MSc thesis project 2019 at the Divisions of Marine Technology and Fluid Dynamics, Department of Mechanics and Maritime Sciences, Chalmers University of Technology

# Evaluating the Performance of Wall-Modelled Large-Eddy Simulation on Unstructured Grids

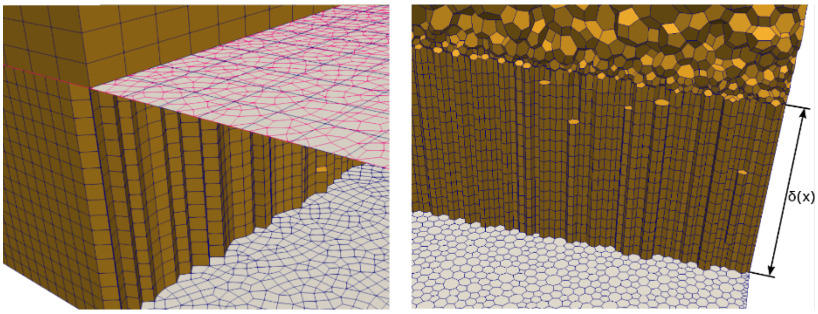
## Background and motivation

Accurate prediction of turbulent flow is central to many industrial applications, including marine and automotive. In the recent years scale-resolving turbulence modelling approaches, such as large-eddy simulation (LES) have received increased attention due to the increase in available computing power. However, to apply them to modelling wall-bounded flows, additional modelling of the near-wall turbulence is still necessary, owning to the multi-scale structure of turbulent boundary layers.

One approach to dealing with near-wall turbulence is wall modelling. Characteristic of this methodology is that only the inner region of the boundary layers is modelled, whereas the outer region should be fully resolved by the computational grid. Consequently, a high-quality grid discretizing the outer layer is necessary. This is easy to achieve using hexahedral grid cells, but for tackling complex-geometry flows, unstructured grids are necessary.

## Objectives and goals

The goal of this thesis work is to systematically evaluate the predictive accuracy of wall-modelled LES on unstructured grids with different cell topologies. Examples of such grids can be seen in the figure below. To that end, state-of-the-art meshing algorithms available in Pointwise will be employed for grid construction, whereas the simulations will be conducted in the open-source CFD software OpenFOAM.




*Examples of unstructured grids for a wall-modelled LES of a turbulent boundary layer.*

Turbulent channel flow will be used as the main test-case, but more difficult cases may be considered if time allows. The outcome of this work will be guidelines for unstructured grid generation for wall-modelled LES that can be used as a starting point for CFD practitioners in both industry and academia.

## Prerequisites

- MTF052 - Fluid mechanics, or equivalent.
- MTF072 - Computational fluid dynamics, or equivalent.
- MTF270 - Turbulence modeling, or equivalent.

## You will

- Gain experience with the most popular open-source CFD code, OpenFOAM.
- Learn to construct unstructured grids using Pointwise, one of the most advanced meshing software on the market.
- Get practical experience with and a solid theoretical knowledge of LES as well as wall modelling.
- Run simulations on many cores using supercomputing facilities available at Chalmers.

## Contact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