Applied Mathematics

McGill Applied Mathematics Seminar

April 29 2002

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Title: Mathematical models that explore signal processing by cell membrane receptors.

Monday April 29,2002

Time: 2:30 pm

Room: Burnside 1205

Abstract: Cell membrane receptors are one of the primary means by which cells communicate with each other and have important roles in cell growth, differentiation, adhesion and processing signals in the nervous system. These protein receptors bind with the signaling molecule to relay messages that affect cellular behavior and gene expression. Cell surface receptors do not regulate gene expression directly. They relay a signal across the cell membrane and the response of the target cell depends on intracellular second messenger molecules and other protein-protein interactions. The dynamic properties of these complex biochemical networks are not well understood but simulations have shown that some interesting emergent properties, such as bistable switches, can arise from these types of interactions (Weng et al (1999), Science, 284, 92-96) I am interested in how these receptors process the primary external signal (hormone, cytokines, neurotransmitters) to mediate a cellular response. I will present an example of an approach to model transmitter-receptor interactions in the synapse of the nervous system. Because of rapidly changing transmitter levels in the synapse, the binding is unlikely to occur at equilibrium. I will describe a mathematical approach that models complex receptor interactions in which the timing and amplitude release of transmitter release is noisy. I will show how exact solutions for simple bimolecular interactions and receptor transitions can be used to model complex reaction schemes by expressing them in sets of difference equations. Using this approach the information processing capabilities of a channel-receptor, GABA receptor, was investigated, and used to predict how pharmacological agents may modify these properties. I will describe how I hope to extend these types of models to understand information processing by Catalytic receptors and G-protein linked receptors.

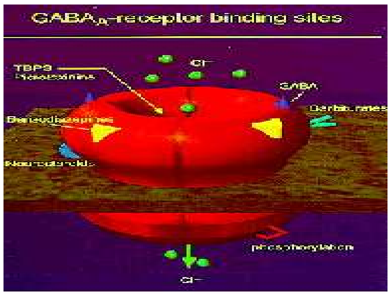

Figure 1: A schematic of GABA-receptor binding sites. www.unizh.ch/phar/molneuro/benson/