Department of Mathematics

Wisdom of the Land

Research Areas

Mathematical modeling in nanotechnology

Assoc. Prof. Duangkamon Baowan

- Works focused on the energy and force distribution between both organic and inorganic molecules
- To understand the energy behaviors at a molecular level

Mathematical modeling of interaction energies between nanoscale objects

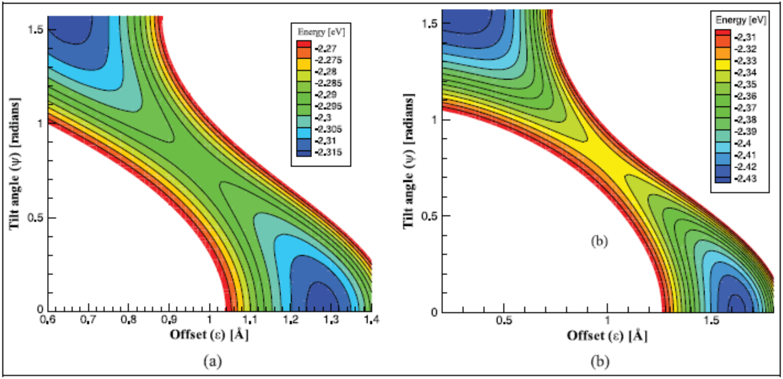


Figure 4. Contour plot of interaction energy for (a) C_{70} fullerene for a 8.0-Å radius nanotube and (b) C_{80} fullerene for a 8.3-Å radius nanotube, showing two distinct and approximately equal local minima.

Schematic representation reproduced from Cox et al.[44] (DOI:10.1088/1751-8113/41/23/235209)

Mathematical modeling and simulation in medical science and agriculture

Assoc. Prof. Chontita Ratanakul

- Signal transduction process
- Biological controls of insect pests of Thailand's economic crops

Signal transduction process 1

- Signal transduction process in living cells and osteoporosis
- Theoretical and numerical approaches

$$I_{t+\Delta t} - I_t = \alpha(BH_{t+\Delta t} - BH_t) + \beta(B1_{t+\Delta t} - B1_t) + \gamma(B2_{t+\Delta t} - B2_t) - \frac{K_F K_{dF} I_t}{K_{dF} + I_t}$$
$$- \frac{K_B K_{dB} I_t}{K_{dB} + I_t} - \varepsilon((I_t - I_e) - s(E_t + E_e)) + \delta_0$$

$$E_{t+\Delta t} - E_t = \varepsilon(I_t - s(E_t + E_e)) - \omega E_t + \lambda X_t$$

$$X_{t+\Delta t} - X_t = \eta_m[\mathrm{H}(E_{t+\Delta t} + E_e - E_m) - \mathrm{H}(E_{t+\Delta t} + E_e - E_M)]\frac{e^{-\mu(E_{t+\Delta t} + E_e - E_m)} - 1}{e^{-\mu(E_M - E_m)} - 1}$$
$$+ \eta_M[1 - \mathrm{H}(E_{t+\Delta t} + E_e - E_M)] + \eta_m\,\mathrm{H}(E_{t+\Delta t} + E_e - E_M)] - \eta_0 X_t$$

Signal transduction process 2

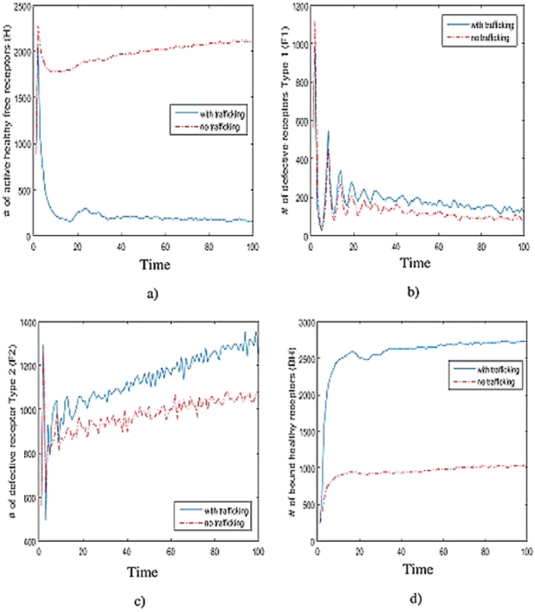


Figure 5 Simulated time courses of the numbers of (a) free healthy receptors, (b) type 1 free defective

