Response to the reviewers for paper OE-D20-01516: *Evolution of Lift in a Pure Cruciform for Energy Harvesting*

We would like to express our gratitude to the anonymous reviewers for their time and insight. Below, we document the comments from the reviewers and our response to the comments. We indicate the changes in the original manuscript using the colour blue.

Answers to Reviewer 1

Comment R1.1 *Why OpenFOAM is employed? If other software can be employed to solve the calculation?*

Answer to R1.1 In our opinion, any CFD software can be employed by a proficient enough user as a means to gain important numerical insight upon a fluid mechanics project. A fluid mechanics project can be of different scales: some are targeted at an individual level, dealing with relatively idealised environments as is the case in an undergraduate class on computational fluid dynamics. However, as soon as the project is commissioned at a more advanced level, e.g. post-graduate or industrial setting, we think that the tool chosen to execute the CFD must fulfill the following criteria.

1. The algorithm required to carry out the numerical work must be built into the software. Else, the software itself must be easily extensible to include the numerical routine required.
2. A high degree of automation must be possible on any aspect of the numerical work, be it meshing, running and control of the simulation, data collection and parameter variation.
3. Parallellisation is built in to the software.
4. A stable software code base.
5. The software allows real-time collaboration with multiple authors across a common platform, allowing each iteration of the project or parts of it to be version controlled.
6. Cost-effective.

OpenFOAM, which at the most fundamental level is a collection of C++ library, is easily modified and extended (point 1) using nothing more than a plain text editor, and then recompiled to include the required functionality. The use of extensible text editors such as VIM or Emacs greatly facilitates this process, and at zero cost.

Any aspect of the workflow using OpenFOAM can be automated (point 2) through the use of PyFOAM, a Python library that allows fine-grain control of virtually every aspect of the simulation. In addition to automating the grid independency study and parameter variation, PyFOAM can also be used to post-process data by exploiting the NumPy Python library. Furthermore, parallellisation is built into the OpenFOAM code (point 3), and the fact that the code is open source, facilitates the discovery and patching of bugs (point 4).

Usage of the OpenFOAM software involves including and modifying configuration files, written as plain text files. As such, one can easily leverage the pre-existing tools used by software engineers such as Git, enabling real-time collaboration (point 5) between project members and provide much-needed version control of the whole project. We would like to point out all the tools mentioned in the previous discussion are available for free, incurring zero extra cost on the team, which can be beneficial especially for new and emerging laboratories, where procurement of hardwares is of higher priority.

Comment R1.2 *Mesh independence test is carried out using GCI method, but I think the reference can be updated. For example:[Applied Thermal Engineering. 2020;171:115090], [https://doi.org/10.1016/j.ene*

Answer to R1.2 We included a more recent example of the GCI study in the revised manuscript at ... following the suggestion of the reviewer.

Comment R1.3 *Some figures' resolution need to be adjusted.*

Answer to R1.3 We exported the figures used in the revised manuscript into the PDF instead of the PNG format used in the previous version of the manuscript for better resolution as per the suggestion of the reviewer.

Comment R1.4 *Boundary conditions need to be shown.*

Answer to R1.4 We included the boundary conditions in a table in the revised manuscript.

Answers to Reviewer 2

Comment R2.1 *It's suggested to define FIM in line 37 of page 3 (sub-section 2.1), even though it's easy to know that FIM means flow-induced motion.*

Answer to R2.1 Answer

Comment R2.2 *Why chose the distance of* $7.5D$ *from front/back boundary to centre of cylinder (Fig 2)? And how did the boundary condition set in this study?*

Answer to R2.2 Answer

Comment R2.3 *It's suggested to presented or validated the time step (or nondimensionalised time step) of the simulation in this work.*

Answer to R2.3 what is gi

Comment R2.4 *In line 30 of page 15, why the sudden jump followed by a gradual drop and a gradual rise in* y^*_{RMS} *can be observed in this study but not in woks ofNguyen et al. (2012) nor Koide et al. (2013)? Any difference of parameters leads to the different results?*

Answer to R2.4 Answer

Comment R2.5 *The CFD over predict the frequency response and the value of St in low reduced velocity range (Fig 10), is this caused by the boundary condition or the size of computational domain?*

Answer to R2.5 Answer

Comment R2.6 *It's interested that the fluctuation exists in Fig 11(a) when* $U^* = 22.7$*, how this exist and how the value of* y^*_{RMS} *and* f^* *calculated for this case (The values can be found in Fig 10)?*

Answer to R2.6 Answer

Comment R2.7 *Looks like that the values still going to decline in Fig 12(a). It means that the vibration here still doesn't stable?*

Answer to R2.7 Answer

Comment R2.8 *How it's possible that* $P_{Fluid,RMS} < P_{Mech.,RMS}$ *for a given reduced velocity (Fig 20)?*

Answer to R2.8 Answer

Comment R2.9 *The fluid power is possible to improve by redirect the energy from the Karman to the streamwise vortex, and how it realizes? It's suggested to clarify a possible measure for it, or try to put forward an example.*

Answer to R2.9 Answer

References

Koide, M., Sekizaki, T., Yamada, S., Takahashi, T., Shirakashi, M., 2013. Prospect of Micro Power Generation Utilizing VIV in Small Stream Based on Verification Experiments of Power Generation in Water Tunnel. Journal of Fluid Science and Technology 8, 294–308. doi:10.1299/jfst.8.294.

Nguyen, T., Koide, M., Yamada, S., Takahashi, T., Shirakashi, M., 2012. Influence of mass and damping ratios on VIVs of a cylinder with a downstream counterpart in cruciform arrangement. Journal of Fluids and Structures 28, 40–55. doi:10.1016/j.jfluidstructs.2011.10.006.