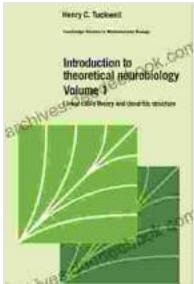


Volume Linear Cable Theory and Dendritic Structure: Cambridge Studies in Neuroscience



Introduction to Theoretical Neurobiology: Volume 1, Linear Cable Theory and Dendritic Structure (Cambridge Studies in Mathematical Biology Book 8)

by Henry C. Tuckwell

★★★★★ 5 out of 5

Language : English

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Screen Reader : Supported

Print length : 304 pages



Dendritic trees are the primary input structures of neurons, and their extensive branching patterns allow them to receive input from a large number of other neurons. The spread of electrical signals in dendritic trees is governed by the passive electrical properties of the dendrites, and by the active electrical properties of the synapses that connect them to other neurons.

The linear cable theory is a mathematical model that describes the passive electrical properties of dendritic trees. It is based on the assumption that the dendrites are cylindrical in shape, and that the electrical properties of the dendrites are uniform along their length. The linear cable theory can be used to calculate the voltage at any point in a dendritic tree, given the input currents and voltages at the synapses.

The dendritic structure of a neuron can have a significant impact on its function. For example, the length and branching pattern of the dendrites can affect the neuron's input resistance, its firing threshold, and its response to different types of input stimuli.

The passive electrical properties of dendritic trees

The passive electrical properties of dendritic trees are determined by the following factors:

- * The resistance of the dendritic membrane
- * The capacitance of the dendritic membrane
- * The axial resistance of the dendritic cytoplasm

The resistance of the dendritic membrane is the resistance to the flow of current across the dendritic membrane. The capacitance of the dendritic membrane is the ability of the dendritic membrane to store electrical charge. The axial resistance of the dendritic cytoplasm is the resistance to the flow of current along the length of the dendrite.

The passive electrical properties of dendritic trees can be measured using a variety of techniques, including patch-clamp recording and voltage-clamp recording.

The active electrical properties of dendritic trees

The active electrical properties of dendritic trees are determined by the following factors:

- * The presence of voltage-gated ion channels in the dendritic membrane
- * The activity of synapses on the dendritic tree

Voltage-gated ion channels are ion channels that open and close in response to changes in the voltage across the membrane. The activity of synapses on the dendritic tree can cause the voltage across the dendritic membrane to change, which can lead to the opening or closing of voltage-gated ion channels.

The active electrical properties of dendritic trees can be measured using a variety of techniques, including patch-clamp recording and voltage-clamp recording.

The application of the linear cable theory to the interpretation of experimental data

The linear cable theory can be used to interpret a wide variety of experimental data, including data on the passive electrical properties of dendritic trees, the active electrical properties of dendritic trees, and the response of dendritic trees to different types of input stimuli.

The linear cable theory can be used to calculate the voltage at any point in a dendritic tree, given the input currents and voltages at the synapses. This information can be used to understand how the dendritic tree integrates different types of input stimuli, and how it generates output signals.

The study of dendritic function in vivo

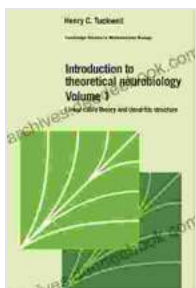
The study of dendritic function in vivo is challenging, due to the small size and complex structure of dendritic trees. However, a number of techniques have been developed to study dendritic function in vivo, including two-photon imaging, patch-clamp recording, and voltage-clamp recording.

Two-photon imaging is a technique that allows researchers to visualize the activity of neurons in vivo. Patch-clamp recording is a technique that allows researchers to record the electrical activity of single neurons in vivo. Voltage-clamp recording is a technique that allows researchers to control the voltage across the membrane of a neuron in vivo.

These techniques have been used to study a variety of aspects of dendritic function in vivo, including the passive electrical properties of dendritic trees, the active electrical properties of dendritic trees, and the response of dendritic trees to different types of input stimuli.

Volume Linear Cable Theory and Dendritic Structure provides an up-to-date account of the linear cable theory of electrotonic structure in dendritic trees. It focuses on the use of the theory to investigate the passive spread of electrical signals in dendritic trees, as well as the active generation of dendritic spikes. The book also considers the application of the theory to the interpretation of experimental data, and to the study of dendritic function in vivo.

This book is an essential resource for anyone who is interested in the electrical properties of dendritic trees, or in the function of neurons in general.



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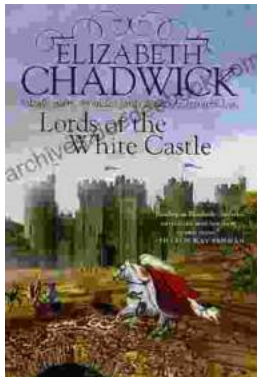
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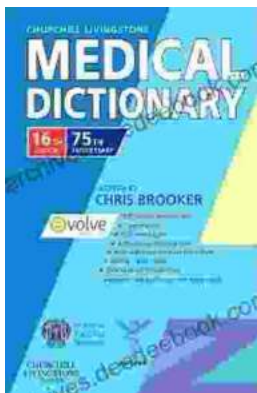
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