Biological controls of insect pests 1

- Biological controls of insect pests of Thailand's economic crops
- System of difference, differential equations, Cellular Automata model and Monte Carlo simulation

$$P_{t+\Delta t}^{i} = P_t^i + r_1\alpha_1 P_t^e - \alpha_2 P_t^i - \beta_1\left(P_t^i, M_t^i\right)M_t^i \quad (1)$$

$$P_{t+\Delta t}^{m} = P_t^m + r_2\alpha_2 P_t^i - \alpha_3 P_t^m - \beta_2\left(P_t^m, M_t^i\right)M_t^i \quad (2)$$

$$P_{t+\Delta t}^{e} = P_t^e + r_3\alpha_4 v_1 P_t^m - \alpha_1 P_t^e - \beta_3\left(P_t^e, M_t^i\right)M_t^i \quad (3)$$

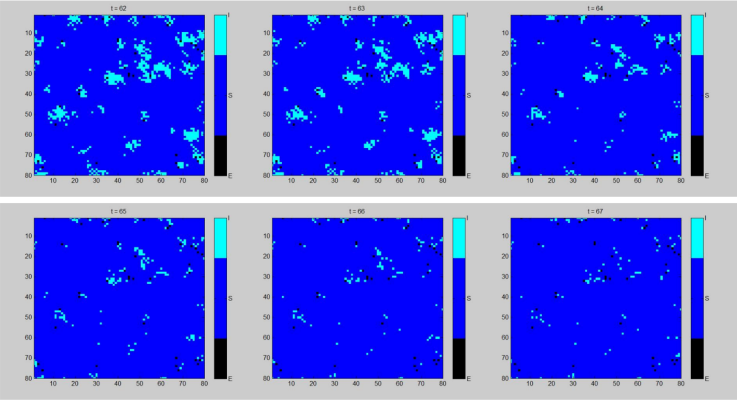
$$M_{t+\Delta t}^{i} = M_t^i + s_1\gamma_1 M_t^e - \gamma_2 M_t^i \quad (4)$$

$$M_{t+\Delta t}^{d} = M_t^d + s_2\gamma_2\delta_1\left(P_t^i, P_t^m, P_t^e, M_t^i\right)M_t^i - \gamma_3 M_t^d \quad (5)$$

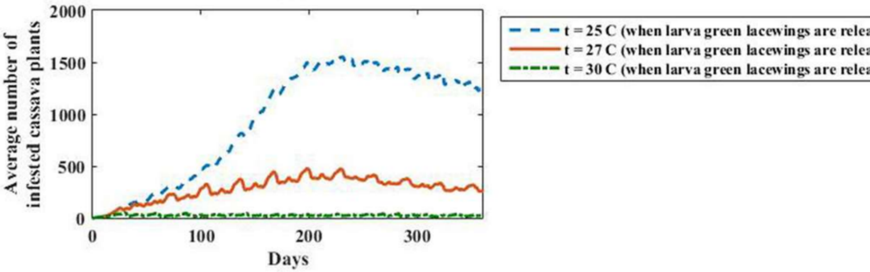
$$M_{t+\Delta t}^{m} = M_t^m + s_3\gamma_3 M_t^d - \delta_2 M_t^m \quad (6)$$

