STRESZCZENIE PO ANGIELSKU

Since the discovery of dendritic spines (the main part of excitatory synapses) by Ramon Cajal, scientist have been constantly trying to understand their function and it's relation to spine size and shape. It is known that dendritic spines constitute a so-called „memory store" and are responsible for the transmission of excitatory signals between neurons. The relationship between the shape of the dendritic spines and the function they perform, however, remains unclear. Many theories and paradigms exist on the subject, including the paradigm that learning relates to changes in the shape and size of the dendritic spines.

In my dissertation, I wanted to address this basic paradigm and tried to answer questions such as which dendritic spines parameters are important and which methods should be used, for their morphological classification, in which dendritic spines distributions the maximum information is encoded related to memory, and how structural analysis of dendritic spines can be used to model the dynamics of interactions between them and what can be deduced from this.

I was able to establish that hidden Markov chains, without or with an autoregressive model, are the methods that can be used to check the selection of dendritic spines classifications by the various available software. Also, it was possible to determine which structural distributions of spine size store the most information and whether this is the optimal amount. Finally, a dynamical physical model was analyzed to examine the amount of encoded information in dendritic spines and its energy cost, based in part on the data from earlier analysis. Simulations of this model helped to answer questions like: how cooperativity (correlation between neighboring dendritic spines) affects the encoded information, its energy efficiency, and whether this information is somehow maximized.