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A reduced order model for prediction of aerodynamic loads on an unmanned aerial system with hybrid quadcopter biplane configuration MORTEZA HEYDARI, HAMID SADAT, University of North Texas — Army Research Lab (ARL) has recognized Unmanned Aerial Systems (UAS) with Vertical Take-Off and Landing (VTOL) to be capable of delivering paramount tasks such as intelligence, surveillance, electronic attack, etc. in the future. Advances in manufacturing and material technologies have opened a new design space for novel VTOL UAS configurations but significant knowledge gaps still exist to design a configuration which can achieve the desired performance. ARL designed research VTOL UAS platforms called Common Research Configuration (CRC) with hybrid quadcopter biplane concept to enable a comprehensive study on such aircraft. Inherent to all VTOL UAS such as CRC platforms is the need for a transition from hover to forward flight and forward flight back to hover throughout a mission. This transition produces highly non-linear loads on the wings due to the rotor-wing interactions and may present a significant challenge for robust control. The aim of this study is to develop a reduced order model (ROM) capable of predicting loads on CRC-3, the smallest size of the CRC generation with 3lb weight. A set of data obtained from hundreds of CFD simulations for a wide range of conditions are used as the training set for a neural network. The predicted loads by the developed ROM show good agreement with the test set. Additionally, the dynamic body equations are coupled with the ROM to investigate the CRC-3 flight dynamics. CFD simulations are conducted using our in-house solver, CFDFoam.

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