Drinking Water Engineering and Science Discussions

Drink. Water Eng. Sci. Discuss., author comment AC2
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Reply on RC2

Fouad Laajine et al.

Author comment on "Modeling of pump performance in a water pumping plant" by Fouad Laajine et al., Drink. Water Eng. Sci. Discuss., https://doi.org/10.5194/dwes-2021-16-AC2, 2022

Dear Dr. Grabowski,

Please find enclosed the revised version for the manuscript entitled "**Modeling of pump performance in a water pumping plant**" **(**Manuscript ID: ID 626534) as well as the answers to the referees questions.

We thank the reviewers for the valuable comments and their positive feedback. The revised version of the manuscript addresses the corrections suggested by the referees and clarifies the raised concerns.

Looking forward to hearing from you.

Sincerely,

Dr D. MAZOUZI

Review report "Modeling of pump performance in a water pumping plant" by Fouad Laajine, Mohammed Machkor and Diss Mazouzi

General comments

The manuscript describes the modelling of a drinking water pumping station using multiple linear regression to model the kWh/m3 ratio depending on the input parameters. It finishes with the technical interpretation of the outcome of the model.

Although the approach is quite original, as it takes into account the real behaviour of the system, major revisions are required. There are many unclear sections in the manuscript, the Results and Discussion section is too concise, the English language has to be improved (the wording, many typo's, inconsistent use of capital letters (e.g. Multiple Linear regression, Multiple linear regression)) and the Tables and Figures are not well explained in the manuscript. The manuscripts looks like a short report and not as a scientific manuscript as any reference to other scientific papers, with the same approach or alternative approaches, is missing. This should be included in the introduction and discussion sections. In the present form it cannot be accepted.

Response: Thanks for your kind reminders.

- We revised the title of our paper, new title: Multiple Linear Regression Analysis of Pumps Performance in Water Pumping Plants.

- We revised, introduction, all the sentences, new reference... of the paper who you find in attached a new paper with all correction asked.

- We hope that the manuscript has been improved towards after this revision.

Specific comments

Abstract

Line 15: what is meant by "real behaviour"?

Response: By using real-time-data, we revised the sentence as follow: "In this context, the main objective of this study was to model accurately the energy consumption of pumping systems in order to optimize the whole water supply system, thus improving its efficiency, especially in the case of a limited renovation"

Line 16: First should be first

Response: We revised the sentence by new version

Line 18: mention the input parameters

Response: The new sentence as follow: "For this purpose, Multiple Linear Regression was fitted to model the produced kWh/m3 ratio according to the following parameters, active and reactive energies, the daily produced water volume, the power factor (Cosj), and the operating time of each pump"

Line 19: what is meant by "phenomenon"?

Response: By the consumption, the new sentence as follow: "The final model describes accurately the consumption per cubic meter produced (R^2=0.91)"

Introduction

In the introduction any reference to other scientific papers dealing with optimizing pumping stations is missing.

Response: Thanks for your nice reminder. We provided the following citations to support this statement.

Adamowski, J., Fung Chan, H., Prasher, S. O., Ozga-Zielinski, B., Sliusarieva, A.: Comparison of multiple linear and nonlinear regression, autoregressive integrated moving average, artificial neural network, and wavelet artificial neural network methods for urban water demand forecasting in Montreal, Canada WATER RESOURCES RESEARCH, VOL. 48, W01528, doi:10.1029/2010WR009945, 2012.

Kusiak, A., Zeng, Y., Zhang, Z. : Modeling and analysis of pumps in a wastewater treatment plant : A data-mining approach, Engineering Applications of Artificial Intelligence., 26, 7, 1643-1651, 2013.

Shankar, A., Umashankar, V. K., Paramasivam, S., Norbert., S. H. : A comprehensive review on energy efficiency enhancement initiatives in centrifugal pumping system, Applied Energy, Elsevier, 181, C, 495-513, 2016

Carravetta, A. ; Giugni, M. ; Malavasi, S. : Application of Innovative Technologies for Active Control and Energy Efficiency in Water Supply Systems. Water, 12, 3278. https://doi.org/10.3390/w12113278, 2020.

Ostfeld, A. and Tubaltzev, A. : Ant Colony Optimization for Least Cost Design and Operation of Pumping and Operation of Pumping Water Distribution Systems. Journal of Water Resources Planning and Management, 134, 107-118. http://dx.doi.org/10.1061/(ASCE)0733-9496(2008)134:2(107), 2008.

Puleo, V., Morley, M., Freni, G., Savić, D., Multi-stage linear programming optimization for pump scheduling Procedia Engineering, 70, 1378-1385, 2014.

Plappally, A.K., Lienhard, J.H. V.: Energy requirements for water production, treatment, end use, reclamation, and disposal Renewable and Sustainable Energy Reviews 16, 4818–4848, 2012.

Rothausen, S., Conway, D. Greenhouse-gas emissions from energy use in the water sector. Nature Clim Change 1, 210–219, https://doi.org/10.1038/nclimate1147, 2011.

Wu, P., Lai, Z., Wu, D., Wang, L.: Optimization research of parallel pump system for improving energy efficiency, Journal of Water Resources Planning and Management, 141, 8, 2015.

Zhou, Y., Lee, E. W. M., Wong, L. T., & Mui, K. W. : Environmental evaluation of pump replacement period in water supply systems of buildings. Journal of Building Engineering, 40, 102750, 2021.

Line 35: What is the current 2023 agenda?

