# Collaborative optimization strategy of Source-Grid-Load-Storage considering dynamic time series complementarity of multiple storages

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## Abstract

The multi-scale flexibility coordination of multiple storages is a key technology to enhance the diversified regulation ability of the power system.This paper first considered the interaction mechanism of multi-type storage peak regulation time sequences based on the Euclidian distance, Dynamic time warping distance, and storage correlation distance. A matching index was proposed to consider the temporal correlation, overall distribution characteristics, and dynamic characteristics of the net load and energy storage. The multitype storage coordination mode, including battery storage, pumped storage, and electric vehicles, was formulated, and a collaborative optimal scheduling system architecture of source-grid-load-storage (SGLS) was constructed. To attain a low-carbon economy, a collaborative optimal scheduling model of SGLS considering the dynamic time-series complementarity of multiple energy storage systems was constructed. The Nash equilibrium theory was used to achieve friendly interaction among the source, grid, load, and storage. Then, an improved transfer reinforcement learning algorithm for SGLS was proposed, which used reinforcement learning and transfer learning algorithms combined with K-means clustering and dual-structure experience pool technology. The test results of actual regional power grid data indicated that the proposed strategy can effectively reduce the economic and carbon treatment costs of the system and improve the absorption capacity of renewable energy.

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