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Dipartimento di Scienze e Tecnologie Aerospaziali

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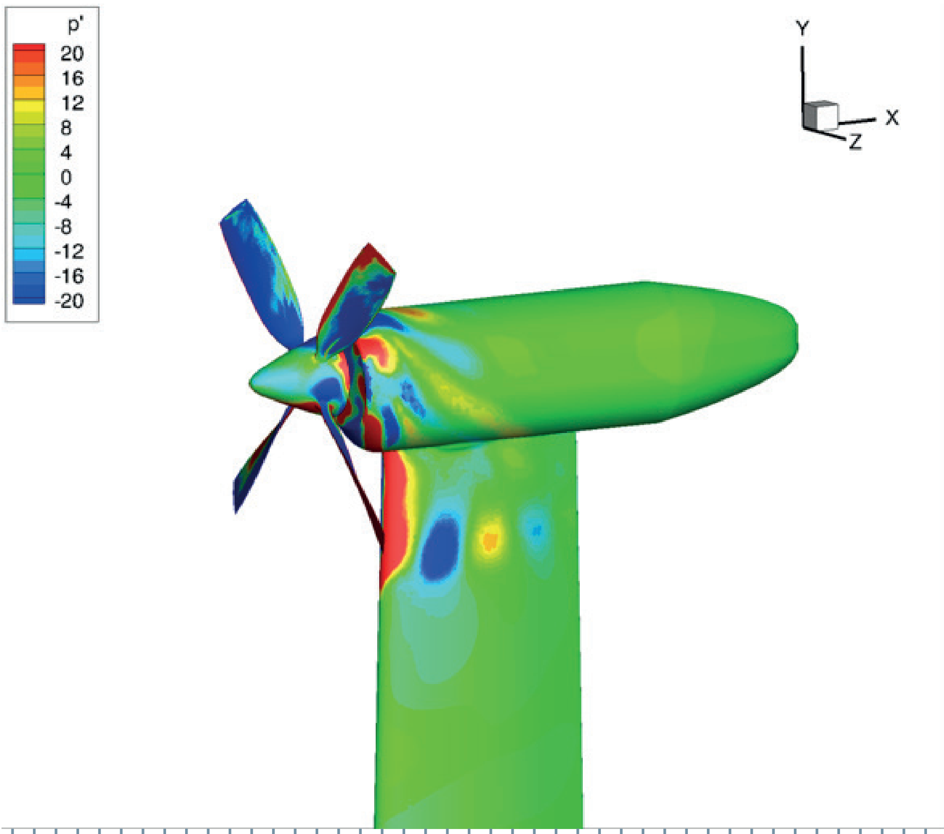

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Aeroacoustic Prediction and Optimization Capabilities in the Open-Source SU2 Solver

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A hybrid noise prediction framework is developed for the open-source SU2 solver suite, in which a permeable surface Ffowcs Williams and Hawkings (FW-H) Equation solver is implemented and coupled with an unsteady Reynolds-averaged Navier-Stokes (URANS) solver. A discrete adjoint solver based on algorithmic differentiation (AD) is developed for the coupled system which directly inherits the convergence properties of the primal flow solver due to the differentiation of the entire nonlinear fixed-point iterator. This framework is applied to tonal noise minimization cases via shape optimization. The lift and noise design objectives were shown to be competing in all cases studied-noise minimization always leads to a marked loss of lift. A number of unconventional optimal designs were obtained, including airfoil designs with wavy surfaces to reduce wake interaction noise. The baseline and optimized designs were also analyzed using a turbulence-resolving delayed detached-eddy simulation (DDES). The results indicate that the tonal noise reduction attained by URANS-FWH-based noise minimization is consistent with the higher-fidelity DDES-FWH noise prediction results.