Response: The new sentence as follow: To reach the sixth Sustainable Development Goal (SDG6) that aims to generalize the access to drinking water supply, the water production cost mustn't impact its price which should stay affordable to the population

Line 40: pumps account for 805 to 90% of the energy consumption, this depends on many factors (surface water or ground water, transport differences, flat or mountain region, etc).

Response: We provided an explanation in Subsection

"Pumping processes consume the largest fraction of total energy (Plappally and Lienhard, 2012). The pumps consumption often presents 80% to 90% of the total energy consumption (Sarbu, 2016). However, this consumption may depend on many factors such as surface water or ground water, transport differences, flat or mountain regions, etc (Rothausen and Conway, 2011) (Plappally and Lienhard, 2012)."

Materials and Methods

- Lines 61-62: nice figure, but how does this research fits in this figure? To which category is it connected?

Response: Thank you very much. We don't think so. Figure 2 is a figure of system energy efficiency

- line 86: tank RCMO? What does RCMO mean?

Response: Tank RMC0 Þ tank destined to provide the water treatment plant with raw

water, it is called RMC0 and having a capacity of 1000 m^3

- Lines 89-90, Figure 5: Are the ND of the suction line and the discharge line correct? They are not in line with the text I lines 79-82.

Response: ND Þ nominal diameter

- Lines 97-103: the parameters should be defined in more detail. It is a list of parameters, while in the model eight input parameters are used: I assume the last (HMGI) covers four pumps? Be precise.

Response: HMG Þ HMG1: the pump operating time "1",

HMG2: the pump operating time "2",

HMG3: the pump operating time "3",

HMG4: the pump operating time "4".

- Line 110: Y is the output variable.

Response: Thank you very much for the reminder, Y is the output variable

- Lines 117-118: Table 1 is not clear. Just include the objective (not "1"), the variables (not "8", the responses (not "1").

Response: Thank you very much for the reminder, we changed it as follows: "The effect of eight variables on the produced Kwh/m^3 ratio was evaluated (Table 1). Of note, 1388 experiments were conducted during 4 years."

- Line 119: Rephrase: Table 1 shows instead of The table above.

Response: Thank you very much for the reminder.

- Lines 122-123, Table 2: mean and standard deviation over the 4-years period?

Response: Thank you very much for the reminder. The mean and standard deviation during period 2015 and 2018

- Line 123: Rephrase: Table 2 shows then mean and standard deviation

Response: Thank you very much for the reminder. The mean and standard deviation during period 2015 and 2018

Results and Discussion

- there should be references to other studies (see also comment in the introduction). This is only a bullet-list of the main observations without any discussion. Please rewrite.

Response: Thank you very much your comments. We have read your comments carefully and tried our best to address them one by one, especially in results and discussion section. We hope that the manuscript has been improved towards after this revision.

- Line 135: what is P?

Response: P is the active energy consumed by the pumping station (measured by a

wattmeter)

- Line 138: What is Q?

Response: Q is the reactive energy consumed by the pumping station (measured by a wattmeter)

- Lines 150-155: I suppose that "ratio" is kWh/m3?

Response: yes, is electricity consumption by the pumps per m^3 of water consumption

- Line s156-157, Table 5: Table 5 is not clear, needs to be explained. Two situations, b and b*? not clear.

Response: Thank you for your nice reminder. We revised most of the table 4 and 5 captions to make them clearer. (b*) is Standardized regression coefficient and (b) is regression coefficient

- Line 166: Multiple linear regression has *shown* that….

Response: Thank you very much for pointing this out. We revised the sentence as follows:

"Besides that, R-square and Adjusted R-square statistic of this model was 0.91 were found and the value standard error estimate statistically significant at the level of 0.05, as shown in Table 6. In view of these results, we can say that the parameters studied are highly variable in the research area, thus, they also confirm the performance of the developed model."

- line 167: Not clear, what is meant by "adjusted"?

Response: is Adjusted R-square

- lines 174-191: Technical interpretation is nice, but it only deals with this case. Comparison should be made with other approaches described in literature. Only one comparison is made in line 187 (five data-mining approaches), but it is not discussed whether this comparison is allowed.

Response: Thank you for your comments. We have gone through your comments carefully and tried our best to address them one by one. We hope the technical interpretation section has been improved accordingly.

- Lines 125-126, Figure 6: What does this figure shows? What is on the Y-axis? What do the markers * and # mean?

- Line s128-129 Figure 7: This is a strange representation of a box plot. What is on the Y-axis? What do the p-values mean?

Response: Thank you for the nice reminder. We combined Figure 6 and 7 into one Figure 6 (A and B). The Y-axis is consumption of water (10^3 m^3). The markers * and # was (*: consumption variation through the years; #: consumption variation through the months)

Conclusions

- They should be rewritten. It is now just one sentence what the study was about and a couple of recommendations. What can be concluded from the research? Does the

approach work? Is it different from other approaches? Etc.

Response: Thank you very much for pointing this out. We revised the sentence of conclusions in new version manuscript:

Principle criteria

Scientific significance: fair

Scientific quality: poor

Presentation quality: poor

Response: Thank you very much for your previous comments that helped us improves this manuscript. The authors wish that the revised version of the manuscript addresses the corrections suggested by the referees and clarifies the raised concerns.

Please also note the supplement to this comment:
https://dwes.copernicus.org/preprints/dwes-2021-16/dwes-2021-16-AC2-supplement.pdf