

Research Report (September, 2022- September, 2023)

Enrollment from
September 2021

Department of modern mechanical engineering

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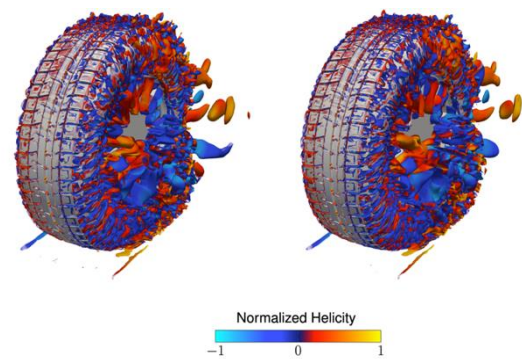
I. List of Papers

II. List of Talks

III. Research Results in AY2022

In 2022, the thermos-fluid computation mesh over the complex pattern of a commercial tire is generated. The mesh is generated by creating the complex pattern surface mesh with Nonuniform Rational B-spline (NURBS) first, then applying a special technique to generate the volume mesh from the surface. The technique has the advantage over commercial software mesh generation, because the former makes it effortless to generate arbitrary boundary layers.

The test computation is then performed over a global domain with the generated mesh. The computation is set for a single tire that is contacting the ground. We observed the normalized helicity from the result. The isosurface of the normalized helicity shows that the vortices are largely peeled and generated from the sidewall of the tire. For the wake flow at the back, vortices are generated from the top and contact region. The structure of the flow is trivial and complicated.



IV. Research Plan for AY2023

In 2023, the main topic will be the refinement of the fluid mesh. From the 2022 computation on complex pattern tires, as well as a number of computations that focus on other topics, it is observed that in the case of applying slip interface (SI), the element dimension along either side of the SI need to match to a certain degree. However, it is usually the case that outside domain is relatively coarse compared to the boundary layer domain. This is caused by the nature of NURBS' insufficiency on local refinement.

We will resolve this by applying T-splines. The procedure is listed as the following.

5. Verification and comparison of computation between T-spline and NURBS over 2D.
6. Design the T-junctions over the mesh that is on the opposite side of the SI.
7. Generate the parametric T-mesh and project the physical mesh.
8. Perform the thermo-fluid computation of tire with the refined mesh.

Another topic is to perform the thermo-fluid computation with the coupling between incompressible flow and thermal transport. The computation is planned to set at a fixed temperature for the tire, and a different temperature from the ground, so that the heat is exchanged from the ground to the air, along the free stream over the heated tire.