Subject: Prospective PhD — ARG-informed Neural SDEs & observation-aware aDNA selection inference

Dear Prof. Nielsen,

Hope this email finds you well!

My name is Yuting Fang (Student ID: 5518340). I am currently completing a Bachelor of Mathematics & Statistics (Honours) at UNSW Sydney, supervised by Professor Quoc Le Gia (School of Maths&Stats) and Professor Flora Salim(School of Computer Science and Engineering). My thesis centers on Neural Stochastic Differential Equations (Neural SDEs) for continuous-time dynamics, with applications to irregular time series. I’m aiming to pursue a computational neuroscience PhD (2026 entry) and would be honoured to explore opportunities in your group.

Your recent Nature Reviews Genetics article positioning ancestral recombination graphs (ARGs) as a unifying scaffold for inference on population size history, migration, recombination and selection strongly shaped my thinking about genealogy-aware modeling. I’m also excited by CLUES2, which leverages ancient + modern DNA and ARG information to estimate time-varying selection coefficients and reconstruct allele histories efficiently.

If there’s a potential fit, I’d love to contribute along two concrete directions:

1. ARG-informed Neural SDEs for s(t)s(t)s(t) and allele trajectories.  
   Use local ARG summaries (e.g., tree sequence features, local TMRCA/rec. rate) as structured inputs to a Neural SDE that models allele-frequency dynamics, with selection s(t)s(t)s(t) driving the drift and recombination/ARG uncertainty modulating diffusion—contrasting SDE estimates with CLUES2 on simulations and public aDNA case studies.
2. Observation-aware aDNA inference.  
   Extend CLUES-style pipelines by jointly modeling sampling/reporting success (degradation, coverage, site ascertainment) as an observation sub-process coupled to the SDE state, aiming to improve calibration and interval coverage for recent-time NeN\_eNe​ and s(t)s(t)s(t) under non-ignorable missingness in aDNA time series.

My background equips me to contribute effectively to these directions: I have a strong foundation in mathematics and statistics, hands-on experience with Neural SDE implementation and time-series inference, and a track record of applying rigorous evaluation methods—including held-out prediction, counterfactual validation, and calibrated uncertainty analysis. Beyond technical skills, I bring genuine enthusiasm for developing high-quality, falsifiable models that are tightly integrated with experimental design and validation.

I am confident that my proficiency in PyTorch, torchsde/torchdyn, probabilistic modeling, and data analysis (including tools like Suite2p and CaImAn) will allow me to make meaningful contributions to these research topics. I would be very grateful for the opportunity to discuss potential PhD projects with you—whether as a thesis student, visiting researcher, or intern. I am happy to arrange an online discussion via any online platform at your convenience, and I can also share my CV, academic transcript, and a detailed research outline beforehand for your reference.

Thank you for your time and consideration. I greatly admire the interdisciplinary rigor of your lab and would be honored to contribute to your research.

Warm regards,  
Yuting Fang

Bachelor of Science with Honors

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