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**Title**

# Wing loads models for a tiltrotor from flight data acquired during tests


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## Abstract

For a tiltrotor the wing loading depends on the flight mode that has been deployed. In airplane mode the lift on the whole wing mainly determines the wing loads. In VTOL mode the lift generated by and the forces on the rotors mounted near the wing tips generate the loads on the wings. While in the flight test campaign for the tiltrotor these wing loads can be directly be measured via strain gauges, the wing loads during service is of interest from a Structural Health Monitoring perspective. Models based on inputs available from the on-board Heath and Usage Monitoring System (HUMS) can have added value.

Within the European Clean Sky 2 project ADMITTED [1] prediction models are build using a database contain flight test data of a tiltrotor. In the current study ANN based models are developed for the prediction of wing loads as is for instance also done in [2]. The loads considered in the current study are the wing beam bending, wing torsion and chord bending at a location near the root. Models has been developed based on the data available from flight tests for a large number of maneuvers. The models use several flight parameters to predict the mean, the minimum and the maximum per rotor round of the wing loads. Besides using the mean value per rotor round of certain flight parameters directly as inputs, derived quantities as air density are used as inputs. Using these physical quantities, the derived models are small and exhibit a good prediction power. The models for the wing bending, wing torsion and wing chord bending have just 8 to 10 input parameters. They can directly deal with the different configurations in which the tiltrotor can operate.
The R2 values of the prediction models vary between 0.973 and 0.998, with the wing chord bending having the lowest value and wing beam bending having the highest value. This indicates that a proper prediction of the wing loads for a tiltrotor can be obtained from HUMS data.



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## References


[1] https://admitted-project.eu
[2] Michael J. Allen and Ryan P. Dibley, Modeling Aircraft Wing Loads from Flight Data Using Neural Networks, NASA Dryden Flight Research Center Edwards, California, NASA/TM-2003-212032