

Biological Nets of the Human Brain

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Introduction

Biological neural nets are the models of nets that have tried to reproduce the human or other living brain organization in an effort to realize fundamental processes as knowledge, recollection, understanding, emotion etc. The consequence of the structure and function and the dynamical behavior of biological neural nets is a topic of significant attention. On the other hand, in probabilistic neural nets we have an aggregation of a large number of neurons, positioned at random in space, that have only partial connectivity, i.e., every neuron is connected to only a very small portion of the whole number of neurons in the system, arbitrarily chosen. The main idea is that this connectivity is given by the binomial distribution.

In our lab, probabilistic neural nets were investigated using Poisson or Gauss distribution of interneuronal connectivity [1-4]. We also compared the theoretical results with experimental findings attained using MEG data from epileptic patients and healthy subjects. The research program was approved by the Research Committee of our University. Magnetoencephalography (MEG) measurements were performed using a second order gradiometer SQUID (Superconducting Quantum Interference Device) (Model 601, Biomagnetic Technologies Inc.), located in a magnetically shielded room. The MEG recordings were performed positioning the MEG sensor 3mm above the scalp of every subject using a reference system based on the International 10–20 Electrode Placement System. Analyzing the MEG it was found that the MEG from epileptic foci had Poisson distributions. This finding was justified by the fact that the Poisson distributions correspond to low internal neural connections, and the neural activity is synchronized during an epileptic seizure. In addition, the MEG from epileptic foci had higher amplitudes compared to the MEG from normal regions, which were comparable with the results from the theoretical neural model. The Poisson distribution matched to the epileptic foci while the Gauss distribution to normal regions [5].

Anninos and Tsagas [6] invented an electronic device that increased the abnormal frequencies of (2-7 Hz) of the MEG of every subject towards frequencies of less than or equal to its frequencies of the alpha frequency range (8-13Hz). The pico Tesla (pT) ($1\text{pT}=10^{-12}\text{ T}$) -TMS electronic device is a modified helmet containing up to 122 coils that cover the 7 brain regions: frontal, vertex, occipital, right - left temporal, right-left parietal. It generated pT-TMS range modulations of magnetic flux in the alpha frequency range of each participant [6]. The application of pT-TMS to epileptic patients changes the

distribution of the MEG data from Poisson to Gauss. This fact implies that application of pT-TMS induces inhibitory effects on the epileptic symptoms with MEG to give valuable functional information. The MEG gained from epileptic patients had high amplitudes described with θ and δ rhythms and absence of α -rhythm due to synchronized and coherence neural activity. Moreover, they followed Poisson distribution. On the other hand, the MEG obtained from normal subjects had lower amplitudes and existence of α -rhythm due to random activity followed by Gauss distribution [7]

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