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Modeling Of Spatial Heterogeneity of Cytochrome *C* Oxidase Localization in Mammalian Visual Cortex

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ABSTRACT

Cytochrome *c* oxidase is one of the most important mitochondrial enzymes. It catalyzes the formation of water from molecular oxygen by oxidizing reduced cytochrome *c* in the mitochondrial respiratory chain. These reactions are associated with proton transfer across the inner mitochondrial membrane, which ensures the formation of an electrochemical gradient. The localization of mitochondria in the brain structures, in particular its cortex, has a strongly marked functional character: the use of energy in brain tissues is closely related to the neuronal activity. Neurons are extremely dependent on glucose as the main substrate and on oxidative phosphorylation as the major process for ATP formation. In addition, neurons are very susceptible to cellular damage if deprived of metabolic substrates even for a few minutes. These biochemical properties, combined with the high metabolic needs of neurons, are responsible for the close relationship between neuronal activity and oxidative energy metabolism in the brain. In our work we consider the influence of heterogeneity of cytochrome *c* oxidase distribution in neurons of the mammalian visual cortex. Modeling of an ensemble of protein complexes is combined with the use of a virtual simulator approach of cytochrome oxidase activity.

Keywords: cytochrome *c* oxidase, visual cortex, virtual simulator

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