



Comment on “A new Digital Harmony Search algorithm for optimizing pump scheduling in water distribution networks” by Francesco De Paola, Francesco Pugliese, Nicola Fontana, Maurizio Giugni

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ABSTRACT

This comment addresses critical issues in De Paola et al. (2025), focusing on (i) the interpretation of pump actuation constraints, (ii) omission of relevant literature, and (iii) feasibility of proposed solutions when validated in EPANET. Evidence shows that the assumptions adopted by De Paola et al. (2025) are inconsistent with Costa (2016) and subsequent clarifications, and that their reported solutions violate hydraulic constraints.

1. Background

The writers appreciated that De Paola et al. (2025) took our research article (Cimorelli et al., 2020) as reference for their work. However, we have a series of objections and comments regarding their results. In particular, at page 9, 2nd paragraph, they state: “Nevertheless, it is argued that if a pump is not activated by hour 24 and it works at hour 1, or conversely, the corresponding switch should be accounted for the overall TN_{SW} counting. This made N_{SWmax} constraint of Eq. (9) not satisfied, by achieving NS equal to 22, 14 and 10 for $N_{SWmax} = 6, 4$ and 2, respectively (Table 1). As to Costa et al. (2016)’s assumptions, in the proposed model TN_{SW} increased when changing the status of the k -th pump between hours 24 and 1. TN_{SW} didn’t raise when getting the same pump status at hours 24 and 1, instead. Conversely, in the Cimorelli et al. (2020) solutions, at least one pump exceeded the set N_{SWmax} , making these solutions infeasible and thus not consistently comparable.”

The authors are basically implying that Costa et al. (2016) adopted such assumptions. This is incorrect because: 1) this assumption is never mentioned in Costa et al. (2016); 2) this assumption is first made explicit in Costa and de Athayde Prata (2021), a discussion to Cimorelli et al. (2020); 3) in the respective closure (Cimorelli et al., 2021), we explained why this assumption was not applied, and we provided new results including the “wrap-around” constraint. However, both aforementioned discussion and closure were ignored by De Paola et al. (2025).

2. The “Wrap-around assumption”

De Paola et al. (2025) claim that Costa et al. (2016) considered “wrap-around” switching. This is incorrect. Costa defines the constraint as “ $NA_k \leq NA_{max} \forall k$ ” (see Eq. (5) in Costa et al. (2016)) without specifying any periodicity of the solutions. Costa and de Athayde Prata (2021) later introduced the “wrap-around” interpretation, which we tested in Cimorelli et al. (2021). Our updated GA solutions, even with “wrap-around”, achieved lower costs than Costa et al. (2016) and De Paola et al. (2025) with 3 max actuations per pump (see Table 1). In absence of explicit statement in Costa et al. (2016), the “wrap-around” assumption was not considered in Cimorelli et al. (2020) as it is unrealistic for the following reasons:

- 1 Pumps can actuate multiple times per hour (manufacturers’ specifications: 4–16 actuations depending on pump type). Therefore, the maximum number of daily actuations should be interpreted as an average daily value rather than a strict limit.
- 2 Daily demand is a stochastic variable and does not repeat identically on consecutive days. This variability means that a schedule optimized for a single day may not be suitable for the following day, making one-day scheduling inherently inadequate for real-world conditions.
- 3 The constraint on final tank levels (Eq. 4 in Costa et al. (2016), Eq. 3 in Cimorelli et al. (2020)) conflicts with periodic operation, as the pump head at the start of two consecutive days would differ. This makes wrap-around counting impractical.

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Table 1

Comparison of results by Costa et al. (2016), Cimorelli et al. (2021) and De Paola et al. (2025).

Scenario	Costa et al. (2016)	Cimorelli et al. (2021)	De Paola et al. (2025)
3 Switches per pump	3578.74	3575.61	3577.4
2 Switches per pump	3618.59	3618.59	3605.53
1 Switch per pump	3916.98	3915.87	3911.52

3. Feasibility of the solutions

EPANET Toolkit (Rossman, 2000) was used to validate the solutions. However, when the minimum tank level in the EPANET input file is set equal to the constraint (66.53 m), the simulator never allows the level to fall below that threshold. Consequently, minimum-level violations cannot be detected, and the 9999 \$ penalty described by De Paola et al. (2025) cannot be activated. When the minimum-level setting is removed, the schedules proposed by the authors do fall below the constraint (Table 2), meaning that such solutions should have been discarded under their own penalization rule.

