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Automatic Feature Selection and Forecast Combination to Enhance and Generalize Renewable Energy Forecasting

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Abstract

Spatially aggregating renewable power plants is beneficial when participating in electricity markets. In this context, a substantial number of features is available from various data sources. In machine learning, feature selection is common so as to relieve the curse of dimensionality and avoid overfitting. However, there is no guarantee that the selected features result in reliable forecasts and post-processing can therefore be valuable. In this study, we combine model agnostic feature selection with linear and nonlinear probabilistic forecast combination techniques. Moreover, the filters automatically compute the weights for our analog ensemble (AnEn) forecast model that does not require training. We verify our model chain by generating intra-day forecasts of the aggregated output of 60 wind turbines and 20 photovoltaic power plants using 831 input features in total. We show that automatic feature selection improves forecast accuracy while forecast combination improves reliability.

Objectives



Improve the accuracy and reliability of forecasts to increase their value in decision-making.



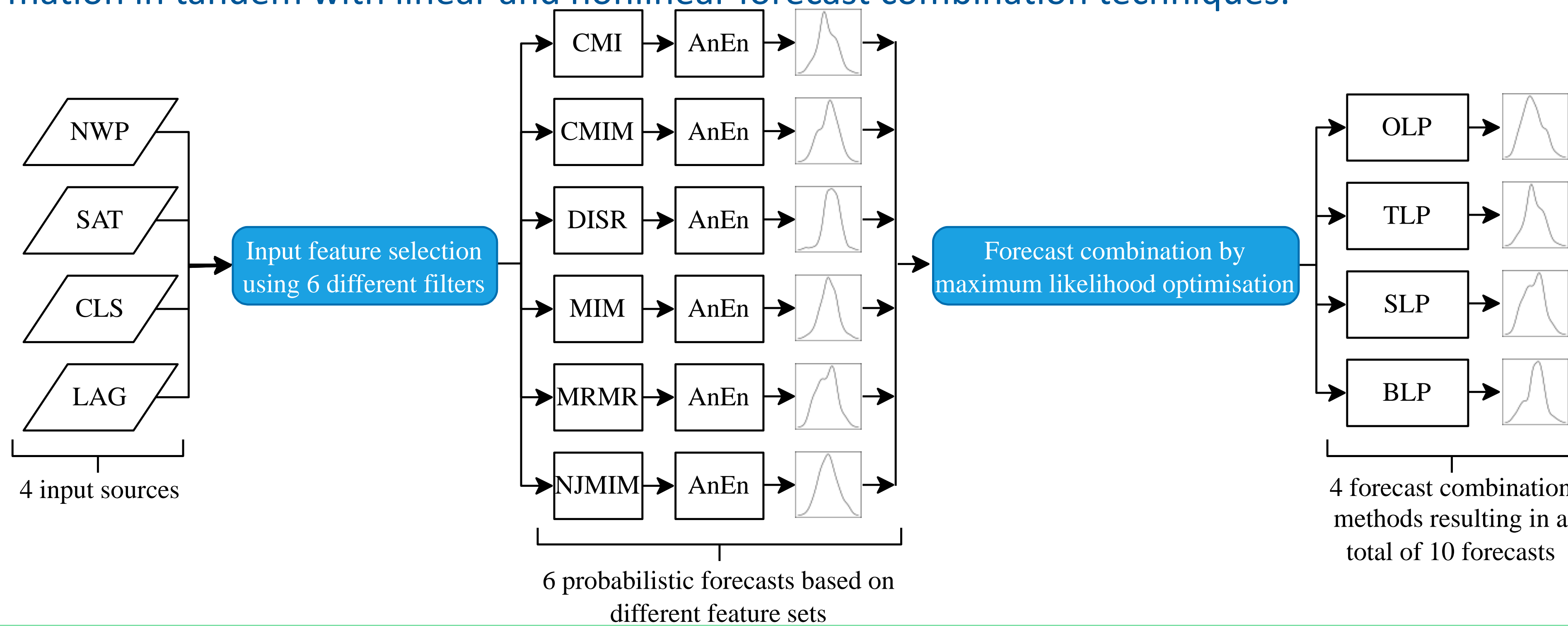
Automatically select features to relieve the curse of dimensionality and avoid overfitting.



Combine probabilistic forecasts to mitigate uncertainty induced by feature selection

Methods

A forecast model chain is proposed that comprises automatic feature selection and feature weighting by means of filters based on mutual information in tandem with linear and nonlinear forecast combination techniques.

