Notice of the Final Oral Examination
for the Degree of Master of Science

of

ZONGZHI YUE

BSc (University of Victoria, 2022)

"A non-local reaction advection-diffusion model
for self-interacting species"

Department of Mathematics and Statistics

Thursday, August 1, 2024
11:00 A.M.
David Strong Building
Room C128

Supervisory Committee:
Dr. Slim Ibrahim, Department of Mathematics and Statistics, University of Victoria (Co-Supervisor)
Dr. Mark Lewis, Department of Mathematics and Statistics, UVic (Co-Supervisor)

External Examiner:
Dr. Thomas Hillen, Department of Mathematical and Statistical Sciences, University of Alberta

Chair of Oral Examination:
Dr. Tim Pelton, Department of Curriculum and Instruction, UVic

Dr. Robin G. Hicks, Dean, Faculty of Graduate Studies

Abstract

In biological models, advection is inherently a non-local process. In this thesis, we proposed a nature extension of the non-local advection-diffusion model in [7] to include the reaction term (birth and death process). This thesis begins with an investigation of the well-posedness and existence of travelling wave solutions for this non-local reaction-advection-diffusion (RAD) equation. We prove the local-in-time existence and positivity of solutions under $H^\beta(\mathbb{R})$ initial conditions and provide a continuation criterion of the equation. Subsequently, we explore the existence of travelling wave solutions of this non-local RAD using a combination of perturbation methods, Fredholm operator theory, and Banach's fixed point theorem. Our analysis reveals that such solutions exist when the non-local advection term is small. Finally, we simulate the travelling wave solution to verify our theoretical findings.

[7] Valeria Giunta, Thomas Hillen, Mark Lewis, and Jonathan R Potts. Local and global existence for nonlocal multispecies advection-diffusion models. *SIAM Journal on Applied Dynamical Systems*, 21(3):1686–1708, 2022.