Mathematical modeling in biology:
Cancer immunotherapy & G protein signaling

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Abstract

In this talk, I will use two examples to show you how mathematical modeling and computation help investigate medical and biological problems.

The first example is about the cancer immunotherapy. CD200-CD200R complex is one of the immune check-point that tumor cells can use this complex to escape from immune responses. However, blockade CD200-CD200R formation induces opposite treatment outcomes in different types of cancers. Therefore, whether blockade CD200-CD200R is a potential cancer treatment is a controversial issue. To help solve this issue, we provide several hypotheses to explain the opposite treatment outcomes of CD200-CD200R, and then use mathematical modeling to verify our hypotheses and then further design appropriate treatment protocols based on the cancer types.

The second example is about the G protein signaling pathway in plant cells. There are many signaling pathways that crosstalk through a single receptor protein AtRGS1 to generate normal physiological mechanism. Moreover, AtRGS1 endocytosis triggers G protein to active different downstream pathways. Our lab created an ODE model to capture the AtRGS1 endocytosis data, and this mathematical model help discover the kinases WNK1 and WNK8/10 with different reaction time scales. Based on this finding, our lab created the transient and stable lines for the WNK1 and WNK8/10 knockout mutations and then measured their AtRGS1 endocytosis data. However, the experimental data between the transient and stable lines are inconsistent to each other. We then use the previous ODE model to decipher that the overexpression of AtRGS1 is the reason causing this inconsistency, and to select seedlings with a reasonable ARGS-YFP amount for normal cell behavior.

Bio:
Dr. Liao graduated from National Chiao Tung University and had her postdoc training with Prof. Avner Friedman and Prof. Yuan Lou in the Mathematical Biosciences Institute at the Ohio State University during 2012-2015, and with Prof. Alan Jones and Prof. Tim Elston in the Department of Biology and Pharmacology at the University of North Carolina at Chapel Hill during 2015-2017. Dr. Liao had a joint appointment between the Departments of Mathematics and Biological Sciences at the University of Manitoba and then moved to the Department of Mathematics a few years ago.

Dr. Liao's research interests are in mathematical modeling and analysis of medical and biological systems, differential equations, delay differential equations, and bifurcation theory. She has been applying the approaches of modeling, computation, and analysis to many interesting biological problems, such as, cancer immunotherapy, morphology, gene regulation, epidemiology, G protein signaling pathway, and evolution in ecology.

日　期:113 年 5 月 22 日(星期三) 15:10~16:00
地　點：本校數學館 527 教室（嘉義縣民雄鄉大學路 168 號）
茶　會：14:30~15:00 數學館四樓 409 室舉行

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