

The comparative performance of control strategies for the water flow rate applied to the Someşul Mic River, Romania

Amalia-Ioana Prodan¹, Elisabeta-Cristina Timiş^{1*}

¹ Department of Chemical Engineering, Computer Aided Process Engineering Research Centre, “Babeş-Bolyai” University, Cluj-Napoca, Cluj, 11, Arany Janos Street, 400028,

*Corresponding author: elisabeta.timis@ubbcluj.ro.

Abstract

Floods and droughts are critical hydro-climatic extremes, significantly impacting ecosystem equilibrium and incurring substantial socio-economic losses. Effective river flow regulation is paramount to mitigating these detrimental effects. Someşul Mic River, as it flows through Floreşti (Cluj, Romania), forms the Floreşti water reservoir, a small artificial lake, primarily used for hydrological regulation and also offering recreational opportunities for the local community. This study is focused on designing a novel control system for the Someşul Mic River reach water flow rate downstream the Floreşti reservoir, leveraging fuzzy logic combined with conventional control. Further, this research involves a rigorous comparative analysis of the proposed FIS-PID controller against conventional PID and Proportional-Integral (PI) controllers when control river flow through reservoir discharge adjustments. Control techniques have been implemented using a MATLAB/Simulink numerical mathematical model for the water flow and water depth along Someşul Mic River. Results show a wider versatility of the FIS-PID control system compared to the simple PID and PI approaches. This approach is particularly advantageous due to its capacity to establish a variable flow rate reference (via the Fuzzy Inference System (FIS)), enabling adaptive and nuanced control responses (performed by the Proportional-Integral-Derivative (PID) controller) across diverse weather scenarios, including both severe flood events and prolonged droughts, primarily by manipulating the reservoir discharge. This comparative assessment aims to elucidate the efficacy and robustness of each control paradigm, thereby contributing to a deeper understanding of proactive measures essential for minimizing damage inflicted by extreme hydrological events.

Keywords: fuzzy logic controller, river flow simulation, water flow control, water management.

Acknowledgments: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS - UEFISCDI, project number PN-IV-P2-2.1-TE-2023-0666, within PNCDI IV.

The International Conference on Science, Engineering and Innovation 2025, 27-28 November 2025, Vientiane, Laos.