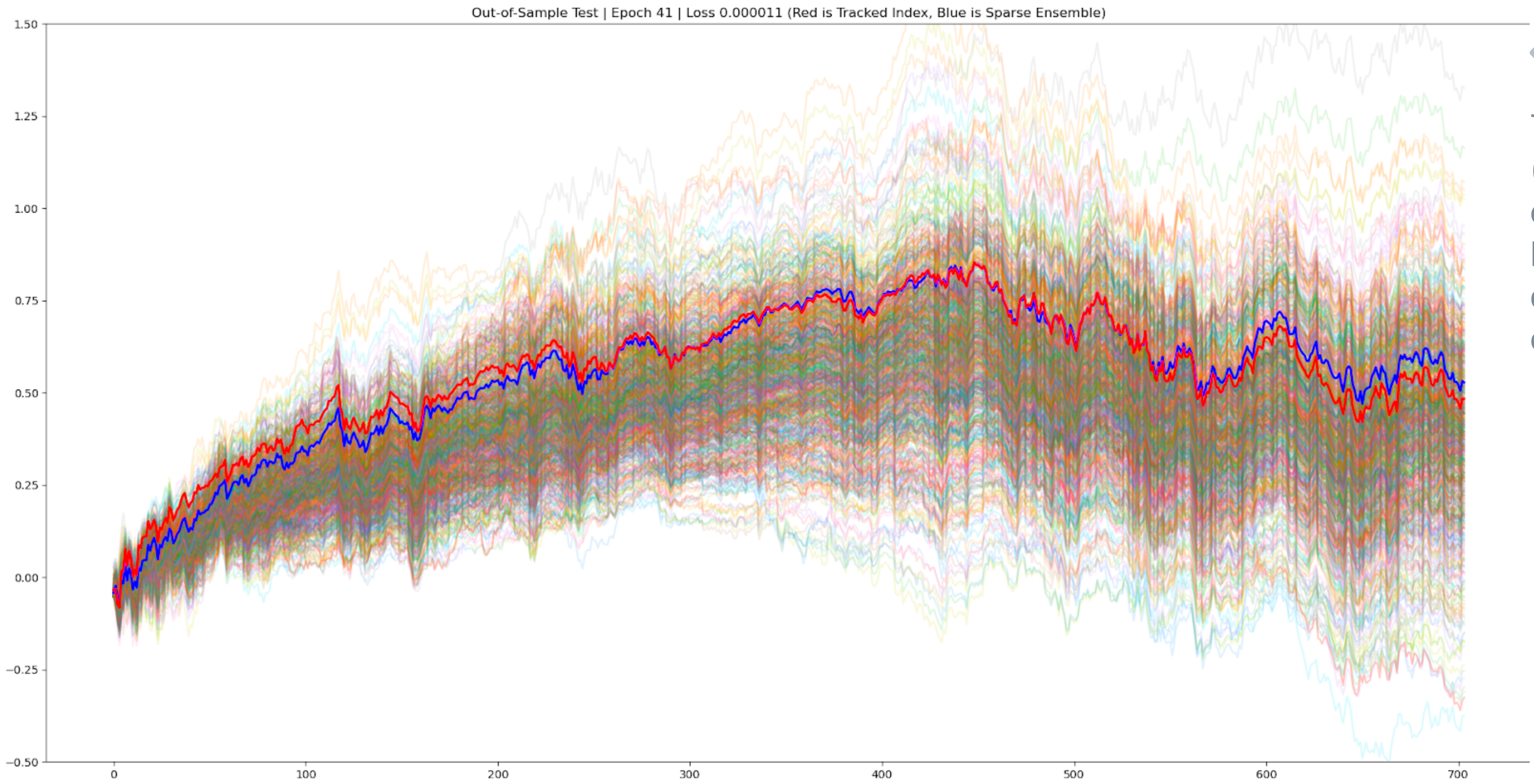
aixplain | **Kamer Ali Yuksel** (kamer@aixplain.com)

