Comparison of LSTM, Koopman-Operator and Transformer Approaches for Predicting Transient Ditching Loads

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This research is concerned with building machine learning (ML) models to predict dynamic ditching loads on aircraft fuselages. The employed learning procedure is structured into two parts, the reconstruction of the spatial loads using a convolutional autoencoder (CAE) and the transient evolution of these loads in a subsequent part.
To predict transient load evolution, the CAE is combined with either a long short-term memory (LSTM) network, a transformer or a Koopman-operator based method. To this end, all approaches advance the solution in time based on information from several previous and the present time step. The training data is compiled by applying an extension of the momentum method of von-Karman and Wagner to simulate the loads on a generic DLR-D150 fuselage model at various approach conditions. Results indicate that all ML models are able to perform accurate ditching load predictions. Predictive differences occur when looking at the different options to capture the temporal evolution of loads and will be outlined in greater detail.