

Active Noise Genesis and Memory Processes in Recurrent Neural Networks

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Activity of cortical neurons is highly irregular and variable, suggesting that noise may play a crucial role in brain's information processing. However, the origin of this noise and its functional implications remain elusive. Recent experiments suggest that excitatory postsynaptic potentials (EPSPs) between cortical neurons obey long-tailed, typically lognormal, distributions in the neocortex and hippocampus. This implies that some cortical synapses are extremely strong. I show that such distributions can generate optimal internal noise for gating spike transmissions in recurrent neural networks. I demonstrate how this noise genesis improves memory processes, such as associative memory and working memory. The long-tailed EPSP distribution may challenge the conventional view that cortical neural networks are designed for parallel distributed processing with weak synapses.