IOCMA 2026 Conference
The 2nd International Online Conference on Mathematics and Applications
10–12 June 2026 | Online
MDPI

A Deep Learning-based Comparative Analysis for EUR/USD Exchange Rate Prediction

Kaushalya H.W.S., Napagoda N.A.D.N.
Department of Mathematical Sciences, Faculty of Applied Sciences, Wayamba University of Sri Lanka.
fas202089@kul.wyb.ac.lk

INTRODUCTION & AIM

- EUR/USD is identified among the most actively traded, highly volatile and nonlinear currency pairs in foreign exchange market.
- Traditional models are inadequate for capturing non-linear exchange rate dynamics, making deep learning and big data analytics increasingly important for forecasting.
- Specially, Multi-CNN and Multi-CNN combined with AM have not been used previously for EUR/USD prediction.

Main objective

To evaluate and compare the predictive performance of three baseline models

- Convolutional Neural Network (CNN),
- Multi-Kernel Convolutional Neural Network (Multi-CNN),
- Attention Mechanism (AM),

and two novel hybrid deep learning models, namely

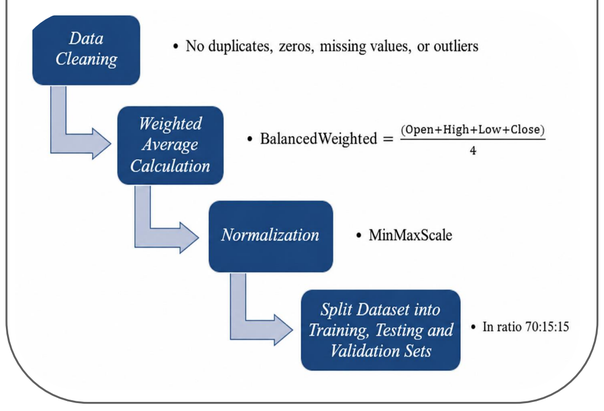
- Deep Attentive Convolutional Fusion (DACF),
- Deep Attentive Multi-Kernel Convolutional Fusion (DAMCF)

for EUR/USD exchange rate prediction.

METHOD

- Dataset: Historical OHLC prices (Open, High, Low, Close) daily data of EUR/USD currency pair from 2003 to 2024, are obtained from Yahoo finance website.

- Data Preprocessing



- Rolling Window Technique
- Candlestick Chart Visualization

Figure 1: Representation of Candlestick Chart

Model Architectures

- **CNNs:** Deep learning models used for feature extraction, pattern recognition, and forecasting tasks.
- **Multi-CNNs:** CNN architectures that use multiple kernel sizes to capture patterns at different scales.
- **AM:** A deep learning technique that focuses on important information and captures long-term dependencies in data.

Novel Hybrid Models

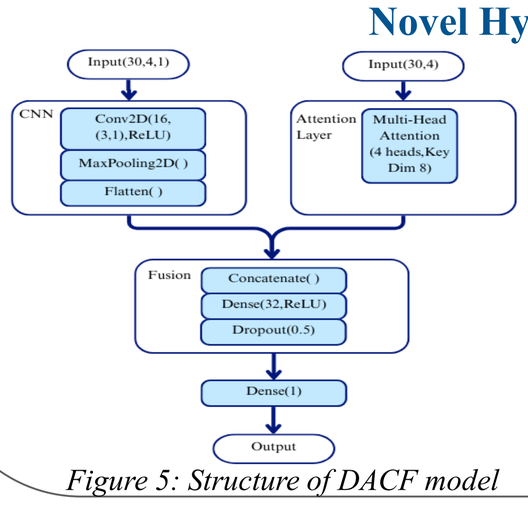


Figure 5: Structure of DACF model

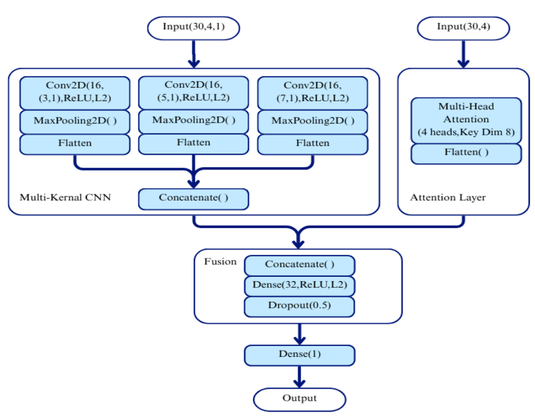


Figure 6: Structure of DAMCF model

RESULTS & DISCUSSION

Rolling Window Analysis

Table 1: MAE for Different window sizes

Window Size (days)	Mean Absolute Error (MAE)
5	0.0088
15	0.0095
30	**0.0078**
45	0.0109
60	0.0083

- Optimal window size: 30-day (MAE=0.0078)

