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WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "Multi-fidelity Fluid-Structure Interaction Analysis of a Membrane Blade Concept in non-rotating, uniform flow condition" *by* M. Saeedi et al.

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- Page 3, line 7: you mention that the work flow can be iterated to improve the performance of the blade. What performance are you referring to: aerodynamic performance of the blade or accuracy of the FSI simulation?

Aerodynamic performance of the blade is meant. (text is revised)

- Page 5, line 8: give details of computers and simulation setup when comparing the run times.

Main specifications of the used hardware: (3.40 GHz, 8M Cache,15GiB RAM). This information is added in the revised paper. Simulation setup is the one described in

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Discussion paper

section 3

- Section 2.1.1 is not very detailed compared to section 2.1.2. You could include more details about the numerical method and models, such as the equations, boundary conditions and wall functions used in the RANS model, and the algorithm to show how the non-matching mesh mapping works.

The boundary conditions used for the fluid model are presented in table 4. The transport equations of the $k - \omega SST$ model are well known, consequently we decided not to put them in the paper. Instead we added citations to main references.
We have added a paragraph on the use of wall function for setting the boundary conditions.
In section 2.3, the mapping technique and its properties in terms of consistency and conservation of energy are elaborated in the updated version.

- Page 6: last paragraph of section 2.1.1: it is not very clear what is done to avoid the computational cost of re-meshing, since you also mention "solving the mesh motion problem". As a side note, you mention "a FSI simulation [: : :] needs to update the mesh at each iteration". This is not true for all FSI techniques. For example, in our embedded techniques [1,2], re-meshing or updates of the fluid mesh is not necessary. Only a solid-concentration field is computed. I would encourage you to add a short review of the different FSI modeling techniques in section 1, including also the work of others. [1] Viré A, Xiang J, Pain CC, "An immersed-shell method for modelling fluid-structure interactions", Philosophical Transactions of the Royal Society A, 373(2035) (2015). [2] Viré A, Xiang J, Milthaler F, Farrell PE, Piggott MD, Latham JP, Pavlidis D, Pain CC, "Modelling of fluid-solid interactions using an adaptive-mesh fluid model coupled with a combined finite-discrete element model", Ocean Dynamics 62, 1487-1501 (2012).

In the utilized FSI tool chain no re-meshing is being done after each FSI iteration. But the mesh is updated by applying the displacement boundary condition for the FSI interface and solving the laplacian-like mesh motion equation. Section 1 is revised by adding comments on embedded and body-fitted technique for the FSI problem. Moreover, we have added respective references.

- Page 10, fig 6: why is the pressure coefficient different than 0 at the trailing edge (the same question applies to Fig 18)? What is also the error made on the maximum cp compared to XFLR5?

Even though the difference in the cp value between the lower side and upper side of the wing should vanish at the vicinity of the trailing edge, it is not clear for the authors why the exact value for the pressure coefficient must be zero. For the S809 airfoil the cp distribution is reported in different publications. In the report below, experimental results for the airfoil are presented and the value of cp at the trailing edge is not necessarily zero. http://www.nrel.gov/docs/legosti/old/6918.pdf

- Page 11, line 9: how is the mapping done? Is it conservative despite the non-matching meshes?

Mortar mapping method is used. The mapping is conservative. Even though mortar mapping is not consistent in general, a novel technique for enforcing consistency on the mapping algorithm by scaling up the structural shape functions for the calculation of mapping matrices is utilized. For the details of this implementation we refer to (Wang, 2016)

- Page 15, fig 12: why did you choose this grid topology instead of a c-grid? A cgrid would avoid very thin cells at the leading and trailing edges and could improve convergence and cp results at these locations.

The mesh is generated using a code to generate a blockMeshDict for OpenFOAM. The code is implemented for a 2-bladed wind turbine and the blocking strategy should be able to work for both blades (the same blocking is extruded along the rotor for the 2-bladed rotor). A c-grid would be perfect for a single blade, but in order to use the same blocking on both blades, symmetry in the blocking is needed. Because the blocks presenting the leading edge of one blade should be able to present the trailing edge of the other blade. As a result the triangular blocks are used at both leading edge and trailing edge.

- Page 16, line 1: details of the wall functions should be provided here or in the theoretical section 2.1.1. The same comment applies to line 10 about the mesh motion algorithm.

Wall functions are detailed more in section 2.1.1. For solving the mesh motion problem, standard laplacian-based mesh motion solver from OpenFOAM is used. The topic is now more elaborated in section 2.1.1, but for the details we have referred to publications on the topic by OpenFOAM developers .

Technical corrections

- Throughout the manuscript, references should be between brackets [].

The journal suggest using [] brackets with the year of the publications. Citations are updated accordingly.

- Page 2, line 6: adaption -> adaptation

corrected in the paper.

- Page 3, line 5: in FSI -> in the FSI

corrected in the paper.

- Page 3, line 6: by evaluation of the -> by evaluating the

corrected in the paper.

- Figure 1 caption: Analysis

corrected in the paper.

- Page 5, last line: add point at the end of sentence

corrected in the paper.

- Page 6, line 1: Navier-Stokes (NS)

corrected in the paper.

- Page 6: line 3: constant viscosity and density

corrected in the paper.

- Page 6: line 7: The SIMPLE

corrected in the paper.

- Page 6: line 9: calculate the kinematic

corrected in the paper.

- Page 9, line 8: In Eq (18), $\mathbf{v}_\infty$ is..-

The text is revised.

- Page 9, line 20: of the developed panel

corrected in the paper.

- Page 10, line 20: interaction -> interactions

corrected in the paper.

- Page 16, line 5: FSI_CFD us -> is

corrected in the paper.

- Page 16, line 6: use the panel

corrected in the paper.

Please also note the supplement to this comment:
http://www.wind-energ-sci-discuss.net/wes-2016-6/wes-2016-6-AC1-supplement.pdf

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