$$M_{t+\Delta t}^{e} = M_t^e + s_4 v_2 M_t^m - \gamma_1 M_t^e \quad (7)$$

Biological controls of insect pests 2



Biological controls of insect pests 3



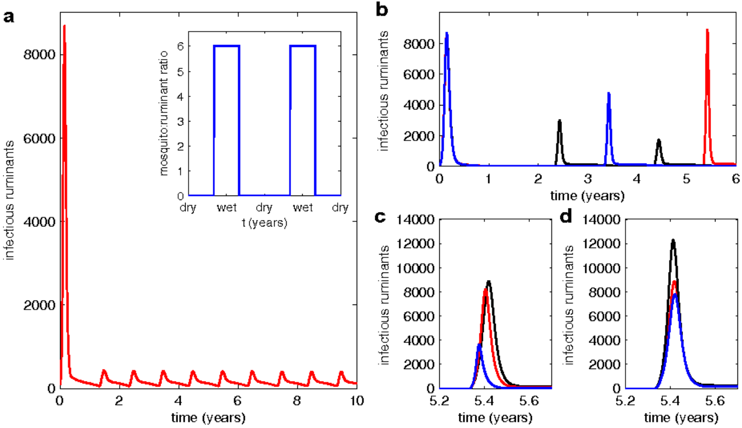
Mathematical modeling of infectious diseases

Asst. Prof. Farida Chamchod

- Dynamics of malaria, antibiotic-resistant bacteria, influenza, and livestock diseases
- Vaccination, host movements, seasonality, and population dynamics

A modeling approach to investigate epizootic outbreaks and enzootic maintenance of rift valley fever virus

$$\frac{dU}{dt} = (1 - \lambda_A - \lambda_C - \lambda_I)\Lambda - (\epsilon\beta_A A + \epsilon\beta_C C + \sigma\beta_I I)U - \gamma_U U$$
$$\frac{dA}{dt} = \lambda_A \Lambda + p(\epsilon\beta_A A + \epsilon\beta_C C + \sigma\beta_I I)U - \gamma_A A$$
$$\frac{dC}{dt} = \lambda_C \Lambda + (1 - p)(\epsilon\beta_A A + \epsilon\beta_C C + \sigma\beta_I I)U + (1 - r)\nu I - \gamma_C C$$
$$\frac{dI}{dt} = \lambda_I \Lambda + q\gamma_C C - \nu I$$


a
infectious ruminants
8000
6000
4000
2000
0
0
2
4
6
8
10
time (years)
mosquito:ruminant ratio
6
5
4
3
2
1
0
dry
wet
dry
wet
dry
t (years)
b
infectious ruminants
8000
6000
4000
2000
0
0
1
2
3
4
5
6
time (years)
c
infectious ruminants
14000
12000
10000
8000
6000
4000
2000
0
5.2
5.4
5.6
time (years)
d
infectious ruminants
14000
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10000
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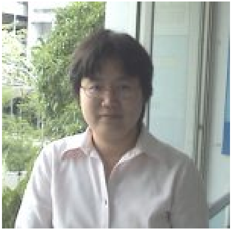
2000
0
5.2
5.4
5.6
time (years)

Mathematical models in biology



Asst. Prof. Kornkanok Bunwong

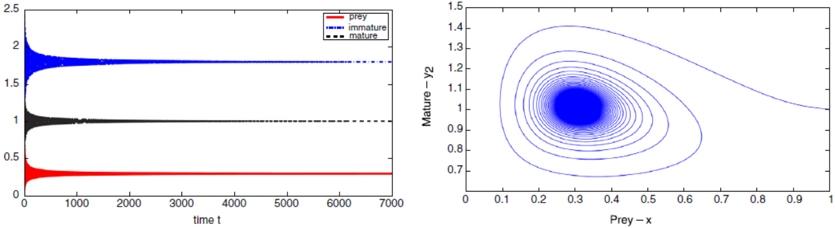
- Ecology, Environment and Evolution
- Dynamical systems

A bifurcation path to chaos in a time-delay fisheries predator–prey model with prey consumption by immature and mature predators

$$\dot{x}(t) = x(t)(r - ax(t)) - \frac{b_1 x(t) y_1(t)}{1 + m_1 x(t)} - \frac{b_2 x(t) y_2(t)}{1 + m_2 x(t)},$$

$$\dot{y}_1(t) = \frac{k_2 b_2 x(t) y_2(t)}{1 + m_2 x(t)} - d_1 y_1(t),$$

$$\dot{y}_2(t) = \frac{k_1 b_1 x(t - \tau) y_1(t - \tau)}{1 + m_1 x(t - \tau)} - d_2 y_2(t).$$



(a) Time series of the solution.

(b) Phase plane plot.

Mathematical modeling of complex systems

Asst. Prof. Pairote Satiracoo

- Develop mathematical models in glucose absorption process.
- Qualitative analyses of nonlinear systems are main tools.

