Research Report (September, 2019 - March, 2020)

In the SGU course of Mathematical Physical Science: September 2017-March 2020

Conferring university	Degree name (by completing a course / by thesis only)	Date of conferment
Waseda University	Ph. D. (Science)	March 15, 2020

Enrollment from September 2017	Department of Pure and Applied Mathematics Keiichi WATANABE

I. List of Papers

[1] K. Watanabe, Strong solutions to compressible--incompressible two-phase flows with phase transitions, *Nonlinear Anal. Real World Appl.* **54** (2020), 103101.

II. List of Talks

[1] K. Watanabe, "Maximal regularity of the Stokes operator in exterior Lipschitz domains," International Workshop on the Multi-Phase Flow; Analysis, Modeling, and Numerics, Waseda Univ., Japan, Nov. 20.

[2] K. Watanabe, "The Stokes operator in exterior Lipschitz domains," Mathematical Analysis of Viscous Incompressible Fluid, Research Institute of Mathematical Science, Kyoto Univ., Japan, Nov. 26.

[3] K. Watanabe, "The Stokes equations in exterior Lipschitz domains," Workshop on fundamental equations of fluid mechanics by young researchers, Nagoya Univ., Jan. 06.

[4] K. Watanabe, "Global solvability of the Navier–Stokes–Korteweg equations with a non-decreasing pressure in Lp-framework," MSJ Spring Meeting 2020, Nihon Univ., Mar. 19.

III. Research Results

    I tackled the moving contact line problems of the Navier-Stokes equations. This problem was studied by Solonnikov (1995) and Wilke (2013) but they imposed the (homogeneous) Dirichlet boundary conditions on the boundary of the domain. However, this is not physically reasonable which was pointed out by Huh and Scriven (1971). I found that it is possible to impose the Robin boundary conditions instead of the Dirichlet boundary conditions under certain conditions.

    I also challenged the global existence of the compressible Navier-Stokes equations with the Coriolis effects. Since I got a rough idea of the proof, I will prove these results rigorously.

IV. Summary (From September 2017 to May 2020)

    I had opportunities to visit London (UK) and Pittsburgh (US) since I enrolled in the SGU course of Mathematical Physical Science from September 2017 to March 2020. Especially, I got ideas of the research on the compressible Navier-Stokes equations with the Coriolis effects and the moving contact line problems of the free boundary problems of the Navier-Stokes equations in London and Pittsburgh, respectively. Besides, the experiments of my long stay in foreign countries made me know not only for the research but also for foreign cultures---this induced an opportunity to learn Japanese culture objectively. I think this helped me to communicate with researchers who came from foreign countries to give lectures at seminars and workshops. I am looking forward to reminding these kinds of opportunities for my future projects.