

Abstract

Global interest in next-generation supersonic aircraft has recently increased, raising concerns about the expected noise levels generated during the Landing and Take-Off (LTO) phases. To ensure public acceptance, future supersonic aircraft should comply with current subsonic noise limits. Whether these targets can realistically be met remains uncertain. Numerous studies have investigated noise mitigation strategies for supersonic aircraft, yielding promising results. However, to more effectively assess the applicability of these measures, a more comprehensive, multi-disciplinary and multi-fidelity approach is required. In this context, this thesis presents an innovative conceptual design methodology that integrates LTO noise prediction capabilities within the early design process. The methodology is structured into two main phases: an initial phase dedicated to aircraft configuration and performance assessment, and a subsequent phase focused on LTO noise estimation. A two-step approach was used to improve performance prediction accuracy by combining low-fidelity analyses with refinements from mid-fidelity aerodynamic and propulsion data. The methodology was applied to a case study representative of a Mach 2 supersonic aircraft similar to the Concorde. Three specific applications demonstrated its potential: parametric analyses evaluating the influence of design and operational parameters on noise emissions, including a discussion of the limitations of the adopted noise model; direct comparisons with ICAO noise certification standards, assessing different engine configurations and take-off procedures; and an airport-level noise assessment quantifying community impact in terms of affected area and population. The noise prediction method employed relies on low-fidelity models commonly used in early design evaluations. To preliminarily assess their accuracy, results for the dominant noise source during take-off, i.e., jet noise, were evaluated against higher-fidelity methods. While further improvements are suggested as future research directions, the methodology has proven to be an effective tool for deriving design considerations that support the development of more environmentally friendly supersonic aircraft.