10-Day Future Forecasting

Table 4.13 : Summary of the 10-day Prediction of the Models

Date (2024)	Actual	CNN	MULTI CNN	AM	DACF	DAMCF
07-08	1.082	1.119	1.112	1.106	1.109	1.107
07-09	1.081	1.119	1.112	1.106	1.109	1.108
07-10	1.082	1.119	1.112	1.106	1.110	1.109
07-11	1.085	1.119	1.112	1.106	1.110	1.110
07-12	1.088	1.119	1.113	1.106	1.111	1.111
07-15	1.089	1.119	1.113	1.107	1.111	1.111
07-16	1.089	1.119	1.113	1.107	1.112	1.112
07-17	1.092	1.119	1.113	1.107	1.112	1.113
07-18	1.091	1.119	1.113	1.107	1.112	1.114
07-19	1.088	1.119	1.113	1.107	1.112	1.114

- The last 30-day rolling window is used to forecast the next 10 business days.

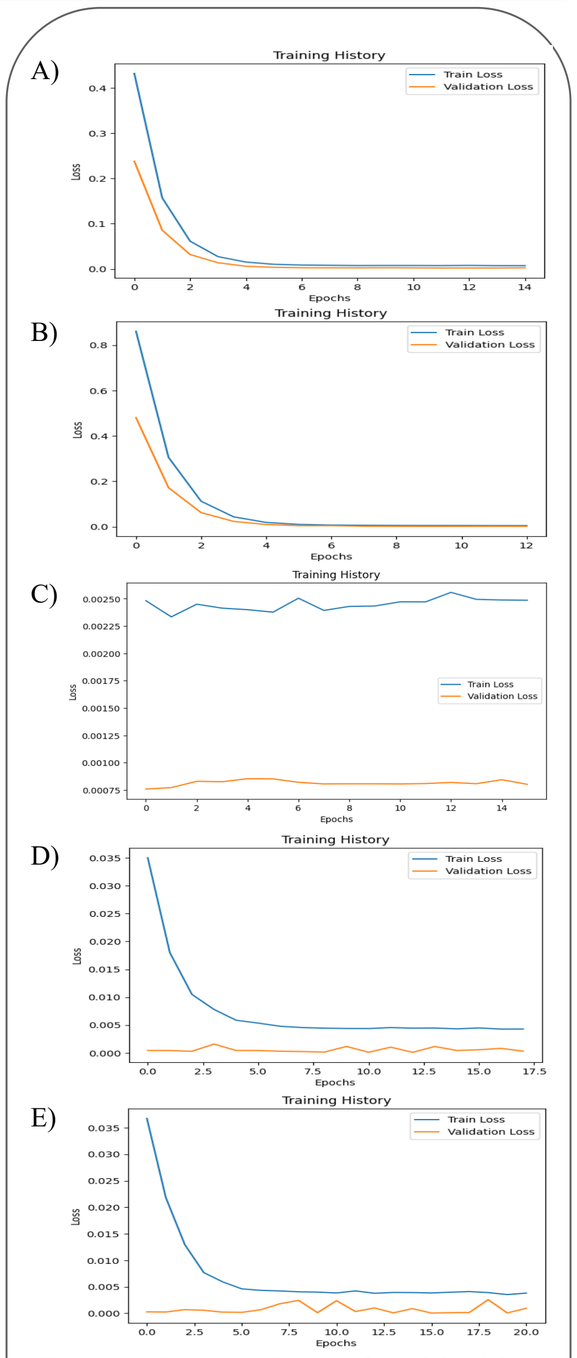


Figure 7 : Training History of models A)CNN; B)Multi-CNN; C)AM; D)DACF; E)DAMCF

Discussion

Table 6: Summary of the Accuracy Measures of the Models

Date	CNN	MULTICNN	AM	DACF	DAMCF
R-Squared	0.7701	0.8662	0.9051	0.9210	**0.9556**
Test Loss	0.0032	0.0025	0.0005	0.0004	**0.0003**
Test MAE	0.0280	0.0216	0.0193	0.0151	**0.0116**

- Best Performing Model: DAMCF

CONCLUSION

- Higher predictive accuracy is obtained when Attention-based models (AM, DACF, DAMCF) were applied.
- The best performance is achieved by **DAMCF** (R^2=95%, MAE=0.0116), making it useful for forex trading and risk management decisions.

FUTURE WORK / REFERENCES

- Other currency pairs can be explored, hybrid models can be enhanced, and real-time deployment can be implemented.

References
Ahoora Rostamian & John G. O'Hara (2022). Event prediction within directional change framework using a CNN-LSTM model. *Neural Computing and Applications*, *34*(20), 17193-17205.
Wanjiru, S., Waititu, A., & Wanjoya, A. Deep Convolution Neural Network with Dropout in Modeling Exchange Rate Volatility.
Weige Huang & Ziwen Chu (2024). Stock Market Prediction Based on CNN with Attention Mechanism. *Available at SSRN 5000005*.