Computational Mathematics

Asst. Prof. Somkid Amornsamankul

- Blood Flow Simulation

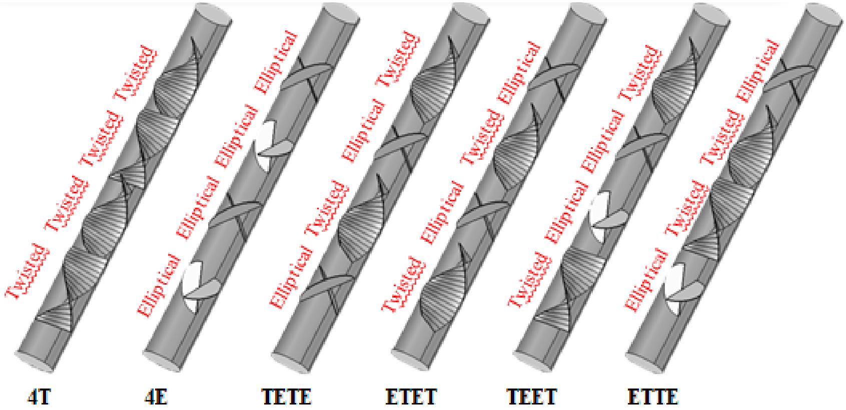
Computational fluid dynamics

Asst. Prof. Wannika Sawangthong

Dr. Nathnarong Khajohnsaksumeth

- Numerical simulation of three-dimension fluid flow in cemented hip replacement
- Numerical simulation of three-dimension fluid flow in coronary artery

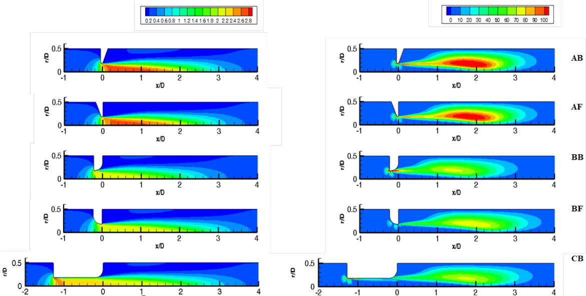
Numerical simulation for efficient static mixers with different geometries



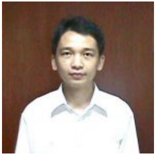
High performance computing

Asst. Prof. Pallop Huabsomboon

- Firespread model
- Thrombus formation process at medical devices in blood flows
- Efficient numerical techniques for solving integral equations

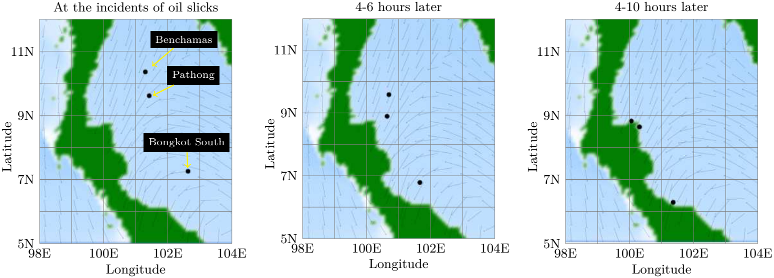


Oil spill prediction



Dr. Kittisak Chanyatrakom

- WAM model



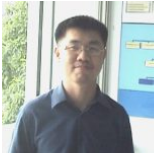
The simulation of the movement of three oil slicks from the different drilling rigs on 4 January 2019, the storm cyclone (Pabuk) day.