Generative Meta-Learning Robust Quality-Diversity Portfolio

INTRODUCTION

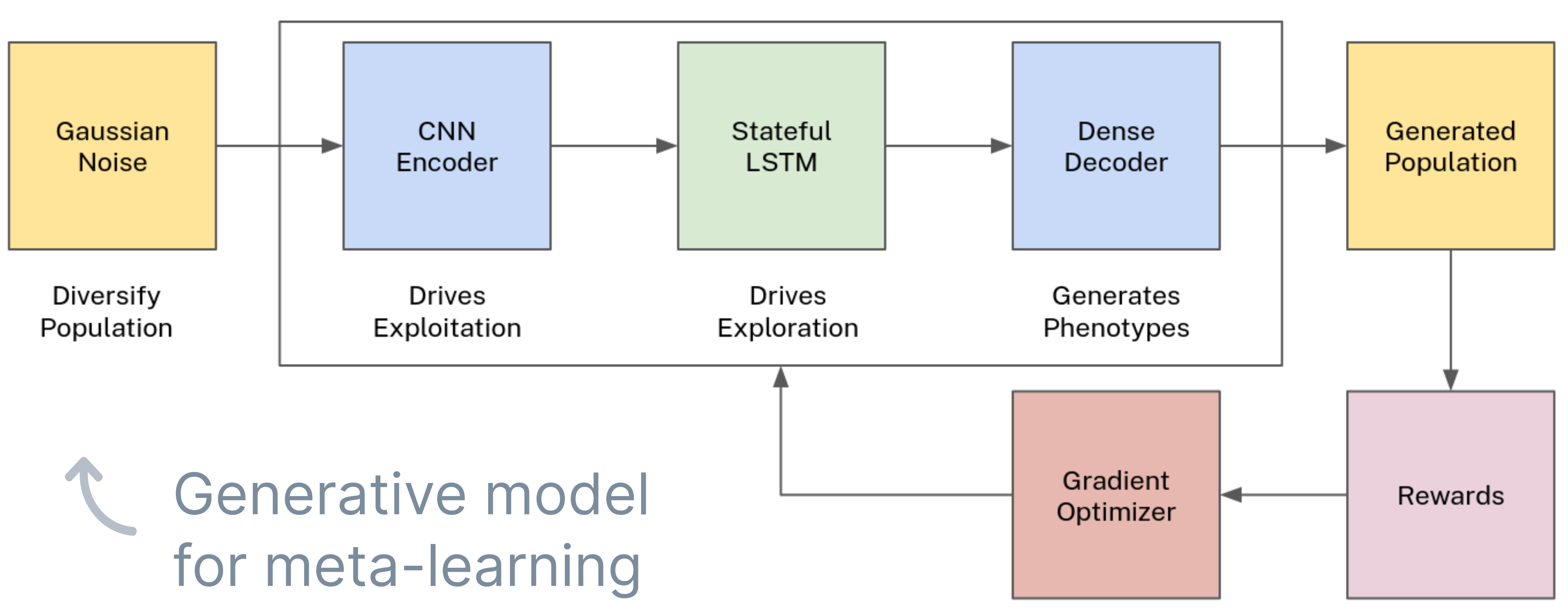
- Portfolio optimization is a challenging problem in finance, and traditional approaches have limitations
- Traditional portfolio optimization methods are based on quadratic or convex optimization, which may lead to suboptimal solutions.
- Robust portfolio optimization techniques are crucial for considering uncertainty and risk in financial markets.
- Bagging and ensembling techniques improve the robustness and generalization performance of machine learning models.
- Deep generative models can be applied to portfolio optimization for generating high-quality and diverse portfolios.



