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Aeroacoustic Analysis of a Landing-Gear Configuration for Noise Reduction using Porous Fairings in the INVENTOR Project

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With the continuous increase of air traffic and the expansion of urban areas, noise in the vicinity of airports is raising concerns due to its effects on citizens' health. Therefore, in parallel to the design of novel breakthrough aircraft configurations, it is essential to reduce the noise of existing ones by reducing both engine and airframe contributions.

The INVENTOR project (INnoVative dEsign of iNstalled airframe componenTs for aircraft nOise Reduction) aims at reducing aircraft noise at the approach certification condition of 1 EPNdB. To reach this target, noise sources must be reduced at sub-system level (airframe and engines), with INVENTOR focusing on airframe noise sources, such as slats, flaps and landing gear, which are of primary concern during take-off and landing. In the present work, we experimentally and numerically investigate the potential benefits of reducing the landing-gear noise contribution, on a LAGOON landing gear model demonstrator, equipped with porous fairings.

Experimental tests have been performed in the vertical anechoic tunnel (A-tunnel) at TU Delft to assess the potential aeroacoustics benefits and aerodynamic performance of this configuration. Several flow permeable materials have been tested to assess the effect of the material geometry and integral properties (i.e., porosity, resistivity). The experimental dataset is complemented with the results of high-fidelity numerical simulations carried out with the commercial software 3DS PowerFLOW based on the lattice-Boltzmann Very Large Eddy Simulation method.

The preliminary analysis of the experimental data shows a variation in noise emission depending on the type of permeable material. It was found that not all the tested materials provide aeroacoustics benefits, although the solid fairing shows larger noise reduction than the flow permeable one. Interestingly, the solid fairing causes larger aerodynamic penalties, indicating that an optimum can be found between aerodynamic interaction and acoustic performance of the fairings. Therefore, details of the aerodynamic interaction between the fairing wake and the landing gear will be provided by the numerical analysis, leading to a better understanding of the noise generation and mitigation mechanisms, with the target of designing innovative silent airframe structures with minor aerodynamic impact.