

DeMa: Dual-Path Delay-Aware Mamba for Efficient Multivariate Time Series Analysis

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Problems & Ideas

- Challenges in time-series analysis models:
 - Transformer-based models** suffer from quadratic computational complexity
 - Mamba-based models** lack explicit cross-variate modeling and have limited ability to capture lagged dependencies.
- Key idea:
 - Decompose time series into **intra-series temporal dynamics** and **inter-series interactions**.
 - Use **Mamba-SSD** to model temporal dependencies and **Mamba-DALA** to capture cross-variate lagged dependencies.

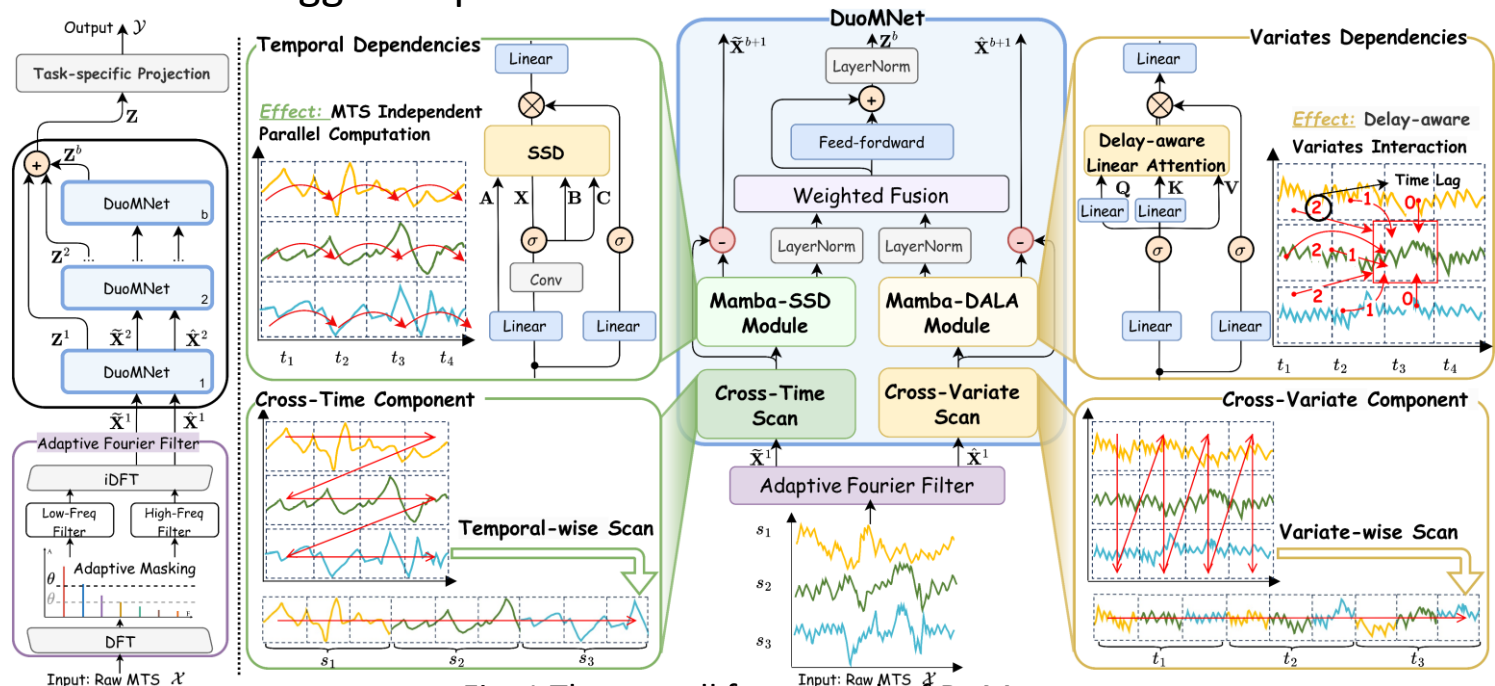


Fig. 1 The overall framework of DeMa.

