

Ying-Jen Yang

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Updated Date: April 19, 2019

Research Interest

Study and develop theories for complex systems by using dynamical system and probability theory/information theory/statistical mechanics.

Education

- 2017/09—Current **Ph.D. Student**, *Department of Applied Mathematics, University of Washington.*
Current average GPA: 3.95/4.00
- 2014/09—2016/06 **Master of Science**, *Department of Physics, National Taiwan University (NTU).*
Overall GPA: 4.19/4.30
Master Thesis
- 2010/09—2014/06 **Bachelor of Science**, *Department of Physics, NTU.*
Overall GPA: 3.94/4.30
GRE physics : 990/990

Honors and Awards

- Olga Jung Wan Endowed Fellowship in Applied Mathematics
(Based on Ph.D. qualification exam performance) 2019 Mar—2019 June
- Award of Excellent Poster, 2015 Annual Meeting of the Physical Society of Republic of China (PSROC)
- College Student Research Fellowship, Minister of Science and Technology, Taiwan
(Based on research proposal) 2013 July—2014 Feb.
- Scholarship of Cultural and Educational Foundation, Taichung County Education Association
(Based on GPA performance) 2012 June

Publications

- Ying-Jen Yang and Hong Qian, “Entropy Productions and Fluctuation Theorems: A Unifying Change-of-measure Formalism.” *ArXiv*. (2019). [Link](#)
- Ying-Jen Yang and Chun-Chung Chen, “Coherent and Anticipatory Synchronization in Random Neural Networks with Dynamical Synaptic Couplings.” (under preparation)
- Ying-Jen Yang, Chun-Chung Chen, Pik-Yin Lai and Chi-Keung Chan, “Adaptive Synchronization and Anticipatory Dynamical Systems.” *Phys. Rev. E* **92**, 030701 (2015). [Link](#)
- Ying-Jen Yang, Sean Chen, Chun-Chung Chen and Chi-Keung Chan, “Anticipatory Dynamics in retina.” *Physics Bimonthly* (2016). [Link](#)
- Ying-Jen Yang, “The interesting and nonlinear heart and brain.” *NTU CASE Press* (2016). [Link](#)

Research Experience

2019/02-2019/04 **Entropy Productions, Time Reversals and Fluctuation Theorems**, Department of Applied Mathematics, University of Washington, Seattle.

Advisor: Hong Qian

Achievements:

- Derived general statistical properties of Entropy Productions including Fluctuation Theorems for general stochastic processes with a change-of-probability-measure formalism.
- Used discrete-time, discrete-state-space, Markov Chain to illustrate the difference between several different reversals of the process.
- Discussed the Domain of Validity for Fluctuation Theorems in physics and chemistry.

2019/01-2019/02 **Non-stationary growth Diffusion: energy landscape not bounded from below**, Department of Applied Mathematics, University of Washington, Seattle.

Advisor: Hong Qian

Achievements:

- Solved the transition probability with piece-wise linear energy landscape
- Reduced the problem to a diffusion with one reflecting BC and one absorbing BC. We derived a general form for stationary measure and show that the stationary measure can not capture the long time spatial structure in this case.

2018/09-2019/01 **Application in Energy Landscape Theories**, Department of Applied Mathematics, University of Washington, Seattle.

Advisor: Hong Qian

Achievements:

- Revisited Fundamental Theorem of Natural Selection and Price Equation
- Explored Gradient Descent of Chemical Reactions with a new definition of inner product.
- Revisited Friston's Free Energy Principle

2018/03-2018/06 **Revisit Information Bottleneck Problem**, Department of Applied Mathematics, University of Washington, Seattle.

Advisor: Eric Shea-Brown

Achievements:

- A thorough review on Information Bottleneck Problem on a Gaussian process

2017/09-2018/01 **Revisit Landauer's Principle and Thermodynamics of Prediction**, Department of Applied Mathematics, University of Washington, Seattle.

