Reviewer 3 Comments and Suggestions for Authors

In the answer on the comment 4 the authors explain that they resolve frequency 0.2fn due to FFT analysis over five revolutions of the runner. This means that a single period of the frequency 0.2fn was considered. In my opinion such result can't be considered as reliable one. Much longer time interval is required to obtain reliable data.

Answer to reviewer’s comment: Thank you for your comments. The frequency 0.2fn was regarded from developing the vortex rope in the draft tube. In addition, some previous studies were conducted with the analysis about five revolutions of runner to investigate the vortex characteristics. Some previous studies were observed with similar range of the frequency from the vortex rope in the draft tube as the frequency of 0.2fn as follows.


Additionally, in order to confirm reliability of the results about the frequency of 0.2fn, the FFT result generated from the eight revolutions of runner was compared with the result of the five revolutions as shown in the below Fig. A. The FFT result over the eight revolutions of runner showed more fine distribution with high resolution. Moreover, the dominant unsteady pressure characteristic was clearly shown at the frequency of 0.2fn as same with the result over the five revolution of runner as follows. Hence, the authors thought that the FFT results are reliable.
After answer on the comment 6 I can't understand till now what useful information can be obtained from averaging of the unsteady-state data over one revolution of the runner. If one tries to compare steady- and unsteady-state analysis results and there exists low frequency process (0.2fn), it will be necessary to average at least over one revolution of the vortex.

**Answer to reviewer’s comment:** Thank you for your comments. The results of unsteady state analysis show a constant cycle over one revolution of runner with maximum and minimum values. Therefore, in order to conduct the validation test with the experimental results, the results over one revolution of runner showing stable change period were averaged and then compared. In addition, because the frequency from vortex is lower than the rotating frequency of runner, the results over one revolution of runner include at least one revolution of the vortex.

The same question relates to the comment 9. If one has precessing vortex rope, then at averaging over one revolution of the runner it will be some blurry image of the vortex. Usually researchers show picture of the vortex in few different phases to demonstrate its rotation. The meaning of averaging remains unclear.

**Answer to reviewer’s comment:** Thank you for your comments. Again, the authors tried to compare the different operating conditions with the time-averaged values (averaged values over one revolution of the runner). Accepting to the reviewer’s comment, in order to provide clear image and compare the different conditions, the results and related sentences of the instantaneous value have been modified in the manuscript as follows. In addition, the vortex ropes according to the time (rotation) were compared in Fig. 17.
“Figure 12 shows the iso-surface distributions of the pressure in the draft tube from the unsteady-state analyses.”

(a) GVAs of 21.5°, 17° and 12.5°  
(b) GVAs of 11°, 8.5° and 7°

**Figure 12.** Iso-surface distributions in the draft tube with GVAs of (a) 21.5°, 17°, and 12.5°, (b) 11°, 8.5°, and 7°.