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# High performance solvers for aeroacoustic simulations for Airbus

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## Abstract

As a part of system design tasks, Airbus simulates the acoustic vibrations sustained by mechanical components during take-off to ensure minimal noise pollution and component damage prevention. These simulations involve solving a coupled sparse-dense linear system, which results from modeling the heterogeneous medium of jet engine flow (with Finite Element Method, FEM) and the homogeneous medium of aircraft surface (with Boundary Element Method, BEM), respectively. Given the massive scale of these sparse-dense coupled systems (hundreds of millions of FEM unknowns and millions of BEM unknowns), optimizing computational time and memory usage is essential. Despite significant advances in sparse and dense direct solvers, their application to coupled sparse-dense systems has been under-explored. This presentation aims to explain and empirically evaluate existing methods that combine sparse and dense direct solvers to tackle these large-scale coupled systems for Airbus. Another goal is to use experimental results to assess whether solving the entire coupled system using a single direct solver (either sparse or dense) can be more efficient than coupling two separate solvers that are not specifically adapted for integration.

**Keywords :** aeroacoustic simulation, large coupled FEM/BEM linear system, direct solver

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\* Supervised by Emmanuel Agullo and Guillaume Sylvand