Advisor: Hong Qian

Achievements:

- A thorough review on Landauer's Principle and the followed-up papers and the Markov Chain illustration of them
- Including time inhomogeneity and using mutual information to extend Landauer's Principle, giving the thermodynamics of prediction

2014/09—2016/06 **Coherent and Anticipatory Dynamics in Random Neural Networks with Dynamical Synapses**, Institute of Physics, Academia Sinica, Taiwan.

Advisor: Chun-Chung Chen

Achievements:

- Numerically solved the stochastic differential equations for randomly-connected neural networks that has thousands of degree-of-freedom by a computer cluster
- Studied how various network properties, e.g. heterogeneity in in-degree, affect the coherence of the spontaneous synchronous firing in the spatially-localized random network

2013/07—2014/08

Anticipatory Dynamics in Adaptive Excitable Systems, Institute of Physics, Academia Sinica, Taiwan.

Advisors: Chun-Chung Chen and Chi-Keung Chan

Achievements:

- Constructed a simple model for a phenomenon observed in several biological systems
- Performed linear stability analysis on the nonlinear ODE we obtained, numerically solved them and found the phase diagram for the model
- Studied the mean field theory for local neural network with short-term synaptic plasticity as a physiological representation for the simple mathematical model we obtained

Teaching Experience

Instructor, University of Washington, Seattle.

2019/06—2019/09

AMATH 351 : Introduction to Differential Equation and Applications

Teaching Assistant, University of Washington, Seattle.

2019/01—2019/03

MATH 125: Calculus II (Integration and Differential Equations)

2018/09—2019/01

AMATH 351 : Introduction to Differential Equation and Applications

2018/03—2018/06

AMATH 301 : Beginning Scientific Computing

2018/01—2018/03

MATH 124: Calculus I (Continuity and Differentiation)

2017/09—2017/12

MATH 125: Calculus II (Integration and Differential Equations)

Teaching Assistant, National Taiwan University.

2016/01—2016/06

Applied Mathematics III: Complex Analysis and Integral Transforms

2015/01—2015/06

Statistical Physics I: Equilibrium Statistical Mechanics

2014/09—2015/01

General Physics a-1: Classical Mechanics and Special Relativity

Presentations

Oral Presentation

2016/06

Ying-Jen Yang, Chun-Chung Chen, Pik-Yin Lai and Chi-Keung Chan, “Anticipatory Dynamics in Adaptive Excitable Systems.” *2016 Cross-Strait Biological-Inspired Theoretical-problems Symposium*. **Slide**

2016/01

Ying-Jen Yang and Chun-Chung Chen, “Coherent and Anticipatory Dynamics in a Random Network with Dynamical Couplings.” *2016 PSROC*. **Slide**

2015/05

Ying-Jen Yang and Chun-Chung Chen, “Adaptive Synchronization and Anticipatory Dynamical System.” *2015 Complex System Symposium (CSC)* **Slide**

2014/06

Ying-Jen Yang, Chun-Chung Chen and Chi-Keung Chan, “Modeling rhythmic memory with simple excitable systems.” *Statphys-Taiwan* and *CSC*. **Slide**

Poster Presentation

- 2015/01 Ying-Jen Yang, Chun-Chung Chen, Pik-Yin Lai and Chi-Keung Chan, “Anticipative Time Perception in an Adaptive Excitable System.” *2015 PSROC Poster*
- 2014/01 Ying-Jen Yang, Chun-Chung Chen and Chi-Keung Chan, “Modeling Rhythmic Memory With Self-Tuning FitzHugh-Nagumo Dynamics.” *2014 PSROC*

Working and Other Experience

- 2018/09—Current **Webmaster**, *Society of Industrial and Applied Mathematics, University of Washington Student Chapter.*
- 2016/08—2017/08 **Alternative Military Service for Education**, *National Feng-yuan Senior High School.*