



Supplemental Figure 5. Bidirectional gating of dendritic spike propagation by excitation and feed-forward inhibition.

(a-e) Opening of the closed gate by SC EPSP in the weak excitability model (left) and closing of the open gate by SC IPSP in the strong excitability model (right).

(a) Response of each model to activation of powerful synapses (3 nS) placed midway along each reconstructed section of the dendritic tuft (19 synapses, red dots in **d**), corresponding to a strong PP input.

(b) Responses of each model an excitatory SC input (5 nS) placed near the end of the primary apical dendrite (red dot indicated by the black arrow in **d**), followed by an inhibitory input (20 nS, $E_{rev} = -75$ mV, 0.5 ms rise time, 20 ms decay, onset = 3 ms after SC excitation) corresponding to GABA_A-mediated feed-forward inhibition.

(c) Response of each model to a combination of the PP input (excitatory) together with the SC input (excitatory-inhibitory). The two simulations differed only in the excitability of the dendritic tree and the relative timing of the PP and SC inputs. In the weak excitability model (left), the SC input follows the PP input by 1.5 ms; thus, the PP response coincided with the excitatory component of the SC input. In the strong excitability model (right), the SC input precedes the PP input by 15 ms; thus, the PP input occurred during the inhibitory component of the SC input. Note that the SC excitatory-inhibitory input can facilitate forward propagation of the PP-evoked dendritic spike (left) or inhibit it (right), depending on the dendritic excitability and the relative timing of the PP and SC inputs.

(d) Color plots of the maximum voltage in the upper half of the apical dendritic tree for the case of the combined perforant path and Schaffer collateral inputs in **c**, respectively. The arrow indicates the location of the SC synapses and the dendritic recording location shown in **a-c**.

(e) Color plots of somatic depolarization for different PP-SC delays. Red corresponds to somatic action potentials and blue corresponds to no action potential. In **e** (left), the red region (gate open) is from -0.3 to +2.7 ms. The purple region (together with red) illustrates the gating region in the absence of inhibition (-4.0 to 2.7 ms). In **e** (right) the blue region (gate closed) is from -34 to 2 ms. These ranges are dependent on the magnitude and kinetics of the SC excitation and inhibition.