Time series analysis of transient CFD simulation data with Recurrent Neural Networks (RNN)

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Time series analysis of transient CFD simulation data has been done using Recurrent Neural Networks (RNN) which is a deep-learning algorithm. The data analyzed here was generated by transient(time-dependent) solar load simulation done in ANSYS-Fluent CFD software (student version) for a simple case of cylindrical room having a top wall, bottom wall and cylindrical side wall. Solar flux is entering the room through the top wall which is semi-transparent and it is hitting other walls. Other two walls are oqaque. Solar load depends on the day and month of a particular year, time of the day, latitude and longitude of the place etc. All these along with sun direction vector and solar irradiation are taken care of by Solar Calculator in ANSYS-Fluent. This time-dependent problem was solved in ANSYS-Fluent using solar ray-tracing model with proper thermal boundary conditions. Simulation was done for 3600 secs (1 hour) and data (Area Weighted Average Static Temperature at bottom wall) was saved at every second. This data has been used here for time series Analysis of bottom wall temperature for last 9 minutes (540 secs) using RNN (Recurrent Neural Networks). For RNN analysis at every second during that last 9 minutes (540 secs), series of data of previous 60 seconds of that particular time were used. RNN predictions were compared with the original simulation data and it was found that RNN predicted the trend of variation of bottom wall temperature with time quite well along with good accuracy. Mean Squared Error (MSE) of training dataset (loss) was 5.0769e-05. Graphical representation of the comparison of results is shown in the figure.