Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **11** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

Reaction-diffusion modeling of neurotransmitter processing at a high frequency synapse

Tuesday, 8 June 2021 16:45 (15 minutes)

In the weakly electric fish *Eigenmannia* (glass knifefish), high frequency (200-600Hz) electric organ discharge (EOD) is driven by high frequency cholinergic synaptic input onto the electrocytes at their electroplaques. Assuming periodic release of ACh into the cylindrical synaptic gap, we solve numerically a one dimensional reaction-diffusion model at 200Hz and 500Hz. The model included the diffusion of ACh and its interactions with AChesterase (AChE) in the gap and with AChRs at the post synaptic membrane. At 500Hz a higher AChE/ACh ratio is needed to remove ACh from the cleft between consecutive ACh releases. Only a small fraction of the ACh molecules reaches the AChRs, and there are residual amounts of ACh molecules from the preceding release. Previous computational studies showed that the persistently present ACh should not impede high frequency electrocyte firing, provided the cholinergic current is subthreshold for triggering firing. Our results suggest that the cholinergic current from the carry-over (persistent) activation of AChRs exceeding the firing threshold sets the upper limit for EOD frequency in *Eigenmannia* individuals, which is observed around 600Hz.

Primary authors: Ms ALKHAMMASH, Elham (University of Ottawa); Prof. L'HEUREUX, Ivan (University of Ottawa); Dr MORRIS, Catherine E (Ottawa Hospital Research Institute); JOOS, Bela (University of Ottawa)

Presenter: JOOS, Bela (University of Ottawa)

Session Classification: TS-6-3 Biosensory Physics (DPMB Symposium) / Physique des biocapteurs (Symposium DPMB)

Track Classification: Symposia Day (DPMB) - Impactful advances in biological and medical physics