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REVIEWER'S REPORT

Manuscript No.: IJAR-50436 Date: 25/02/2025

Title: - Wastewater Pipe Rating Classification Using Physics-Based K-Nearest Neighbors: A Data-Driven Approach for Reliable Infrastructure Assessment

Recommendation:
Accept as it is ....
Accept after minor revision.................
Accept after major revision ....
Do not accept (*Reasons below*) ....

Rating	Excel.	Good	Fair	Poor
Originality		-		
Techn. Quality	-			
Clarity		-		
Significance		-		

Reviewer Name: Dr. Deep Upadhyaya

Reviewer's Comment for Publication.

This study highlights the challenges faced by municipal agencies due to aging wastewater infrastructure, which can lead to contamination, health risks, and expensive repairs. Traditional assessment methods often rely on subjective inspections and empirical rules. The study introduces a physics-based K-nearest neighbors (K-NN) framework that incorporates fluid and structural mechanics, corrosion, and hydraulic factors into the classification process. By weighting important physical features like hoop stress and material stiffness, the model achieved 92.5% classification accuracy, outperforming other methods. This approach offers a robust, interpretable, and scalable solution to guide proactive maintenance and minimize failures in wastewater pipes.

Detailed Reviewer's Report

The study addresses the significant challenges municipal agencies face due to aging wastewater infrastructure, which can lead to contamination, public health risks, and costly repairs. Traditional assessment techniques rely on subjective inspections and empirical rules, limiting their accuracy and predictive capabilities. To enhance infrastructure evaluation, the research introduces a physics-based K-Nearest Neighbors (K-NN) framework that integrates key physical parameters such as hoop stress, material stiffness, corrosion, and hydraulic conditions into the classification process. By assigning weighted importance to these features, the model achieves a classification accuracy of 92.5%, surpassing traditional methods. The findings highlight the benefits of incorporating physics-based parameters into machine learning models, offering improved interpretability compared to black-box approaches and enabling proactive maintenance planning for wastewater pipelines.

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The study's strengths include its innovative integration of fundamental engineering principles with machine learning, high classification accuracy, and scalability to different wastewater systems. The framework provides a transparent and interpretable approach to infrastructure assessment, making it more practical for real-world applications. However, there are some limitations, such as the lack of discussion on dataset size and diversity, computational efficiency concerns, and the need for comparisons with other advanced machine learning techniques. Additionally, real-world deployment challenges, including data collection constraints and integration with existing municipal systems, are not thoroughly addressed. Future research should expand the dataset to include diverse pipeline conditions, explore computational optimizations, and conduct real-world pilot implementations to validate the model's performance in operational settings. Overall, this study presents a promising approach to wastewater infrastructure assessment, with significant potential for guiding proactive maintenance strategies and minimizing failures in aging wastewater systems.