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Direct aeroacoustic simulations based on domain decompositions

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For CAA, an accurate and feasible direct simulation that considers both the generation of sound within the flow and its propagation into the far-field is hard to realize with one numerical method in a single computational domain. On the other hand, a direct approach contains automatically the interaction of the acoustic perturbations with the flow-field, a property which lacks the popular acoustic analogy models. The proposed method is basically a direct simulation, but it simplifies the problem that has to be solved for individual regions in the computational domain. The idea is to use a non-overlapping domain decomposition method where the equations, methods, grids and even the time steps are adapted to meet the local requirements. Inside the coupling framework, high-order solvers from different classes of methods are available: On unstructured grids, a reconstructed ADER finite volume method (ADER-FV) is used for linear and nonlinear problems, as well as a discontinuous Galerkin method. On structured grids, the ADER-FV and the ADER-FD method are efficiently implemented for nonlinear (FV) and linear (FV, FD) problems. These high-order accuracy methods ensure excellent wave propagation capabilities throughout the entire computational domain. In the subdomains, the Navier-Stokes, Euler and the linearized Euler equations are solved.