314 SIMPLE AND COMPLEX SPIKE GENERATION IN A COMPUTER MODEL OF CEREBELLAR PURKINJE CELLS. A. Pellionisz and R. Llinás. Div. Neurobiology, Univ. of Iowa, Oakdale, Ia. 52319.

A software Purkinje cell model has been developed utilizing a PDP-15 (DEC) computer. The model is based on current morphological and physiological data from frog Purkinje cells. It allows detailed analysis of the passive cable properties, spike generation activity in the axon, soma and dendrites, and overall integrative properties of this neuron. The model comprises 31 dendritic branches, 15 branch bifurcation areas, a soma, an axonal initial segment, 7 nodes and 7 myelinated segments. Each of these 62 compartments includes morphological parameters such as the physical dimensions of each segment as well as physiological parameters such as Hodgkin and Huxley equations (after Frankenhaeuser and Huxley, J. Physiol., 1964). The equations were solved with an integration time varying between 200 nsec and 25 μsec, depending on the rate of change of potentials with respect to time. The Hodgkin-Huxley parameters were successively approximated to provide a proper antidromic invasion as well as a climbing fiber evoked EPSP and climbing fiber spike bursts, as known from intracellular recording. Different configurations of parallel fiber orthodromic input were also studied. The analysis suggests that the climbing fiber evoked spike burst is triggered by repetitive firing in the initial segment, supported by the firing of active regions in the dendritic tree. The model also postulates a slightly higher sodium permeability for the initial segment (125%) than that in the node, and a considerably lower potassium permeability for the dendritic tree than for the soma and axon. This model exemplifies the class of Purkinje cell utilized in the development of a large simulation of electrical activity of the frog cerebellar cortex. (Supported by PHS research grant NS-09916 from NINDS)

Pellionisz, A. & Llinàs, R. (1975) Simple and Complex Spike Generation in a Computer Model of Cerebellar Purkinje Cells. Soc. Neurosci. Abst. 1, p. 319.

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