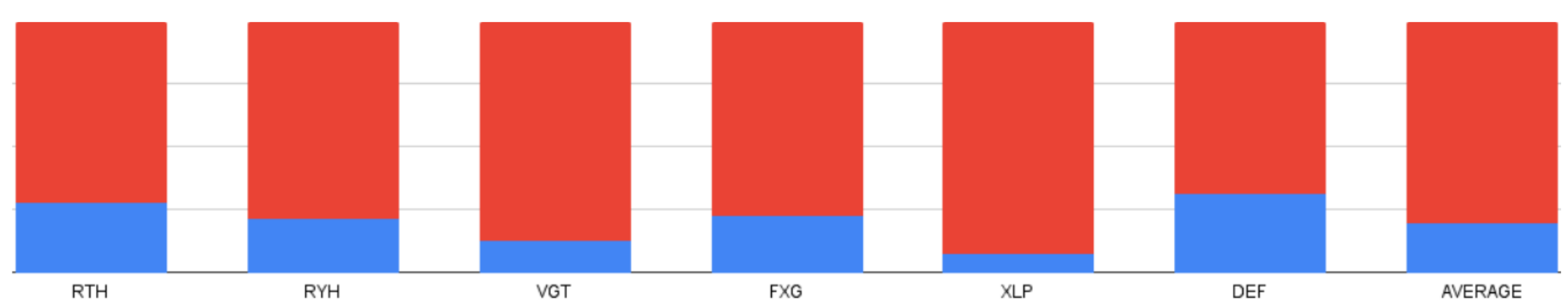
The index to be tracked (shown in red), the sparse ensemble portfolio (shown in blue), and behaviorally-diverse sub-portfolios co-optimized

METHODOLOGY

- Proposed method: deep generative model for meta-learning a robust portfolio ensemble.
- The proposed method utilizes a deep generative model consisting of a convolutional layer, LSTM module, and dense network.
- The generative model generates diverse and high-quality sub-portfolios to form an ensemble portfolio.
- The objective function balances maximizing sub-portfolio performance with minimizing correlation to achieve robustness.
- Stochastic optimization techniques and Monte-Carlo simulation enhance the robustness of the ensemble portfolio.



