

Neural Electronic Signal Detection Fidelity and Membrane Conductance

The combination of biological neurons with microelectronic devices, such as transistors, in circuits affords the potential for development of robust neural prosthetic devices. Successful implementation of the technology will rely on the improvement of the electrical characteristics of the neural electronic interface. In a recent study, we investigated the impact of various factors on the fidelity of the neural signal detected by a transistor interfaced with a biological neuron. We modeled the neuron interfaced with the device using a dual membrane lumped parameter equivalent circuit. Simulation studies have shown that in order to obtain a high fidelity reproduction of the action potential generated by the neuron in the junction between the cell and the device gate, there must be no appreciable variation in potential across the region of the membrane interfaced with the device. Further simulation studies presented in this work confirm that when there is a high fidelity reproduction of the neural action potential generated by the cell, there is no appreciable conductance change in the interfaced region of the membrane. A closer examination of the time course of the gating variables m , n and h further corroborates this finding.