DualMamba: a patch-based model with dual mamba for long-term time series forecasting

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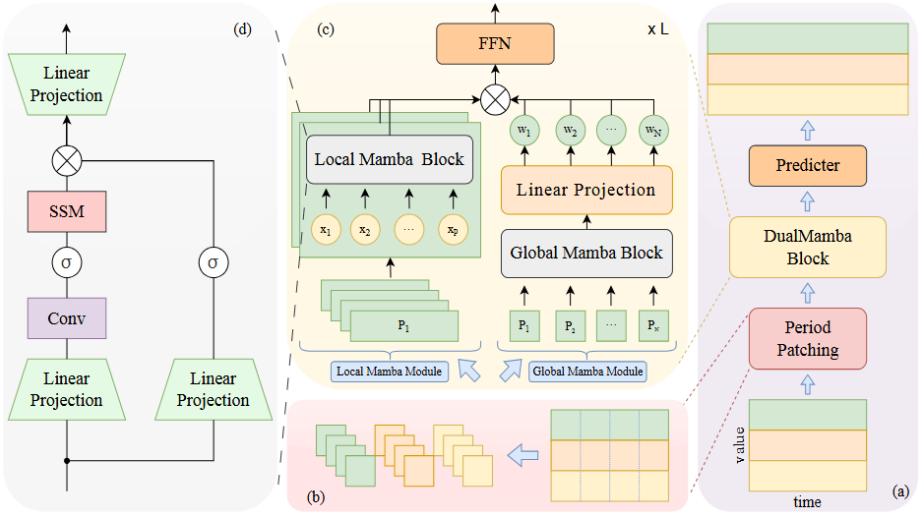
Problems & Ideas

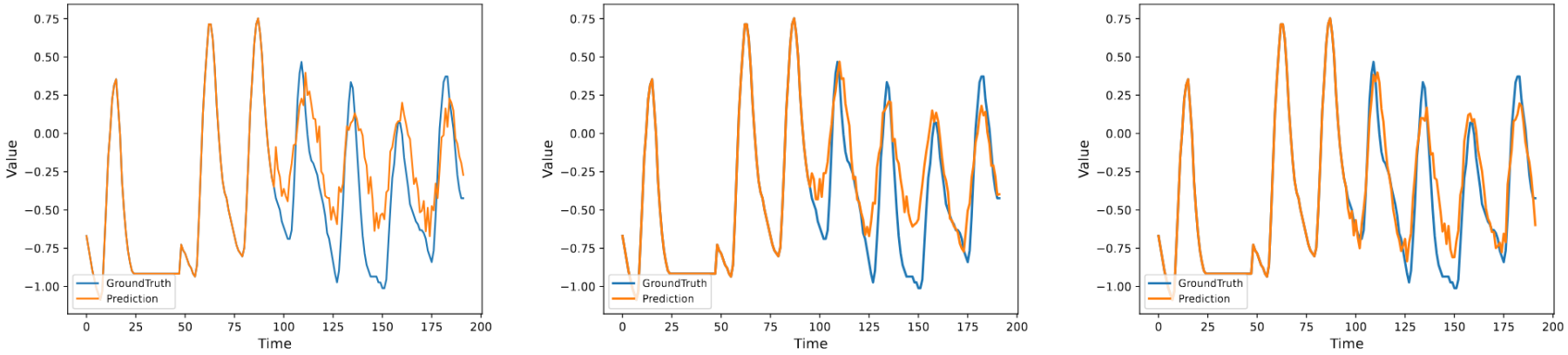
- Problems of conventional time series forecasting approaches:
  - The quadratic complexity of the attention mechanism limits its performance in long-term time series forecasting.
  - Models struggle to effectively unify the information between intra-patch and inter-patch.
- Ideas: Dual Mamba modules are employed to model point-wise and patch-wise representation, respectively. The patch-wise representation are utilized as weights to guide the modeling of point-wise representation.



(a)Overview of DualMamba framework. (b) The input time series is divided into patches, each containing a fixed number of time steps. (c) DualMamba Block incorporates two parallel Mamba modules—one focusing on local dependencies within each patch and the other on global dependencies across patches. The outputs of these modules are fused by multiply fusion mechanism and integrated using a feed-forward network (FFN). (d) Mamba's structure.

Main Contributions

- Contributions:
  - A novel model composed of Global Mamba Module and Local Mamba module, which is the first model to utilize SSM modules for capturing both local and global information by patching, enabling it to capture temporal dependencies in long-term time series;
  - A multi-scale information fusion method that allows global information to better guide the modeling of local information;
  - We conducted extensive experiments on various real-world datasets and achieved state-of-the-art accuracy.



(a) iTransformer with prediction length 96 (b) PatchTST with prediction length 96 (c) DualMamba with prediction length 96

Visualization of iTransformer, PatchTST and DualMamba on ETTh2 dataset with the prediction length 96, demonstrating DualMamba's superior capability in capturing fine-grained details.