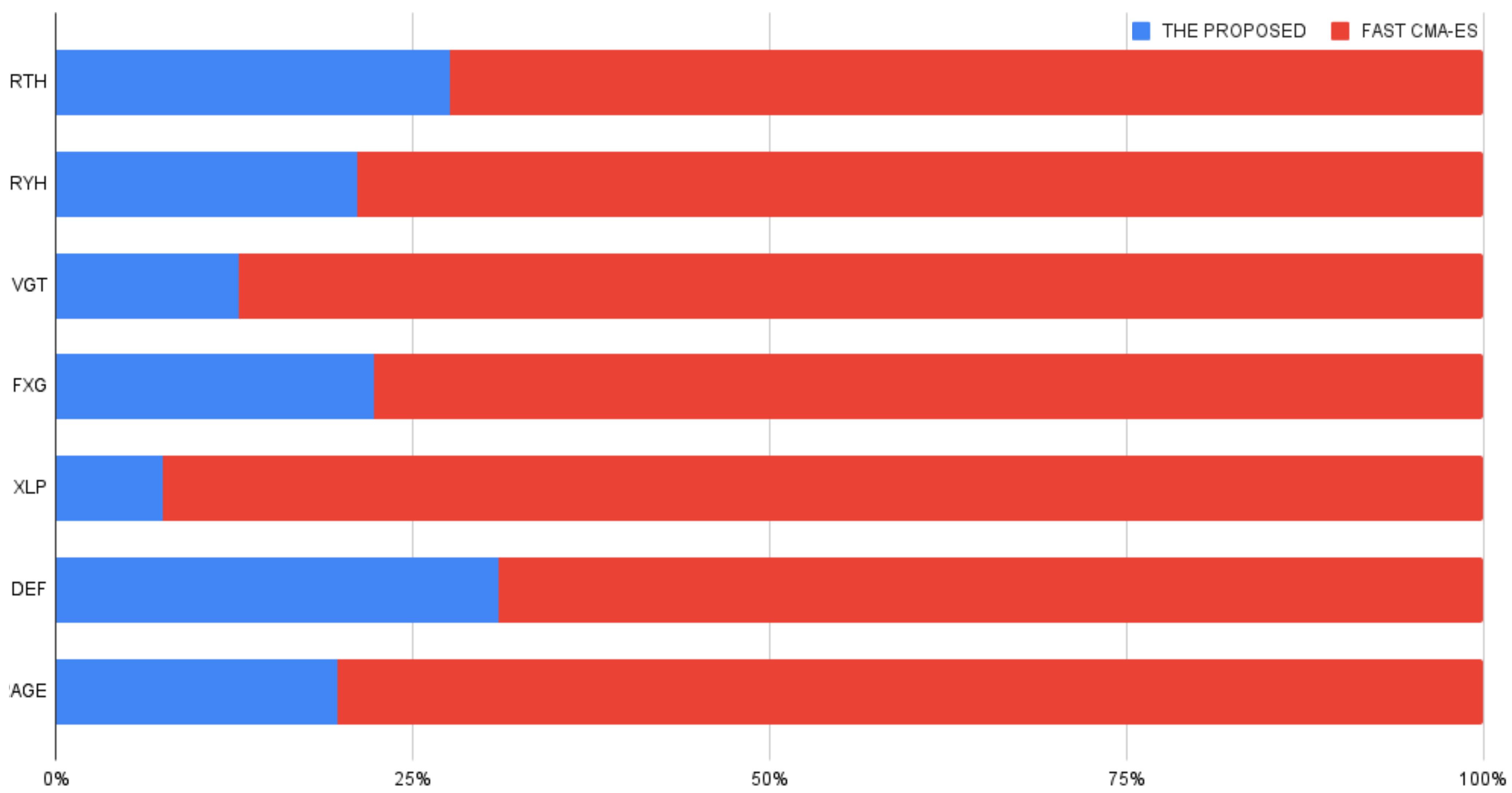
Generative model for meta-learning



Comparison with Fast CMA-ES (sparse index-tracking validation errors)

EXPERIMENTS

- Experiments were conducted on a large-scale sparse index tracking problem using a real-world US stock-market dataset.
- The proposed meta-learning approach outperforms popular optimizers in deep learning.
- Validation performance shows superior results in sparse tracking of Retail, Healthcare, and Information-Technology indexes.
- The proposed method demonstrates better out-of-distribution robustness and generalization.



Comparison of best index-tracking validation loss achieved on out-of-sample period (after 100 iterations)

Optimizer	RTH	RYH	VGT
SGD	0.000087	0.000091	0.000175
CMA-ES	0.000039	0.000030	0.000068
RAdam	0.000032	0.000025	0.000065
NAdam	0.000042	0.000031	0.000040
RMSprop	0.000028	0.000015	0.000037
Adagrad	0.000024	0.000009	0.000031
Adam	0.000023	0.000011	0.000027
AdamW	0.000023	0.000011	0.000027
Adamax	0.000021	0.000009	0.000027
Rprop	0.000012	0.000009	0.000015
Proposed	**0.000010**	**0.000008**	**0.000011**

The sparse index tracking errors achieved for various ETF(s) by different optimizers, in the out-of-sample period

CONCLUSION

- The proposed generative meta-learning approach optimizes a robust portfolio ensemble.
- The proposed method combines deep learning and ensemble learning for robust portfolio optimization.
- Deep generative models and optimization techniques provide an efficient and effective solution to portfolio optimization problems.
- Meta-learning approach is suitable for problems requiring behavioral diversity and can be applied to various portfolio optimization problems.
- The method achieves superior performance, robustness, and generalization compared to traditional methods.
- Applicable to a wide range of portfolio optimization problems, including index tracking.

CONTRIBUTIONS

- A novel meta-learning approach using a deep generative model is proposed for optimizing a robust portfolio ensemble.
- The method balances maximizing the performance of the sub-portfolios with minimizing their maximum correlation, resulting in a robust ensemble portfolio against systematic shocks.
- Experiments demonstrate that the ensemble portfolio obtained by bagging (taking the average of) generated sub-portfolio weights is robust and generalized well.
- The method can be applied to problems where behavioral diversity is desired among co-optimized solutions for a robust ensemble.