# BIOPHYSICAL MODELING OF CORRELATED FIRING AND GAIN CONTROL IN THE ELECTROSENSORY SYSTEM.

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Weakly electric fish emit a quasi-sinusoidal electric field (~800-1000 Hz) known as the electric organ discharge or EOD. Their electrosensory system processes spatial-temporal amplitude and phase modulations of the EOD caused e.g. by rocks, daphnia, and the EOD of other fish. It is designed to process information from lower frequency electrocommunication signals as well as higher frequency electrocommunication signals. We present a biophysical model for information processing in the initial stage of the electrosensory system of the fish Apteronotus Leptorhynchus. Our computational model shows that the correlations in the "baseline" firing of the electroreceptors lead to an enhancement of the mutual information between input band-limited random EOD modulations and output spike trains from single electroreceptors. For low frequency signals, we demonstrate that the correlations enhance signal detection by producing a minimum in the spike train variability at long counting times (~250 EOD cycles).

The intrinsic neuronal noise in the model also enhances the coding of EOD variations that are otherwise too small to alter the phase locking pattern. Finally we discuss two simple ways in which the dynamics of the pyramidal cells to which the electroreceptors project can lead to divisive gain control in this system. The first relies on noise, while the second relies on feedback from higher brain structures.