

Petr Marsalek

Charles University in Prague, Czech Republic

and

Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

Perception across sound and space modalities at the level of neural responses

It is known that subjective and neural sound intensity is encoded by a total number of spikes transmitted by the auditory nerve in a time interval. Sound pitch is encoded by tonotopic principle in cochlea (tonotopy). The tonotopy is not the sole mechanism of encoding sound frequency. For lower sound frequencies, comparable with the discharge rate of individual neurons, sound frequency is also encoded by spike timing locked to cochlear phase. As well, loudness and low frequency tones are multiplexed into spike counts. Cross-modality encoding and multiplexing of modalities are present at all stages of input processing in the auditory pathway. Several higher level modalities, like those related to the sound localization, are encoded in activities of higher level neurons in the auditory pathway.

We present classification of the above discussed encoding schemes. We discuss applications of spike train analysis and description, including the concept of ergodicity in the neural population coding. Ergodicity means that average taken over a long time period and over smaller population should equal to the average in shorter time and larger population. As other concepts in statistical physics and mean field theories, ergodicity concept is useful in description of neural coding.