probing Neuron Mechanics with a Micropipette Force Sensor

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Abstract : Advances in micromanipulation techniques and real-time particle tracking with nanometer resolution have enabled biological force measurements at scales relevant to neuron mechanics. An approach to precisely control and maneuver neurite-tethered polystyrene beads is presented. Analogous to an Atomic Force Microscope (AFM), this multi-purpose platform is a force sensor with imaging acquisition and manipulation capabilities. A mechanical probe composed of a micropipette with its tip fixed to a functionalized bead is used to incite the formation of a neurite in a sample of rat hippocampal neurons while simultaneously measuring the tension in said neurite as the sample is pulled away from the beaded tip. With optical imaging methods, a force resolution of 12 pN is achieved. Moreover, the advantages of this technique over alternatives such as AFM, namely ease of manipulation which ultimately allows higher throughput investigation of the mechanical properties of neurons, is demonstrated.

Keywords : axonal growth, axonal guidance, force probe, pipette micromanipulation, neurite tension, neuron mechanics
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