*M.Sc.-thesis research*

Robustness improvement of polyhedral mesh method for airbag deployment simulations

Company profile

TNO Automotive Safety Solutions (TASS) is a leading provider of software solutions for crash-simulation. Looking back at over 30 years of development, our MADYMO solver platform comprises advanced Multi-Body (MB), Finite-Element (FE), Computational Fluid Dynamics (CFD) and Contact models. The MADYMO Solver may be used as a stand-alone product as well as coupled to several external FE partners.
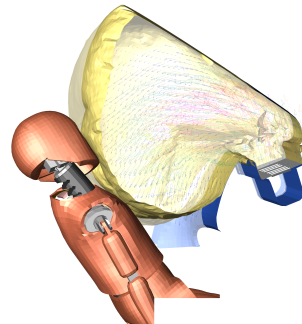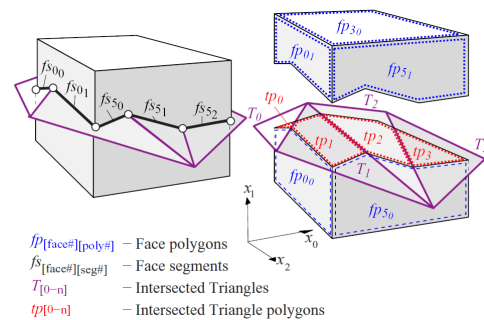
Project background

A madymo airbag deployment simulation is a coupled simulation of the airbag fabric dynamics (structural equations of motion) and the fluid inside the airbag (Euler equations of fluid motion). In such a simulation the fluid domain is bounded by the time-dependent position of the airbag fabric discretized as triangular (linear) finite elements. The required finite volume mesh for the CFD solution consists of 2 parts, i.e. the structured part containing the cubic cells which have no interaction with the airbag fabric and an unstructured part consisting of the cells which are cut by the airbag fabric. These cut-cells are denoted by (flow) polyhedrons. See figure below for an example of a cell split into its polyhedrons. To obtain an accurate solution these polyhedrons are reconstructed from its polygons. Note however that only the flow polyhedrons located in the interior of the AB are necessary for the calculation. The exterior polyhedron can be discarded since it does not contain a flow state. This approach implies that for each polygon of the polyhedrons the question arises whether it belongs to an interior or exterior polyhedron. Finding the answer to this question is in essence the research topic of this M.Sc.-project.

Tasks

You will develop and analyze robust algorithms for the research question specifically and for the generation of the polyhedral mesh in general as used in the MADYMO CFD module.

In particular, you will

- Study the implemented algorithms originating from computational geometry and recommend the best fit for MADYMO;

- Implement and analyze this algorithm with respect to robustness and computational efficiency;

- Write a final report about this project.

$fp_{[\text{face\#}][\text{poly\#}]}$ − Face polygons
$fs_{[\text{face\#}][\text{seg\#}]}$ − Face segments
$T_{[0-n]}$ − Intersected Triangles
$tp_{[0-n]}$ − Intersected Triangle polygons

Requirements:

- A critical mindset and a can-do mentality.

- Able to work in a Linux/Unix environment and some programming experience (Matlab, Fortran or C).

Start date / Duration: TBD / 9-10 months

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