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Development and Evaluation of AI System to Specify Favourable Launch Windows of Space Vehicles from the MST Radar Data

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Abstract

Weather being a complex system – a NP system (Nondeterministic Polynomial time), forecasting weather parameters has been a major challenge for so long and continues to be so. To address the pressing challenges, new prediction models are developed that vary in the prediction duration and accuracy. Predicting the wind speed, wind direction and turbulence is of significant interest to Rocket industry as that would leverage them to time their launches. Also, Launch vehicle trajectory would use the altitude based mean wind biasing during atmospheric phase of flight to reduce significantly the effect of atmospheric winds on the structural loads experienced by the vehicle. Biasing the open loop pitch and yaw programs to the mean wind condition of launch month is known as monthly mean wind biasing.

Moreover, atmospheric phase of flight refers to the wind profile up to 20 km altitude, the height resolution and accuracy is important. Diurnal variation on the day of launch is critical. Surface winds are measured at various tower heights up to 100 metres. While upper wind is measured with Radiosonde mounted to Rawin balloons or with the expensive and difficult to procure Jimsphere or with MST radars.

MST radar is far superior to the traditional Radiosonde mounted to Rawin balloons in that the MST radar can be operated on a continuous basis to obtain measurements of the wind every few minutes. MST Radar data is considered in the present study. Usually, numerical methods involving complex mathematical modelling else statistical estimates are employed for weather forecasting. In this article, an appropriate soft computing technique such as the Feed Forward based Back Propagation Neural Networks and Fuzzy System are proposed. Neural networks are good at fitting any nonlinear nature of function with several mathematical learning co-efficient variables, similarly, the fuzzy system involves as non-mathematical functional variations. Therefore, analyses are carried out using MATLAB software for assessing the launch windows of space vehicles and its applications.

Key words: Space Vehicles, MST Radar, Numerical Methods, Feed Forward based Back Propagation Neural Networks, Fuzzy Systems, Learning Coefficient Variable.