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Meshing procedure for atmospheric wind flow modelling

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Meshing is an important step in any CFD modelling process which directly influences the accuracy and quality of the results as well as the stability and the computation time of the model. Together with other pre-processing tasks meshing can be very time consuming leading to high costs due to the elevated number of man hours. Therefore, in order to be cost effective, it is of utmost importance to well define and, where possible, automize the meshing procedure.

This paper explains the complete process of mesh creation currently used in CENER for the modelling of wind flow over terrain and mention tools that are currently in development. The type of mesh chosen for that purpose is a structured, hexagonal mesh, rotated to face the wind direction and with local refinement for modelling wake effects.

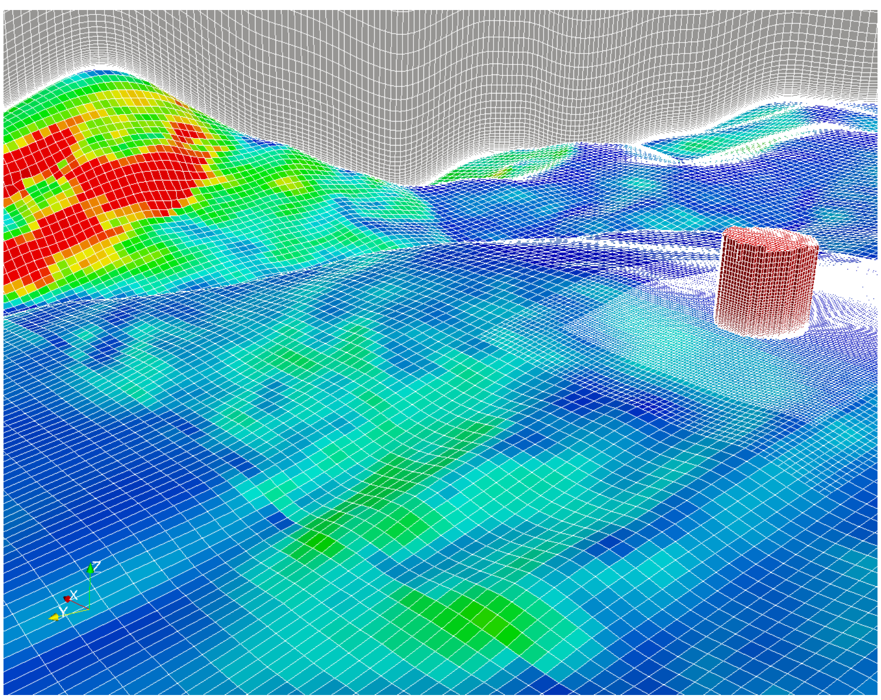

Figure 1: Mesh of Alaiz with local refinement for a LIDAR.

In order to justify the approach presented here, it will begin with a description of mesh properties specific

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for the modelling of atmospheric wind flow and describe how a theoretical, perfect mesh should look like [1]. Typical problems with input files are then summarized, followed by a description of how to handle and preprocess them to speed up the work later on.

Finally the paper focuses on the mesh generation procedure which is divided into three steps:

- The base mesh generation - a simple mesh rotated to the direction of the wind, which can be generated for any terrain.
- A set of intelligent filters which improve the quality of the mesh.
- Scripts making use of OpenFOAM [2] tools to refine the area of interest and to select cells corresponding to wind turbines, met masts or LIDAR's, which can later be used for modelling of wakes and post-processing.

The conclusions on the different meshing approaches will be supported by the results achieved from the modelling of the Bolund test case [3] within IEA Task 31 Wakebench [4].

References

[1] Joe F. Thompson, Bharat K. Soni, and Nigel P. Weatherhill, editors. *Handbook of Grid Generation*. CRC Press, 1999.

[2] OpenCFD. *OpenFOAM - The Open Source CFD Toolbox - User's Guide*. OpenCFD Ltd., United Kingdom, 1.4 edition, 11 April 2007.

[3] A. Bechmann, J. Berg, S. Courtney, H.E. Jørgensen, J. Mann, N.N. Sørensen, and Risø National Lab. for Sustainable Energy. Wind Energy Div Technical Univ. of Denmark. *The Bolund Experiment: Overview and Background Wind Conditions in Complex Terrain*. Contract ENS-33033-0062. 2009.

[4] IEA Wind. Task 31, wakebench: Benchmarking wind farm flow models. `http://www.ieawind.org/task_31.html`, January 2014.