Burst

see Burst suppression.

Spike rate within a burst.

In the context of neuroscience, a burst refers to a rapid sequence of action potentials (spikes) emitted by a neuron within a short period of time, typically followed by a period of quiescence (silence or no spiking). Bursting is a distinct pattern of neuronal firing that is different from tonic firing, where action potentials occur at a more regular and continuous rate. Bursts are often crucial for specific types of information processing in the brain.

Key Characteristics of Bursts: Action Potentials in a Burst:

Definition: A burst consists of multiple action potentials occurring in quick succession. The spikes within a burst are usually closely spaced in time, often with inter-spike intervals (the time between consecutive spikes) significantly shorter than during tonic firing. Duration: The duration of a burst can vary, ranging from a few milliseconds to several hundred milliseconds, depending on the type of neuron and the context of the burst. Physiological Functions of Bursting:

Signal Amplification: Bursts can amplify the signal transmitted by a neuron. Multiple spikes in a short time can make it more likely for the signal to be detected by the postsynaptic neuron, especially in noisy environments. Reliability of Communication: Bursting enhances the reliability of synaptic transmission. A single action potential might not always successfully trigger a response in the postsynaptic neuron, but a burst increases the chances that at least one spike will be effective. Encoding Information: Bursts can encode different types of information, such as the intensity or timing of a stimulus. For instance, the number of spikes in a burst or the frequency of bursting can represent different sensory or motor information. Types of Bursting:

Phasic Bursting: Occurs intermittently, often in response to specific stimuli or during particular behavioral states. This type of bursting is typically seen in sensory systems or during specific cognitive tasks. Tonic Bursting: Happens more regularly and continuously, often seen in neurons involved in rhythmic activities, such as those controlling breathing or walking. Adaptive Bursting: The burst pattern adapts based on the input or environmental conditions, which can help the neuron respond optimally to different types of stimuli. Mechanisms Underlying Bursting:

Ion Channels: Bursting behavior is typically driven by a complex interplay of different ion channels, including voltage-gated sodium, calcium, and potassium channels. Calcium channels, in particular, often play a key role in initiating and sustaining bursts. Membrane Potential Oscillations: Some neurons exhibit intrinsic oscillations in their membrane potential, which can lead to periodic bursts of action potentials. These oscillations are often influenced by the ionic currents flowing through the neuron's membrane. Network Interactions: In some cases, bursts are not solely a property of individual neurons but are driven by interactions within a network of neurons. For example, synchronized bursts across a group of neurons can occur due to reciprocal excitatory connections or inhibitory feedback loops. Bursting in Different Neurons:

Thalamic Neurons: In the thalamus, neurons can switch between tonic firing and burst firing depending on the state of consciousness. Bursting is more common during sleep or under anesthesia, while tonic firing dominates during wakefulness. Hippocampal Neurons: Bursting is common in hippocampal pyramidal neurons and is thought to play a role in memory encoding and retrieval. The hippocampus uses burst firing to communicate important information to other brain regions, particularly during learning and memory consolidation. Cerebellar Neurons: Purkinje cells in the cerebellum exhibit bursting activity that is crucial for fine-tuning motor control and learning. Clinical and Pathological Aspects:

Epilepsy: Abnormal bursting patterns are a hallmark of epilepsy. Seizures often involve excessive and synchronized bursting across large networks of neurons, leading to uncontrolled electrical activity in the brain. Parkinson's Disease: In Parkinson's disease, altered bursting in certain brain regions, such as the basal ganglia, contributes to motor symptoms like tremors and rigidity. Pain Perception: Changes in bursting patterns in pain pathways can contribute to chronic pain conditions, as bursts can enhance the perception of pain signals. In summary, a burst is a rapid series of action potentials fired by a neuron in quick succession, playing a critical role in neural communication and information processing. Bursting can amplify signals, increase the reliability of transmission, and encode specific types of information. Bursts are driven by intrinsic properties of neurons as well as network dynamics and are implicated in both normal brain functions and various neurological disorders.