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Revisiting Multivariate Time Series Forecasting via Multi-Scale Selective Enhancement and Cross-Level Attention

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Multivariate time series forecasting often suffers from noise interference, inconsistent dynamics across variables, and limited capacity to capture both short-term fluctuations and long-term trends. This paper proposes a novel framework that addresses these challenges through three coordinated modules. First, a channel-wise modulation mechanism selectively filters anomalous patterns by assigning learnable weights to individual time points. Second, a multi-scale temporal pooling module extracts coarse- to-fine features within each sequence, enabling the model to capture diverse temporal structures. Third, a cross-level attention mechanism bridgeslow-level signals and high-level abstractions to enhance semantic integration across timescales. Together, these components allow the model to focus adaptively on informative patterns while maintaining computational efficiency. Experiments on seven public datasets demonstrate that the proposed method achieves superior accuracy compared to existing approaches, particularly in scenarios with strong periodicity or irregular variance. The design also offers low memory overhead, making it suitable for deployment in resource-constrained environments.

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