Main Contributions

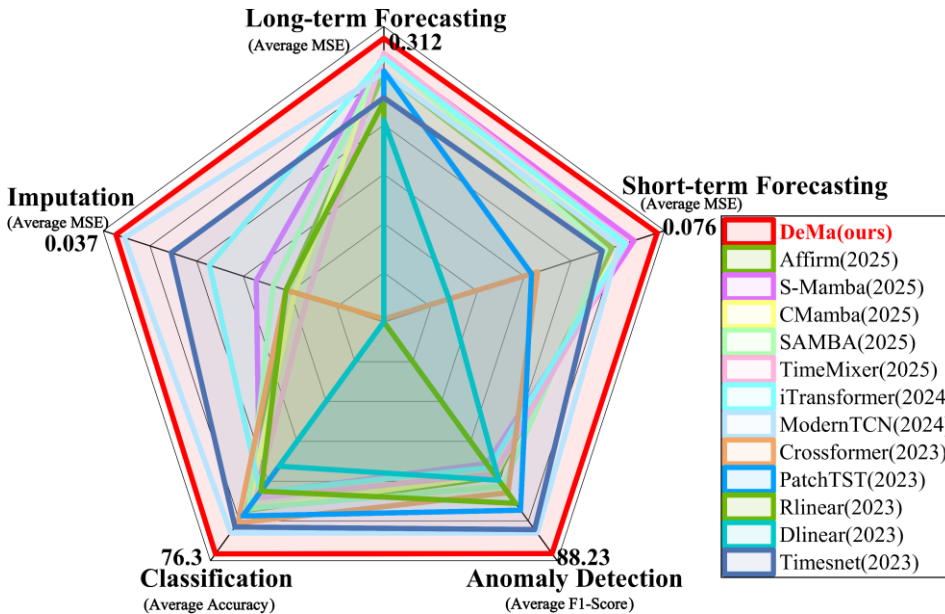
Contributions:

- **Computational complexity:** The running time and memory usage grow nearly linearly with input length, which is important for practical deployment.
- DeMa achieves **state-of-the-art** performance on **five** time series analysis tasks, while maintaining superior **computational efficiency** and a **lower memory footprint**.

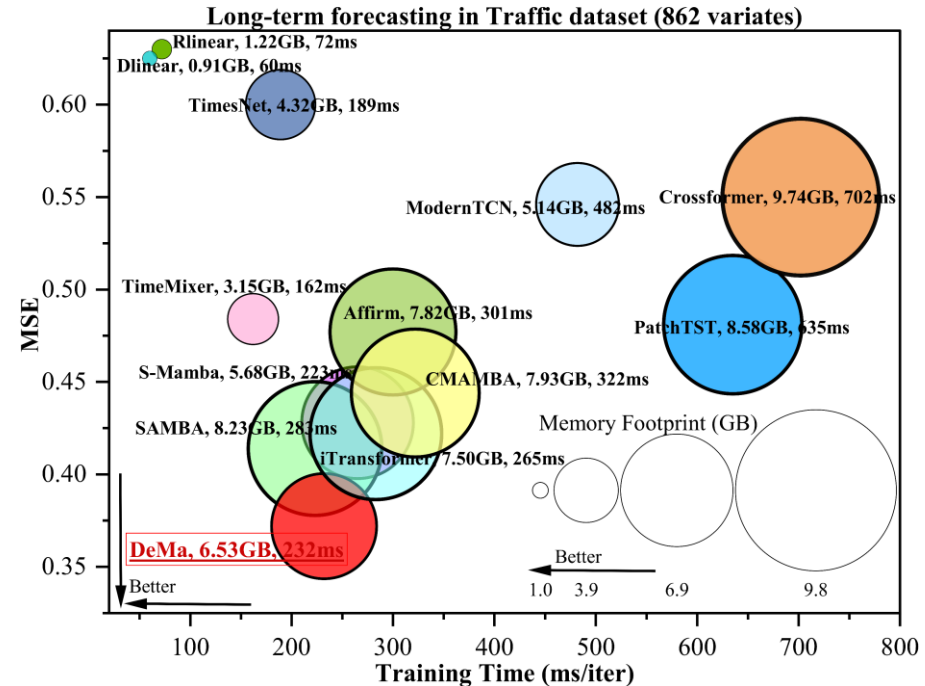
$$\text{Previous} \rightarrow \text{Now}$$

$$\mathcal{O}(NL^2d) \rightarrow \mathcal{O}(NLd^2),$$

$$L \gg N, d$$



(a) Overall performance across five tasks



(b) Performance–efficiency trade-off.

Fig. 2 Comparison of model performance and efficiency.