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**ALLAN WILLMS**, University of Guelph, Guelph, ON, N1G 2W1  
*A Geometric Comparison of Hodgkin–Huxley and Multi-State Models*

Multi-state models of ion channel gating have been used extensively, but choosing optimally small yet sufficiently complex models to describe particular experimental data remains a difficult task. In order to provide some insight into appropriate model selection, we present some basic results about the behaviour of solutions of multi-state models, particularly those arranged in a chain formation. Some properties of the eigenvalues of constant-rate multi-state models are presented, and an expression for the product of the eigenvalues of a coupled chain is developed in terms of those of its constituent chains. We look at a geometric description of a three-state chain and in particular, analyze differences between a chain equivalent to a Hodgkin–Huxley model and a chain with identical rates. One distinguishing feature between these two types of chains is that decay from the open state in the Hodgkin–Huxley model is dominated by the most negative eigenvalue while the identical rate chain displays a mix of modes over all eigenvalues.