Predictive analytics system for forecasting non-stationary operating conditions of hydropower plants based on singular value decomposition and LSTM networks.

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The paper considers the problem of forecasting non-stationary operating conditions of hydropower plants under the complex dynamics conditions of hydrological and power-system processes.

A predictive analytics system based on a hybrid approach integrating singular value decomposition of the trajectory matrix and recurrent neural networks with a long short-term memory (LSTM) architecture is proposed. Singular decomposition is used to perform the adaptive decomposition of the original signals, illustrated by water inflow indicators, into trend, oscillatory, and noise-related components, followed by iterative cleaning of the noise residual component. For each component group, dedicated LSTM models are developed and combined into an ensemble, which makes it possible to account for the heterogeneous dynamics of the processes and to improve the accuracy of multi-step forecasting.

The practical implementation of the proposed approach can increase the reliability of hydropower plant operating condition prediction, optimize water resource management, and reduce the risk of emergency events.

Key words: hydropower plant, predictive forecasting, singular value decomposition, non-stationary processes, neural networks.