BP 14: Posters: Neurobiophysics, Theoretical Neuroscience, Sensory Transduction

Time: Monday 17:15–20:00 Location: P3

BP 14.1 Mon 17:15 P3

Optical properties of cells in the vertebrate retina — •Silke Agte[1,2], Sabrina Matthias[1], Stephan Junek[3], Elke Ulbricht[1], Ines Erdmann[1], Detlef Schild[3], Josef Käs[2], and Andreas Reichenbach[1] — [1]Paul-Flechsig-Institute for Brain Research, Department of Neurophysiology, Jahnallee 59, 04109 Leipzig, Germany — [2]Institute of Physics, Department of Soft Matter Physics, Linnèstrasse 5, 04103 Leipzig, Germany — [3]Center of Physiology and Pathophysiology, Department of Neurophysiology and Cellular Biophysics, Humboldtallee 23, 37073 Göttingen, Germany

In vertebrate eyes, images are projected onto an inverted retina where photons must pass most of the retinal layers before they are captured by the light-sensitive cells. Scattering in the retinal layers the light passes should obstruct clear vision yet our eye displays splendid visual abilities. This contradiction can be resolved by the function of radial glial (Müller) cells as effective light-guiding fibers in the living retina. For light that hits a Müller cell endfoot, intraretinal light scatter is minimized, and the beam diameter is conserved suppressing divergence such that the photon intensity arriving at the photoreceptors is high. Thus, an optimized signal-to-noise ratio overcomes the visual obstacle of retinal layers light has to pass through and increases visual sensitivity and contrast. Moreover, by quantitative evaluation we show that the ratio between Müller cells and cone photoreceptors - responsible for acute vision - is roughly one. This suggests that high spatiotemporal resolution may be achieved by each cone receiving its part of the image via its 'individual' Müller cell-light guide.

BP 14.2 Mon 17:15 P3

Noise reduction in systems of coupled hair bundles — •Kai Dierkes, Benjamin Lindner, and Frank Jülicher — Max Planck Institute for the Physics of Complex Systems, Dresden

Auditory signal detection relies on amplification to boost sound-induced vibrations within the inner ear. Active motility of sensory hair-cell bundles has been suggested to constitute a decisive component of this amplifier. The responsiveness of a single hair bundle to periodic stimulation, however, is limited by intrinsic fluctuations. *In vivo*, hair bundles are often attached to overlying membranes. Such elastic coupling can synchronize hair-bundle motions and lead to an effective noise reduction, thus enhancing a hair bundle's sensitivity and frequency selectivity (Dierkes et al. (*PNAS*, 2008), Barral et al. (*PNAS*, 2010)). Here, we discuss the mechanism underlying this coupling-induced noise reduction within the framework of a mean-field type argument. In particular, we show that for strong coupling, fluctuations limiting a hair bundle's responsiveness are effectively reduced in proportion to the number of coupled hair bundles.

BP 14.3 Mon 17:15 P3

Analyzing Multi-electrode Array Measurements of Neurons — •Stephan Kramer[1], Kai Bröking[2], and Annette Witt[2] — [1]Institut f. Numerische u. Angewandte Mathematik, Uni Göttingen — [2]Max-Planck-Institut f. Dynamik u. Selbstorganisation, Göttingen

Measurements from neuronal networks cultured on multi-electrode arrays (MEAs) yield noisy time series of the extracellular potential. As each electrode records signals from multiple neurons a principle component analysis followed by a cluster finding analysis is performed to be able to assign spikes to neurons [1]. Although this procedure can be formulated by means of the basic linear algebraic subroutines (BLAS) library the large amount of raw data requires to investigate non-standard hardware like GPUs to achieve best performance. Due to the inherent hardware-dependence of most BLAS libraries programming effort can only be minimized by abstracting the algorithm employed from BLAS and hence hardware specifics. We show how to resolve this dependency by designing a C++-based domain-specific embedded language [2] so that algorithms can be stated in a hardware-independent, compact vectorized form. We discuss the performance of the algorithm proposed in [1] on different kinds of hardware architectures for a particular example (10000 spikes emitted by several hundred neurons).

[1] S. Shoham et al., 2003. Robust, automatic spike sorting using mixtures of multivariate t-distributions. JNM 127 (2), 111 - 122

[2] D. Abrahams, A. Gurtovoy, 2004. C++ Template Metaprogramming: Concepts, Tools, and Techniques from Boost and Beyond, Addison-Wesley