International Workshop for Young Scientists 2017

Analysis and its Applications to Geometry

5 – 9 June 2017

School of Science, Tokyo Institute of Technology
Room H201, the Main Building

Program

Monday, 5 June

10:30 - Registration / Coffee

11:00 - Opening

- *Welcome address by the Dean, Prof. Tetsuo Okada*
- *Introduction of Tokyo Tech by Prof. Yasuhiro Ohshima*
- *Remarks*
- *Group Photo*

12:00 - 14:00 Lunch

14:00 - 15:30 Research Presentations by the Participants (1)

15:30 - 16:00 Coffee Break

16:00 - 17:30 Research Presentations by the Participants (2)

18:00 - 20:00 Welcome Party at *Dai-ichi Shokudo* (Student CO-OP)

Tuesday, 6 June

9:00 - 12:00 Lectures A1 - A2 / Coffee Break

- *Lecturer: Prof. Eiji Yanagida (Tokyo Tech)*
- *Title: Stability Analysis for Dynamical Systems*

12:00 - 14:00 Lunch

14:00 - 16:30 Research Projects A3 / Coffee Break

16:30 - 17:30 Presentations A4

Wednesday, 7 June

9:00 - 12:00 Lectures B1 - B2 / Coffee Break

- *Lecturer: Prof. Hiroshige Shiga (Tokyo Tech)*
- *Title: Riemann Surface and Moduli Space*

12:00 - 14:00 Lunch

14:00 - 16:30 Research Projects B3 / Coffee Break

16:30 - 17:30 Presentations B4

Thursday, 8 June

9:00 - 12:00 Lectures C1 - C2 / Coffee Break

- *Lecturer: Prof. Kazuo Akutagawa (Tokyo Tech)*
- *Title: Differential Geometry — Existence of Closed Geodesics on Surfaces —*

12:00 - 14:00 Lunch

14:00 - Intercultural Study

Friday, 9 June

9:00 - 12:00 Lectures D1 - D2 / Coffee Break

- *Lecturer: Prof. Yoshihiro Tonegawa (Tokyo Tech)*
- *Title: How to Construct a Mean Curvature Flow with Singularities*

12:00 - 14:00 Lunch

14:00 - 16:30 Research Projects D3 / Coffee Break

16:30 - 17:30 Presentations D4

18:00 - 20:00 Farewell Party at *Issyoh* (near Ookayama Station)

Abstracts

Lectures A1 and A2 (Tuesday)

Lecturer. *Professor Eiji Yanagida (Tokyo Tech)*

Title. *Stability Analysis for Dynamical Systems*

Abstract. Stability is one of the most important concepts in the theory of dynamical systems. I will analyze the stability of equilibria in systems of ordinary differential equations, systems of linear parabolic partial differential equations with constant coefficients, and scalar reaction-diffusion equations. To this purpose, the method of Lyapunov and linearized eigenvalue problems are introduced.

References.

[1] N. Chafee, Asymptotic behavior for solutions of a one-dimensional parabolic equation with homogeneous Neumann boundary conditions, J. Diff. Eqs. **18** (1975), 111–134.

[2] L. C. Evans, Partial Differential Equations, American Mathematical Society, 2010.

[3] M. Hirsch, S. Smale and R. L. Devaney Differential Equations, Dynamical Systems, and an Introduction to Chaos, Academic Press, 2003.

[4] J. Smoller, Shock Waves and Reaction-Diffusion Equations, Springer, 1994.

[5] A. M. Turing, The chemical basis of morphogenesis, Phil. Trans. Roy. Soc. London, B237 (1952), 37–72.

Lectures B1 and B2 (Wednesday)

Lecturer. *Professor Hiroshige Shiga (Tokyo Tech)*

Title. *Riemann Surface and Moduli Space*

Abstract. A one-dimensional complex manifold is called a Riemann surface. While it is a simple notion, one may see that Riemann surfaces appear in many fields of mathematics and also in physics. In this lecture, after presenting some fundamental facts on Riemann surfaces, we give concrete constructions of Riemann surfaces to understand the moduli spaces which are deformation spaces of Riemann surfaces.

Lectures C1 and C2 (Thursday)

Lecturer. *Professor Kazuo Akutagawa (Tokyo Tech)*

Title. *Differential Geometry — Existence of Closed Geodesics on Surfaces —*

Abstract. In these two lectures, we study on the existence of closed geodesics on a closed surface, by using the **direct method** and the **min-max method**. The min-max method will be more powerful in the future, especially for the existence problem of Einstein metrics on closed manifolds. The plan of my lectures is the following:

(1) What are "geodesics"?

(2) Existence of closed geodesics on a closed surface of genus ≥ 1.

(3) Existence of closed geodesics on 2-sphere.

References.

Differential Geometry

- J. A. Thorpe, *Elementary Topics in Differential Geometry*, Springer-Verlag (1979).
- I. Chavel, *Riemannian Geometry; A Modern Introduction*, 2nd ed., **Cambridge Univ. Press** (2006).
- P. Petersen, *Riemannian Geometry*, 3rd ed., **GMT 171**, Springer (2016).

Variational Methods

- S. Nishaikawa, *Variational Methods in Geometry*, Transl. Math. Monographs, **Amer. Math. Soc.** (2002).
- M. Struwe, *Variational Methods*, 3rd ed., **EMG 34**, Springer (2000).

Closed Geodesics

- W. Klingenberg, *Lectures on Closed Geodesics*, **GMW 230**, Springer-Verlag (1978).

Lectures D1 and D2 (Friday)

Lecturer. *Professor Yoshihiro Tonegawa (Tokyo Tech)*

Title. *How to Construct a Mean Curvature Flow with Singularities*

Abstract. A time-parametrized family of surfaces is called mean curvature flow if the velocity of motion is equal to the mean curvature at each point and time. Mean curvature flow is a flow of surfaces which decreases the surface area and is one of the most fundamental geometric flow problems along with the Ricci flow. In this lecture, I will describe some essence of how we construct a mean curvature flow given an arbitrary closed set with singularities in our recent paper: Lami Kim, Yoshihiro Tonegawa, On the mean curvature flow of grain boundaries, Annales de l'Institut Fourier (Grenoble) 66, (2017) no. 1, 43 – 142.