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Numerical characterization of helicopter noise hemispheres

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ABSTRACT

Numerical tools aiming at the evaluation of ground acoustic impact of helicopters typically rely on databases given in terms of acoustic disturbance over hemispheres surrounding the helicopter (noise hemispheres). These are evaluated for a discrete number of steady flights falling within the flight envelope. The objective of the present work is the identification of flight parameters to be considered for the characterization of noise hemispheres, particularly when related to unsteady maneuvers. To this purpose, different approaches based on steady flight aeroelastic/aerodynamic/aeroacoustic predictions are examined for assessing their capability of simulating the acoustic impact of helicopters in arbitrary unsteady flight. The numerical investigation demonstrates that at least three parameters, including disk loading, are required to adequately characterize noise hemispheres. Conversely, the similarity of kinematic parameters alone may yield steady flight acoustic predictions poorly correlated with those obtained for unsteady maneuvers.

Keywords: computational aeroacoustics; helicopter noise hemisphere; unsteady maneuver noise; inverse helicopter dynamics; rotor aeroelasticity.

1. Introduction

Noise emission represents one of the main drawbacks of civil aviation operations on human communities. In particular, the reduction of the acoustic impact leading to a wider public acceptance of helicopter support to human activities in populated areas is among the present and near-future strategic goals of rotorcraft operators. This interest is demonstrated by EU-funded large research efforts in the framework of the current Green Rotorcraft project within the European Joint Technology Initiative Clean Sky, starting from the results of the former Integrated Project FRIENDCOPTER, that was

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