

Research Report (September, 2021- September, 2022)

Enrollment from
September 2021

Department of Modern
Mechanical Engineering

Xu Zhaojing

I. List of Papers

T. Kuraishi, S. Yamasaki, K. Takizawa, T.E. Tezduyar, **Z. Xu**, S. Yamasaki, "Space-time isogeometric analysis of car and tire aerodynamics with road contact and tire deformation and rotation", *Computational Mechanics*, **70** (2022) 49–72, doi:10.1007/s00466-022-02155-0

T. Kuraishi, **Z. Xu**, K. Takizawa, T.E. Tezduyar, S. Yamasaki, "High-resolution multi-domain space-time isogeometric analysis of car and tire aerodynamics with road contact and tire deformation and rotation", *Computational Mechanics*, (2022), doi:10.1007/s00466-022-02228-0

II. List of Talks

Xu Zhaojing, "乗用車とそのタイヤの路面接触を考慮したマルチドメイン Space-Time 法による流体解析", 第 35 回数値流体力学シンポジウム, オンライン(Zoom), 12 月 14 日

Xu Zhaojing, "複雑トレッドパターンを有するタイヤの路面接触を考慮した Space-Time 法による流体解析", 日本流体力学会 年会 2022, 京都, 9 月 28 日

III. Research Results in AY2021

In 2021, our first goal is to include the tire with the car body to simulate a more realistic condition. Thus, we did computations of a car body over four tires. The computations were done with two specifications. One of them was done on a mesh with reasonable mesh resolution, and the other one was done on a mesh that focus on one side of the car, including front and rear tires and the side of the car. The latter has finer mesh resolution to achieve higher accuracy result.

Our second goal is to enable computations that include tires with complex tire patterns. The two computations done for the first goal used tires that have only the longitudinal grooves. As one of the main aspects of the research, we developed a computational framework so that tires with complex tire patterns can rotate and keep contacting the road. A computation that has a single tire with complex patterns is being done for the time being.

IV. Research Plan for AY2022

In 2022, we are going to finish the computation of a single tire with complex patterns. Investigations need to be made upon the result we obtained. After that, there are two main goals: First, we need to investigate and update the structure analysis of tires. Second, we need to enable thermo-fluid computations. A plan is given below:

Investigate the thermal situation of tires on a running car.

Obtain deformation shape of a tire with complex patterns from structure analysis.

Generate and improve a mesh that contains a car and its tires with complex patterns.

Perform thermo-fluid analysis of a car with tires with complex patterns.

Investigate and improve the computation until valid result is obtained

Analyze the result obtained and evaluate the thermo-fluid behavior of flow.