Abstract:
The linear-nonlinear cascade model (LN model) has proven very useful in representing a neural system’s encoding properties, but has proven less successful in reproducing the firing patterns of individual neurons whose behavior is strongly dependent on prior firing history. While the cell’s behavior can still usefully be considered as feature detection acting on a fluctuating input, some of the coding capacity of the cell is taken up by the increased firing rate due to a constant “driving” direct current (DC) stimulus. Furthermore, both the DC input and the post-spike refractory period generate regular firing, reducing the spike-timing entropy available for encoding time-varying fluctuations. In this paper, we address these issues, focusing on the example of motoneurons in which an afterhyperpolarization (AHP) current plays a dominant role regularizing firing behavior. We explore the accuracy and generalizability of several alternative models for single neurons under changes in DC and variance of the stimulus input. We use a motoneuron simulation to compare coding models in neurons with and without the AHP current. Finally, we quantify the tradeoff between instantaneously encoding information about fluctuations and about the DC.