Biology and Medicine Through Mathematics Conference

2016

May 20th, 11:15 AM - 11:45 AM

Deterministic and Stochastic Mathematical Modeling of Melanopsin's Light Response in iPRGCs and HEK Cell

Kathleen Hoffman
UMBC, khoffman@umbc.edu

Hye-won Kang
UMBC, hwkang@umbc.edu

Phyllis Robinson
UMBC, probinso@umbc.edu

DETERMINISTIC AND STOCHASTIC MATHEMATICAL MODELING OF MELANOPSIN's LIGHT RESPONSE IN iPRGCS AND HEK CELL

Kathleen Hoffman, Phyllis Robinson, Hye-won Kang

Melanopsin, a visual pigment expressed in intrinsically photosensitive retinal ganglion cells (ipRGCs), primarily affects non-image forming vision with a hypothesized G-protein phototransduction pathway similar to the phototransduction pathway found in Drosophila photoreceptors. The biochemical cascade underlying the light response in ipRGCs has not yet been fully elucidated. A deterministic and stochastic mathematical model of the hypothesized pathway is developed to probe key elements of the pathway. The rate constants, initial conditions and parameters are fit to voltage clamp data from ipRGCs and also calcium imaging data from HEK cells transfected with mouse melanopsin. Sensitivity analysis reveals key steps in the phototransduction pathway, independent of the experimental conditions, as well as key differences attributable to the different experimental conditions.

Acknowledgement: Research has been funded by a grant from NSF for Interdisciplinary Training for Undergraduates in Biological and Mathematical Sciences (NSF-UBM:1031420) and NSF (IOSO721608) and NEI (R01Y019053) to P.R.R. This is joint work with UBM students Kimberly Daniels, Jaquelyn Meisel, Kevin Herod, Drew Thatcher, Jessica Ortega, Abigail Jackson and Adam Byerly. Stochastic model was developed with the WhAM! Group sponsored by the IMA. We thank Devyani Ujla, Preethi Somasundaram, and Evan G. Cameron calcium imaging data. Dr. R. Lane Brown for provided the electrophysiological data.