Research Report (April, 2019 - March, 2023)

In the SGU course of Mathematical Physical Science: April 2019-March 2023

Conferring university	Degree name	Date of conferment
Waseda University	Doctor of Engineering (by completing a course)	March 15, 2023

Enrollment from April 2019 | Department of Applied Mechanics and Aerospace Engineering | Masahito WATANABE

I. List of Papers

[1] M. Watanabe and H. Yoshimura, "Resonance, symmetry, and bifurcation of periodic orbits in perturbed Rayleigh-Bénard convection", Nonlinearity, Vol. 36, No. 2, pp. 955-999, 2023. (Peer-reviewed)

[2] M. Watanabe and H. Yoshimura, "Experimental observation of Lagrangian coherent structures in perturbed Rayleigh-Benard convection", Journal of Fluids Engineering, Vol. 144, No. 4, 040902, 2022. (Peer-reviewed. Transferred from ASME 2021 Fluids Engineering Division Summer Meeting, Flow Visualization Competition.)

[3] M. Watanabe and H. Yoshimura, "Experimental observations of Lagrangian coherent structures and fluid transports in perturbed Rayleigh-Bénard convection", Proc. Third IFAC Conference on Modelling, Identification and Control of Nonlinear Systems, pp. 473-478, Online, September, 2021. (Peer-reviewed)

[4] M. Watanabe and H. Yoshimura, ”Experimental investigation of Lagrangian coherent structures and lobe dynamics in perturbed Rayleigh-Benard convection”, Proc. ASME 2021 Fluids Engineering Division Summer Meeting, No. 64945, Online, August, 2021. (Peer-reviewed)

[5] M. Watanabe, Y. Kitamura, N. Hatta, and H. Yoshimura, ”Experimental analysis of Lagrangian coherent structures and chaotic mixing in Rayleigh-Benard convection”, Proc. ASME 2020 Fluids Engineering Division Summer Meeting, No. 20116, Orlando, USA (Online), July, 2020. (Peer-reviewed)

II. Record of Awards

[6] Young Researcher Encouragement Prize (Wakate-Kenkyuusha-Shourei-shou), Waseda Research Institute for Science and Engineering, March, 2022.

[7] 2nd Prize, Research Presentation Competition, 11-th Early-Bird Program, Waseda Research Institute for Science and Engineering, March, 2022.

[8] K. Iha, T. Suzuki, M. Takakuwa, T. Chou, M. Watanabe, 1st Prize, Collaborative Research Plan Competition, 11-th Early-Bird Program, Waseda Research Institute for Science and Engineering, March, 2022.

[9] M. Watanabe and H. Yoshimura, 2nd prize, Flow Visualization Competition (Images Category), ASME 2021 Fluids Engineering Division Summer Meeting, August, 2021.

[10] ASME Fluids Engineering Division 2020 Graduate Student Scholarship Award, March, 2021.

[11] JSW Movie Prize, HIRAKU 3MT Competition 2020, November, 2020.

III. List of Talks

＜International Conference＞

[12] M. Watanabe and H. Yoshimura, ”Bifurcations of periodic orbits in perturbed Rayleigh-Benard convection”, Bifurcation Governed by Partial Differential Equations, Waseda University, Tokyo, Japan, December, 2022.

[13] M. Watanabe and H. Yoshimura, ”Lagrangian coherent structures in Rayleigh-Benard convection with perturbations”, International Workshop on Multiphase Flows: Analysis, Modelling and Numerics, Waseda University, Tokyo, Japan (Online), December, 2020.

[14] M. Watanabe and H. Yoshimura, ”Chaotic mixing in two-dimensional Rayleigh-Bénard convection with periodic perturbations”, Fourth International Conference on Recent Advances in Nonlinear Mechanics, pp. 49-52, Lodz, Poland, May, 2019. (Peer-reviewed)

＜Domestic Conference and Meetings＞

[15] M. Watanabe, Y. Mohri, Y. Haga, Y. Nakahara, Y. Ohtsuka, and H. Yoshimura, "Chaotic fluid transport and Lagrangian coherent structures in Rayleigh-Bénard convection", The 2nd Waseda-Suuri-Wakate-Kenkyuukai, Waseda University, February, 2023. (in Japanese)

[16] M. Watanabe, Y. Mohri, Y. Haga, Y. Nakahara, Y. Ohtsuka, and H. Yoshimura, "Chaotic fluid transport and Lagrangian coherent structures in Rayleigh-Bénard convection", The 1st Waseda-Suuri-Wakate-Kenkyuukai, Waseda University, December, 2022. (Poster. in Japanese)

[17] M. Watanabe and H. Yoshimura, "Experimental observations of perturbed Rayleigh-Benard convection and analysis of chaotic fluid transport", JSME Dynamics and Design Conference 2021, No. 117, Tokyo University (Online), September, 2021. (in Japanese)

[18] M. Watanabe and H. Yoshimura, "Experimental analysis on Lagrangian coherent structures and fluid transport in perturbed Rayleigh-Bénard convection", JSIAM 2021 Annual Meeting, pp. 232-233, Shibaura Institute of Technology (Online), September, 2021. (in Japanese)

[19] M. Watanabe, Y. Kitamura, N. Hatta, R. Kamakura, H. Yoshimura, "Lagrangian coherent structures and lobe dynamics in perturbed Rayleigh-Bénard convection", JSIAM 2020 Annual Meeting, pp. 359-360, Ehime University (Online), September, 2020. (in Japanese)

[20] M. Watanabe, Y. Kitamura, N. Hatta, R. Kamakura, H. Yoshimura, "Experimental analysis of chaotic transport and Lagrangian coherent structures in Rayleigh-Benard convection", JSME 2020 Annual Meeting, S05307, Nagoya University (Online), September, 2020. (in Japanese)

[21] M. Watanabe and H. Yoshimura, "Chaotic mixing and bifurcation phenomena of a perturbed Rayleigh Benard convection", JSME Kanto branch 26th Meeting, 17G13, Waseda University, March, 2020. (in Japanese)

[22] M. Watanabe and H. Yoshimura, ”Chaotic mixing and bifurcation structures in perturbed Rayleigh-Bénard convection", JSIAM 2019 Annual Meeting, pp. 198-199, Tokyo University, September, 2019. (in Japanese)

[23] M. Watanabe and H. Yoshimura, "Chaotic mixing and bifurcation in a Rayleigh-Benard convection with periodic perturbation", JSME Dynamics and Design Conference 2019, No. 154, Kyuushu University, August, 2019. (in Japanese)

IV. Research Results in AY 2022

We have mainly worked on three topics in AY2022. First, we investigated the periodic orbits in the perturbed Hamiltonian model of Rayleigh-Bénard convection from the perspectives of resonance and symmetry as well as bifurcation when the amplitude of perturbation is varied. The results were published in Nonlinearity in January, 2023. Second, we experimentally explored the global structures of stable fluid transport in perturbed Rayleigh-Bénard convection by detecting elliptic Lagrangian coherent structures (LCSs) from velocity data obtained by Particle Image Velocimetry (PIV). Third, we developed a perturbed Hamiltonian model that elucidates the experimental results better.

V. Summary (From April 2019 to May 2023)

We have studied the global structures of fluid transport in perturbed Rayleigh-Bénard convection with great supports from "Top Global University Project". Although unfortunately I did not have a chance to study abroad due to the COVID-19 pandemic, I had a valuable experience through this project by making a presentation in some international workshops, taking some classes in other fields, and talking with other young researchers in various departments. We greatly appreciate to the Professors and staff in the project.