Deep Learning for Time Series Forecasting: A Survey of Recent Advances

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Problems & Ideas

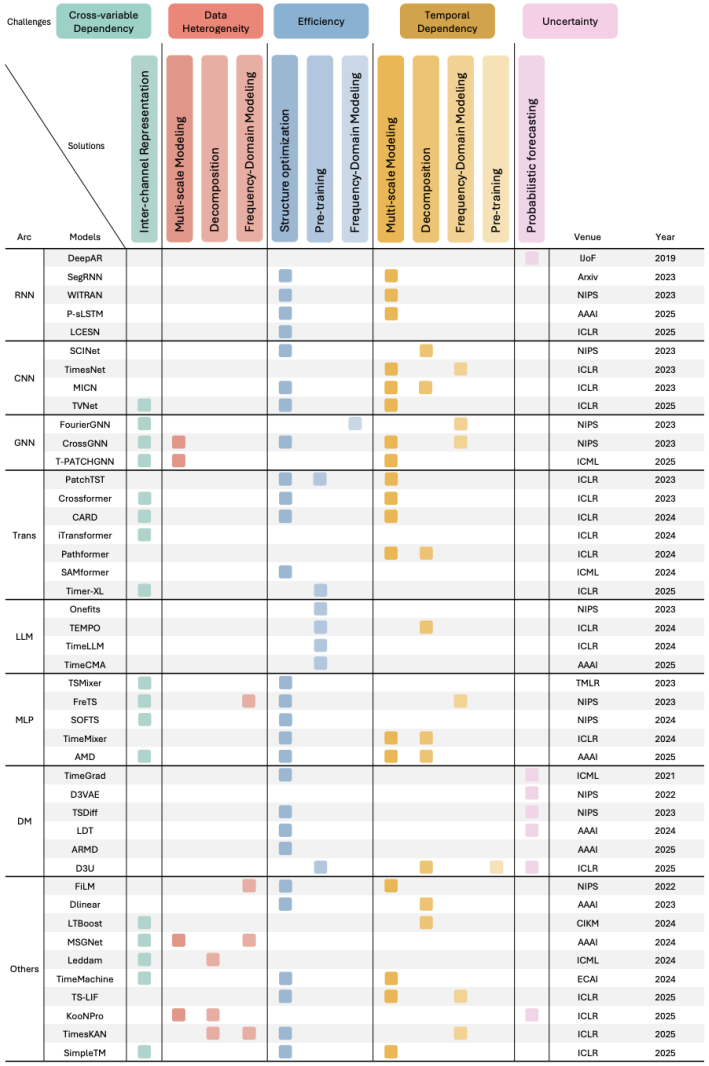

Fig. 2 Model–challenge mapping across design trends in time series forecasting. This diagram summarizes what key design principles representative deep learning models adopt to address major challenges in time series forecasting. It highlights patterns of methodological convergence, showing which design strategies are effective for tackling particular challenges.

Deep learning models face five key challenges in time series forecasting: temporal dependency, cross-variable dependency, data heterogeneity, efficiency, and uncertainty.

- Real-world time series data are noisy, high-dimensional, and non-stationary, making accurate forecasting difficult.
- Traditional models struggle with long-term patterns and variable interactions.
- Our paper systematically identifies major forecasting challenges and connects them with recent modeling innovations.
- We provide a design-oriented perspective, mapping modern deep learning techniques to the specific challenges they address.

Key Findings & Trends

•State-of-the-art models adopt hybrid strategies: modifying both input data (e.g., decomposition, rearrangement) and model components (e.g., specialized layers).

•Techniques like multi-scale modeling, decomposition, and frequency-domain learning have become dominant trends.

•This dual strategy leads to more robust, efficient, and generalizable forecasting systems.

•Our work provides a roadmap for selecting and designing deep learning models based on these evolving practices.

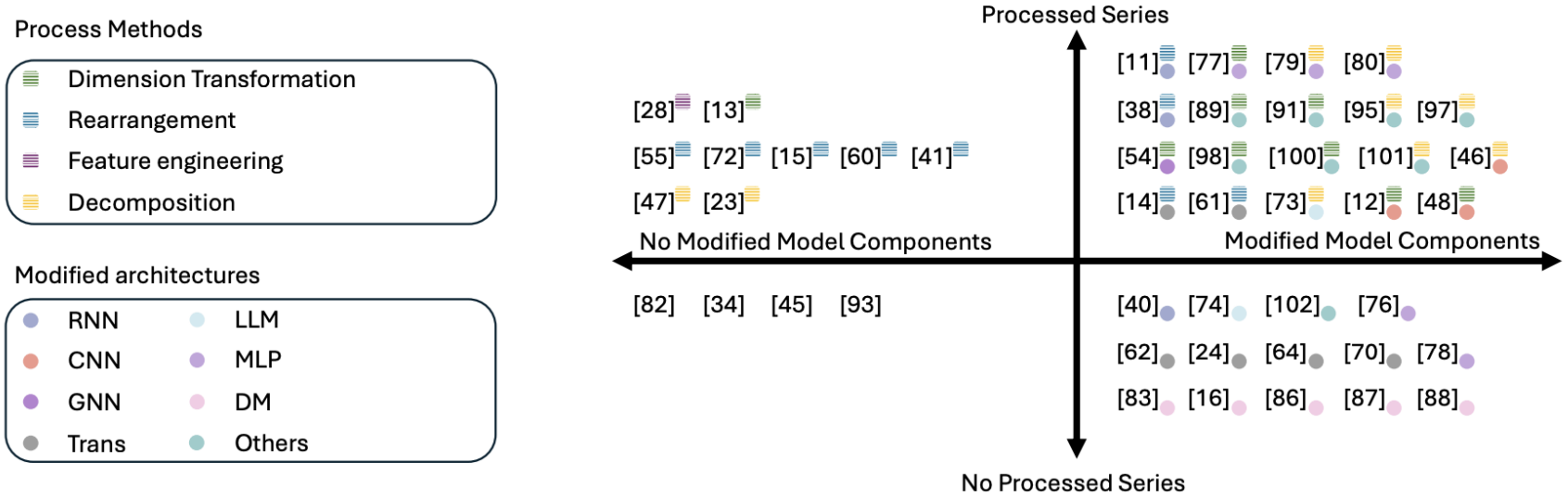

Fig. 3 Overview of design trends in time series forecasting. This figure categorizes recent deep learning models based on two binary dimensions: whether they process the input time series (vertical axis) and whether they modify model components (horizontal axis). Each model is annotated with its processing methods and the type of architecture it modifies . This 2×2 grid highlights four distinct design trends and reveals how methodological choices align with architectural innovation across the forecasting literature this paper explored.

Recent models increasingly combine series preprocessing with architecture modifications, balancing performance and efficiency.