Coding theory

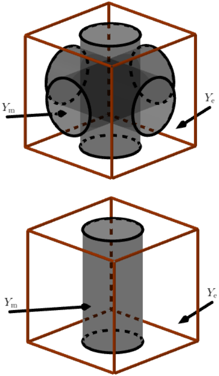
Asst. Prof. Wittawat Kositwattanarerk

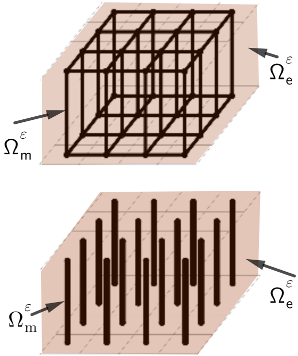
- The study of how information can be transmitted efficiently and reliably
- Low-density parity- check (LDPC) codes

Applied functional analysis in modeling in Physics, distribution theory



Dr. Somsak Orankitjaroen



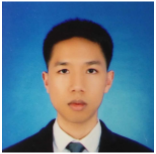


- Mathematical modeling of fiber reinforced structures by homogenization
- Mathematical modeling of a thin plate by reduction of dimension process

Operations Research

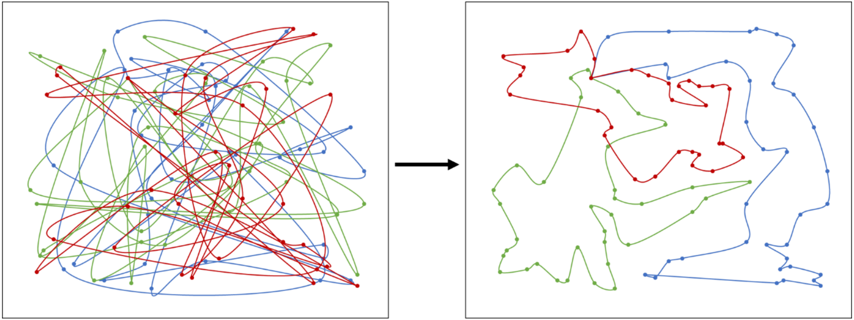
Dr. Rawee Suwandechochai

Dr. Wasakorn Laesanklang



Dr. Wasin Padungwech

Route optimization for large-scale real-world problems

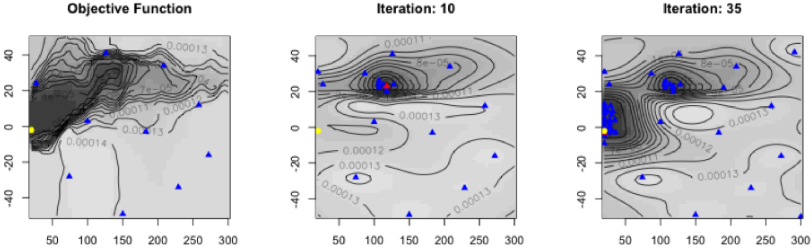


- vehicle routing optimization with multiple constraints
- exact methods and heuristic methods

Efficient algorithms for computationally expensive black-box optimization problems

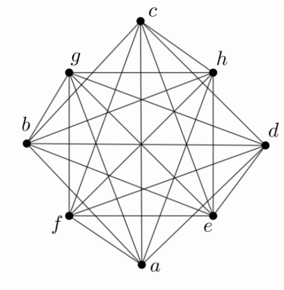
Dr. Tipaluck Krityakierne

- response surface models
- Gaussian Process (GP) models for large-scale problems

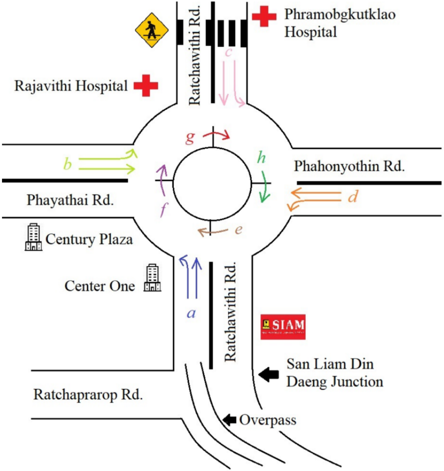


Graph Theory

Dr. Chanun Lewchalermvong



- Graph theory to problems in traffic control



Rings and modules

Dr. Nguyen Van Sanh

Approximation theory, potential theory

Asst. Prof. Nattapong Bosuwan

- Polynomial and Rational Interpolation and Approximation
- Padé Approximants
- Orthogonal Polynomials
- Minimal Energy and Riesz Polarization Problems

Differential geometry, computational mathematics, group theory and theory of formal languages

Dr. Dmitry Berdinsky

- Surface theory in Thurston geometries
- Isogeometric analysis
- Cayley automatic groups