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Optically measured propagation speed of action potential in dendrites during different regenerative events

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The computation properties of cortical neurons are significantly influenced by temporal distribution of neuronal inputs. Multiple inputs can either inhibit short and long term potentiation or depression depending on the time difference between them. Temporal distribution even can influence if the summation is linear or supralinear. Since propagation speed might be an important factor in network properties. Neuronal propagation speed was already measured electrophysiological with multiple (dendritic and somatic) patch-clamp. However this method is expressively complicated and it is yet impossible to perform such measurement in more than a couple points, at thin dendrites, or at very small distances. We developed new optical methods to measure propagation speed in neuronal projection, but still less phototoxic than voltage sensitive measurements. Since the number and distribution of the points under investigation are only limited by the optical properties of the system we are able to measure temporal difference both at large (~300 μm) and relatively small distances (~5 μm) in multiple points and in thin dendrites or axons. This method made us possible to support the existence of dendritic local NMDA spikes by measuring the speed difference between spikes and subtreshold events. The measured propagation speeds well met with the result measured with electrophysiology and what was got from neuronal modeling.