Name: Yasuhito Miyamoto

Research field: Differential Equations

Keywords: Nonlinear Partial Differential Equations of Parabolic and Elliptic type; Bifurcation Diagram; Global Attractor; Shape of the solutions; Hot spots; Stability

Current research:

I mainly study nonlinear partial differential equations of parabolic and elliptic type. My dissertation was about the structure of the global attractor of the semiflow generated by a one-dimensional semilinear parabolic equation. Specifically, I studied the heteroclinic connections in the global attractor. I continued studying in this direction for two years. After that, I mainly studied qualitative properties of solutions of semilinear elliptic equations, namely, the shape and the Morse index.

More recently, I have been working on bifurcation diagrams of semilinear elliptic equations with supercritical exponent. I have obtained detailed bifurcation diagrams of the Dirichlet problem with general supercritical nonlinearity and the Neumann problem of the equation $\varepsilon^2\Delta u - u + u^p = 0$ provided that the domain is a ball.

There is general methods (such as functional analysis and variational methods). However, they are not enough in order to obtain much information of solutions of PDEs. I am interested in obtaining deep theorems, using special methods using features of each equation.

I have studied topics including

- bifurcation diagrams of elliptic equations with supercritical exponent,
- bifurcation diagrams of elliptic equations with general nonlinearity,
- shapes of the second eigenfunctions of the Neumann Laplacian and hot spots,
- stable steady states of semilinear parabolic equations and systems, and
- qualitative properties of the global attractor of semilinear parabolic equations and systems.

Notice for the students:

Basic knowledge of ordinary differential equations and partial differential equations is necessary. For example, you have to be able to solve ODEs of a first order differential equation, an inhomogeneous second order differential equation with constant coefficient, and a one-dimensional heat equation on a finite interval or a disk. Some knowledge of functional analysis (such as Hilbert spaces, compact operators, and Sobolev embedding theorems) is desirable. It may be good for your research that you know variational methods, fixed point theorems, and phase plane methods.