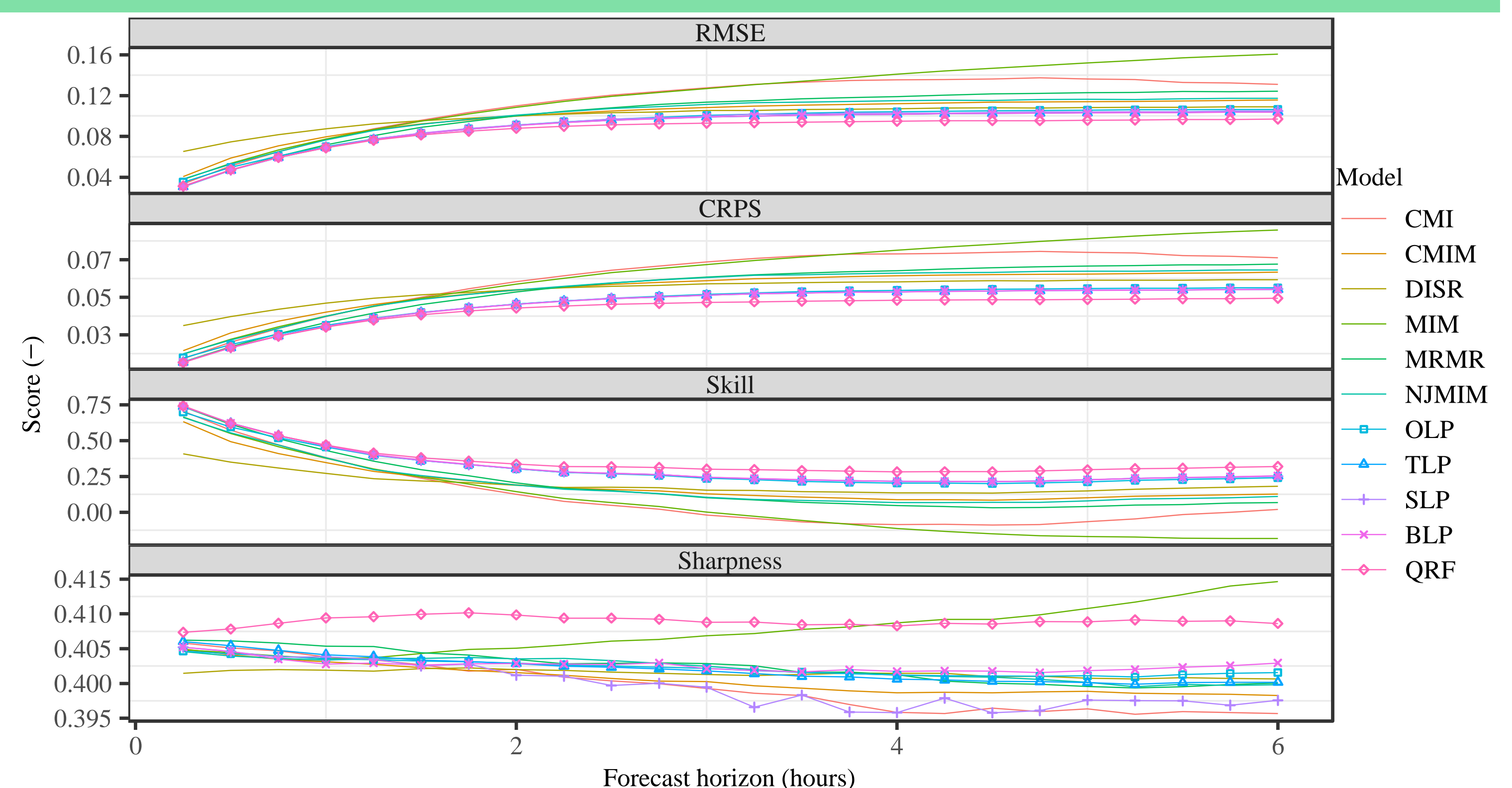


Evaluate forecasts:

- Root mean squared error (RMSE).
- Continuous ranked probability score (CRPS).
- Skill w.r.t. AnEn without feature selection.
- Sharpness (root mean variance).
- Advanced benchmark: quantile regression forests (QRF).

Results

- Feature selection results in positive skill when compared to AnEn forecast model without feature selection.
- Generating 6 forecasts with feature selection is approximately 60% faster than generating 1 forecast without feature selection.
- Nonlinear forecast combination (SLP and BLP) performs slightly better than linear forecast combination (OLP and TLP).
- Nevertheless, naïve forecast combination (OLP) is competitive and straightforward to implement.
- QRF and combination methods perform similarly for the first two hours, then QRF performs better.



Conclusions

The study presents a forecast model chain that automatically selects and weighs features from diverse input sources and where the probabilistic forecasts are optimally combined.

The proposed approach outperforms the same forecast model without feature selection and is substantially faster. Although nonlinear forecast combination outperforms linear forecast combination, naïve forecast combination is recommended to every forecaster.

Acknowledgments

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