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Activity of large neuronal populations imaged with high speed 3D random access two photon microscopy

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Due to progress in fluorescent marking techniques, to-date, two photon microscopy allows the functional exploration of neuronal activity at multiple scales, from the sub-processes of a single cell (dendrites, single spines…), through single cells or small networks of a few neurons, up to large neuronal populations in the order of a cortical column, in vitro as well as in-vivo. Moreover, recent advances in laser scanning technology using acousto-optical devices has not only increased scanning speed (up to 30 kHz or more), but also warranted to access points randomly distributed within a relatively large volume (order of one cubic millimeter). It becomes therefore possible to investigate in real time the activity of local neuronal networks in three dimensions, at the resolution of the individual neuron. We will report on such measurements, on the challenges encountered when the spike trains have to be reconstructed from fluorescent traces recorded from large neuronal populations and on some approaches to deal with them.