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Abstract

Governance of artificial intelligence techniques in wastewater treatment: bibliometric analysis, critical review and future challenges †

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Abstract: Wastewater treatment is of great importance for reducing pollutants and improving the water environment. The complexity of natural conditions, multiple processing technologies, and variation in parameters result in an inaccurate description of the wastewater treatment system, which is not conducive to efficient management. The traditional environmental model has certain limitations, mainly including the lack of effective algorithms for processing defective data, excessive calculation time, and poor scalability of scenarios. As an emerging and powerful technology, artificial intelligence (AI) has shown its role in modeling complex phenomena to improve the efficiency of system management, which provides a path to problem solving. The current study presents a bibliometric analysis of the application of AI technology in wastewater treatment and reveals publication characteristics and country distribution. Furthermore, an overview about the characteristics of various AI algorithms in the applications of wastewater treatment are introduced. Specific applications of AI technology in wastewater treatment are also highlighted, including the prediction of water quality indicators, simulation of microbial action, system monitoring and diagnosis, optimization of system energy, regulation of wastewater reuse, and innovative applications in the future. Finally, the challenges of AI application are summarized, mainly including algorithm defects caused by the lack of wastewater treatment knowledge of the developers, imperfect engineering database in large-scale water treatment operation system, and insufficient investment in system resources and hardware facilities. This review provides an insightful discussion for researchers to achieve accurate wastewater treatment management in the future.

Keywords: artificial intelligence; wastewater treatment; bibliometric analysis; simulation and control; future expectations

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