

Studying cell dynamics: Interference microscopy vs. double-wavelet analysis

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ABSTRACT

Neuronal activity involves a multitude of regulatory processes that occur over many different time scales both in the plasma membrane and in the various cytoplasmic compartments. Information concerning the mutual interactions among these processes could contribute significantly to a better understanding of cellular regulation and function.

This talk is based on our recent paper (Sosnovtseva et al. 2005) [1] We combine a novel experimental approach to the study of intracellular processes with a newly developed technique for multimode time-series analysis. Experiments are performed on isolated pond snail (*Lymnaea stagnalis*) neurons.

- We showed that at the rest conditions neurons display a complex intrinsic optical activity. This is expressed through the changes of the cellular refractive index as detected by laser interference microscopy [2] that are caused by various intracellular processes;
- We for the first time established the characteristic frequencies of the refractive index changes in the range 0–25 Hz and revealed the presence of nonlinear interactions in the form of frequency modulation of the fast oscillations by the slower processes via double-wavelet analysis.
- Further analysis of refractive index dynamics and relations between the revealed frequencies of the refractive index changes and identified cellular processes will be useful for better understanding of the function and interaction of different time-scale processes in *different neuron compartments* at rest conditions as well as *under the influence of external stimuli*.

The presented work is a collaborative project of Group of Biophysics and Complex Systems, Department of Physics, Technical University of Denmark (Lyngby, Denmark) and Biophysics Department, Biological Faculty, Moscow State University (Moscow, Russia).

References

- [1] O.V. Sosnovtseva, A.N. Pavlov, N.A. Brazhe, A.R. Brazhe, L.A. Erokhova, G.V. Maksimov, E. Mosekilde, Interference microscopy under double-wavelet analysis: A new approach to studying cell dynamics, *Phys. Rev. Lett.*, 2005 (in press)
- [2] V.P. Tychinskii, Coherent phase microscopy of intracellular processes, *Physics Uspekhi* **44**, 683–696 (2001).