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Machine learning and IoT trends for intelligent prediction of aircraft wing anti-icing system temperature

ملخص البحث (الثامن) باللغة الإنجليزية

Airplane manufacturers are frequently faced with formidable challenges to improving both aircraft performance and customer safety. Ice accumulation on the wings of aircraft is one of the challenges, which could result in major accidents and a reduction in aerodynamic performance. Anti-icing systems, which use the hot bleed airflow from the engine compressor, are considered one of the most significant solutions utilized in aircraft applications to prevent ice accumulation. In the current study, a novel approach based on machine learning (ML) and the Internet of Things (IoT) is proposed to predict the thermal performance characteristics of a partial span wing anti-icing system constructed using the NACA 23014 airfoil section. To verify the proposed strategy, the obtained results are compared with those obtained using computational ANSYS 2019 software. An artificial neural network (ANN) is used to build a forecasting model of wing temperature based on experimental data and computational fluid dynamics (CFD) data. In addition, the ThingSpeak platform is applied in this article to realize the concept of the IoT, collect the measured data, and publish the data in a private channel. Different performance metrics, namely, mean square error (MSE), maximum relative error (MAE), and absolute variance (R²), are used to evaluate the prediction model. Based on the performance indices, the results prove the efficiency of the proposed approach based on ANN and the IoT in designing a forecasting model to predict the wing temperature compared to the numerical CFD method, which consumes a lot of time and requires highspeed simulation devices. Therefore, it is suggested that the ANN-IoT approach be applied in aviation.