Both Costa and Cimorelli explicitly addressed this issue. Costa's public Branch-and-Bound implementation checks feasibility using a tolerance (i.e., a violation is flagged when $S < S_{min} + 0.0001$), ensuring that violations are detected even when EPANET clamps the level at S_{min} . Conversely, Cimorelli et al. (2020) adopted a complementary approach by modifying the EPANET tank limits—lowering the minimum and raising the maximum—to avoid clamping, as clearly stated in their ATM case study:

“the minimum and maximum tank water levels in the EPANET input file have been set equal to $61.53 \text{ m} \leq h_{min}$ and $75.53 \text{ m} \geq h_{max}$, respectively. This numerical trick is fundamental in order to allow the activation of the constraint...”

In contrast, De Paola et al. (2025) set the EPANET minimum tank level equal to the constraint value and did not apply any external tolerance check, making minimum-level violations inherently undetectable and leading to the acceptance of hydraulically infeasible solutions. Finally, constraint checking should follow the 30-minute hydraulic time step used in Costa et al. (2016).

For transparency and reproducibility, the EPANET .inp files containing the pump schedules reported by De Paola et al. (2025), as implemented by the authors of this Comment, are provided as supplementary material. These files allow direct verification of the constraint violations summarized in Table 2.

4. Misleading comparison

At page 9, 3rd paragraph, of De Paola et al. (2025), the authors state that:

“Nevertheless, aimed to get the overall optimal cost solution, a further simulation was run, discarding the constraint of the maximum number of daily switches of each pump set by Eq. (9). The cost of 3574.9 \$/day was achieved with the same $NS = 22$ (after about 110 s of simulation), resulting in pump switches TNSW of 10, 8 and 4, for P1, P2 and P3, respectively (Table 2). This led to the slight improvement of the daily energy cost achieved by Cimorelli et al. (2020) while supposing the same number of switches in the network.”

De Paola et al. (2025) report an “overall optimal cost” of \$3574.9 by removing the constraint on pump switches, claiming improvement over Cimorelli et al. (2020). However, this solution is not feasible (see Table 2) and should have been discarded. Moreover, eliminating the constraint makes the result incomparable with scenarios limited to three

Table 2

Constraint violation in the optimal pump scheduling solutions proposed in De Paola et al. (2025).

Solution in De Paola et al. (2025) for the ATM case study	Constraint Violation	
	Pressure	Level
1 switch per pump	Node 170: 29.99946 m at 21:30.	Tank 265: 66.43401 m at 21:30
2 switches per pump	Node 170: 29.96857 m at 21:30.	Tank 65: 66.52355 m at 21:00; Tank 265: 66.44405 m at 21:30.
3 switches per pump	No Violation	Tank 65: 66.51709 m at 21:00;
Constraint on pump switches removed	No Violation	Tank 65: 66.52531 m at 21:00;

switches per pump, as in Costa et al. (2016) and Cimorelli et al. (2020). Finally, the claim of “same total switches” is misleading as the constraint applies to the single pump and not to the system as a whole. In fact, pump 1 actuates 5 times and pump 2 actuates 4 times, exceeding the limit used in previous works. Therefore, the comparison is invalid.

5. Conclusions

The analysis shows that the assumptions claimed by De Paola et al. (2025) are inconsistent with Costa et al. (2016) and subsequent clarifications (Costa and de Athayde Prata, 2021; Cimorelli et al., 2021), and that their proposed solutions violate hydraulic constraints when validated with the same hydraulic solver (EPANET Toolkit). Consequently, these schedules cannot be considered feasible nor do they represent any improvement over previous works. Future comparisons should ensure full compliance with constraints and include all relevant literature to avoid misleading conclusions.

CRedit authorship contribution statement

Luigi Cimorelli: Writing – review & editing, Writing – original draft. **Andrea D’Aniello:** Writing – review & editing. **Luca Cozzolino:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.wroa.2026.100521](https://doi.org/10.1016/j.wroa.2026.100521).

Data availability

Data will be made available on request

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