Research Report（April, 2018 - March, 2019）

Enrollment from April 2017 | Department of Modern Mechanical Engineering | Takuya TERAHARA

I. List of Papers

1. K. Takizawa, T.E. Tezduyar, H. Uchikawa, T. Terahara, T. Sasaki, and A. Yoshida, “Mesh Refinement influence and cardiac-cycle flow periodicity in aorta flow analysis with isogeometric discretization”, *Computers & Fluids, published online, DOI: 10.1016/j.compfluid.2018.05.025* (2018), 10.1016/j.compfluid.2018.05.025.
2. K. Takizawa, T.E. Tezduyar, H. Uchikawa, T. Terahara, T. Sasaki, K. Shiozaki, A. Yoshida, K. Komiya, and G. Inoue, “Aorta flow analysis and heart valve flow and structure analysis”, *Frontiers in Computational Fluid–Structure Interaction and Flow Simulation: Research from Lead Investigators under Forty – 2018* (2018) 29-89, 10.1007/978-3-319-96469-0_2

II. List of Talks

1. T. Terahara, K. Takizawa, T.E. Tezduyar, M.-C. Hsu, and Y. Bazilevs, "Heart Valve Sequentially-coupled FSI Analysis with the ST-SI-TC-IGA", *Proceedings of IGA 2018*, Texas, USA, (2018).
2. T. Terahara, T. Sasaki, K. Shiozaki, K. Takizawa, T.E. Tezduyar, “Heart Valve Computational Flow Analysis with Resolved Jet Flow Near Leaflet Surfaces”, in *Extended Abstracts of Research Committee on Blood Flow and Cardiovascular System*, Nagano, (2018).
3. T. Terahra, K. Shiozaki, R. Kobayashi, A. Tsushima, K. Takizawa, T.E. Tezduyar, “Computational Analysis of the Blood Flow in the Aorta and Heart Valve with ST-SI-TC-IGA”, in *Extended Abstracts of JST CREST-PRESTO-AIMaP Symposium 2019*, Tokyo, (2018).

III. Research Results in AY2018

Toward an FSI analysis of a heart valve problem, a fluid mechanics computation using the motion of the heart valve, extracted from an FSI analysis with an immersed boundary method, was carried out. The leaflets of the heart valve contact. Because of this, we collapse elements at the contact region. The contact motion from the FSI analysis was complicated as each leaflet slides on other leaflets. Therefore, it is difficult to obtain the volume mesh automatically using the current mesh-moving techniques. To approach this problem, we separate the mesh into two parts, near the contact region and the other region. For the part including contact region, we move the mesh semi-manual fashion. For the other part, we use an existing automatic mesh-moving technique. Then, we successfully carried out the fluid mechanics computation and obtained the shear stress on the leaflets.

IV. Research Plan for AY2019

We use space–time slip interface (ST-SI) method for the fluid mechanics computation of the heart valve. ST-SI allows us computing the fluid mechanics even when the contact location changes. We need to move and deform the SI following the shape of the leaflets. However, there is no method which can control the SI. Therefore, we will develop a method to control the SI and investigate what kind of shape is better.