Abstract View

MINIATURE POSTSYNAPTIC CURRENTS WITH RESTRICTED RECEPTOR AREAS

T.M. Bartol[1*]; T.J. Sejnowski[1]; B.R. Land[2]; E.E. Salpeter[2]; M.M. Salpeter (Deceased)[2]

1. Salk Institute, La Jolla, CA, USA
2. Cornell University, Ithaca, NY, USA

One of the key issues in understanding synaptic transmission is the degree to which the number of neurotransmitter molecules in a quantal packet (Nn) saturates the number of receptors (Nr) on the postsynaptic
membrane. In previous simulations of miniature postsynaptic currents (MPSCs) using MCell, a Monte Carlo simulator of subcellular signaling, we assumed that Nr >> Nn (see the MPSC catalog at http://www.mcell.cnl.salk.edu/database) which is appropriate for the neuromuscular junction (NMJ). Here we explore the range Nn >> Nr which is more appropriate for central synapses whose receptors are located within a small area.
One consequence of central synapse geometry and small Nr/Nn is that receptors are saturated to a greater degree than at the NMJ (i.e. when Nr/Nn >> 1) and at the same time the current rise time is increased much less when the receptor site density is reduced than at the NMJ. Measuring current rise times after partial receptor inactivation may
thus yield information on Nr/Nn and degree of receptor saturation for some central synapses. The diagnostic possibilities of the "plateau time", the period separating the rising and falling phases of the MPSC, will also be presented. All results are given in the form of dimensionless ratios, with special emphasis on the ratio of fall time to rise time. MCell was run on BlueHorizon, a 1152 processor IBM SP supercomputer at the San Diego Supercomputer Center. The expanded catalog is available at the above URL.
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