Dear Reviewer prof. Liu,

thank you very much for your suggestions and comments. We will answer to them in the following lines.

1)

My major concern is the water wheel technology. Water wheel has been used as a energy generation device for hundreds of years, why the authors still stick with this technology instead of using turbines and other advance hydro-kinetic devices? The authors have to convince the readers that (1) the presented water wheel is a competitive energy technology comparing to the advance hydraulic energy conversion technologies; and (2) the paper does bring some original contribution on the existing knowledge base. The authors mentioned that the water wheels have "several advantages over turbines" but did not support this statement with enough proofs.

Thank you. We clarify that we are talking about gravity water wheels (undershot, breastshot and overshot), that are gravity machines and are different from hydro-kinetic devices. Hydro kinetic devices are used in flowing water and exploit the flow kinetic energy (like Darrius turbines or stream water wheels). Instead, gravity wheels are used in sites with small heads, and use the water weight to generate mechanical energy. The investigated wheel, instead, partially exploits also the kinetic energy, although the water weight is still the predominant driving force. Moreover, water wheels are safer for fish, since they do not have pressurized structures like conduits. They also need few engineering works, making them suitable for rural areas.

We have added the following information to answer to comment 1):

Due to their several advantages over turbines water wheels may constitute a suitable technology for the economic development, in particular in rural areas and lower-income countries . Indeed, the efficiency can be maintained constant over a wide range of external conditions, without acting on the pitch of the blades. The total cost of a water wheel depends on its dimensions and geometry. In Germany (Müller and Kauppert, 2002), overshot water wheels are currently built (including installation and grid connection) for 3900÷4400 €/kW. Undershot wheels cost 6900÷8700 €/kW, Archimedes screws approximately 7400÷7800 €/kW of installed capacity. For comparison, low head Kaplan turbines cost 13000÷13900 €/kW. Water wheels cost is between 33% and 66% of reaction turbines. Payback periods can be estimated as 14÷16 for Archimedes screws, 7÷9 years for an overshot and 12÷17 years for an undershot wheel, (with expected life time of 30 years), which are very low if compared to Kaplan turbine installations, where 25 ÷30 years payback periods can be expected (Müller and Kauppert 2004).

Concerning with comment 2), in section 1.1 we have discussed the scope of the work. It is not clear if the blade profile affects the performance of fast breastshot wheels. Therefore, our aim is to investigate this point, showing how the blade profile can affect the performance.

2)

I also have questions about the benchmark of the optimal design. The authors displayed three wheel profiles to compare, how the three profiles were selected? why not other shapes (3D spiral etc.)? How the dimensions were determined? what if we change the radius of the circular profile or the curvature of the elliptical profile? It is not convincing that the listed profiles and dimensions would necessarily lead to the optimal performance. From the results, by using the circular profile, the momentum increasing was only 5.6% but it may cause extra cost in fabricating water wheels with complex shapes, is it feasible to design and fabricate circular wheels for only 5.6% increment?

We have chosen the two shapes because they are well defined geometric shapes; this means that their fabrication process can be automated easily, also when water wheels are constructed by artisans, for example in rural areas and lower-income countries. Gravity water wheels are not axial machines and they are not immersed in water.

Those curvatures were chosen to satisfy the three points explained in section 1.1. In particular: profile 2) (the circular) was chosen because the lower the curvature radius of the blades, the better the power output, since the higher the changing in momentum of the water flow, i.e. the generated force. However, there is a limit on the minimum radius. For example, in our case, and considering the configuration in the entry point, a curvature radius of 0.2 m (1/5 R, where R is the wheel radius) would have a portion of the profile that would be vertical. This would generate separation of flow and would increase the resistance; the flow would tend to fall down during the filling process, with additional power losses. Therefore, the chosen circular radius is an optimal one. Then, we have added an elliptical profile that satisfies the three points in section 1.1 in order to compare the effect of changing the profile itself.

3)

A complete research paper should include at least two ways to "proofreading" the obtained results. A section of experimental study and a detailed demonstration of experimental results and comparison of the experimental results to the numerical results are necessary!

The CFD simulation part needs more information, what software was used for modeling and simulation? what types of element (2D? 3D?) were used to mesh the model? What material properties were used for modeling the water/fluid and the water wheel/solid?

Thank you. The experimental results are well described in Quaranta and Revelli (2015 and 2016), so we have preferred to remind to these two papers in order to make this paper more concise and simpler.

Concerning with the mesh, in section 2.2 we have described it, and now we have added the missing information. In section 2.3, we have written the water properties.

4)

The topic of hydropower generation technology and water/paddle wheel design optimization has been visited by many researchers. The authors at least need to pay attention to some recent studies.

Yes, thank you. We have added these references, considering, however, that we are dealing with gravity wheels not immersed in water, while paddle wheels are in flowing water and are partially immersed in it. Anyway, we think that the suggested additional papers can be useful to complete our paper and to show more information about CFD applied to water wheels in general. Thank you. We have also corrected the minor typos.