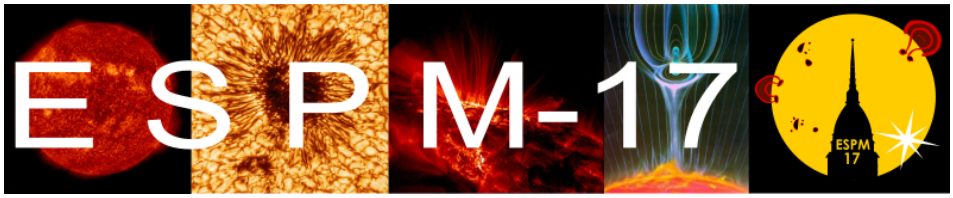

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The use of artificial intelligence techniques in the prediction of the solar activity cycle 25

Predicting future solar activity cycles is a complex task that requires the incorporation of machine learning techniques. The aim of this study is to apply neural network techniques to the prediction of the 25th period of the solar cycle series. We consider two methods for the prediction models, namely the Nonlinear AutoRegressive eXogenous (NARX) and the Voting Regressor (VR) (with combinations). The input data are the observed sunspot numbers (SSN) of the last four cycles. Several models are constructed and their performance is evaluated using the following metrics: Root Mean Square Error (RMSE), Pearson Correlation Coefficient (PCC) and Nash-Sutcliffe Efficiency (NSE) evaluation metrics. The obtained results from the VR algorithm of the solar maximum activity of the 25th cyles is 119.19 < $R_{max,VR}$ < 126.27 which is expected to be in the period between November - December 2024. The evaluation metrics obtained are 3.4 < $RMSE_{VR}$ < 6.7, 0.997 < r_{VR} < 0.998 and 0.972 < NSE_{VR} < 0.994. The results obtained from the NARX algorithm show a maximum value of $R_{max,NARX}$ = 130.84, which is expected in April 2025. The evaluation metrics are $RMSE_{NARX}$ = 7.515, NSE_{NARX} = 0.972 and r_{NARX} = 0.986. The results of these two models are compared with the observations and used to predict the next solar cycles.

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Session Classification: Coffee break and poster session 2

Track Classification: Diagnostic tools and numerical methods in solar physics