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Complex Nozzle Optimization Techniques using Machine Learning[1] DOM DIDOMINIC, JONATHAN FITZGERALD, EMMA GIST, MARK GLAUSER, Syracuse University — Advances in the aviation industry have led to the expanded use of complex nozzles on next-generation-plus aircraft that allow for seamless integration in the airframe. Complex nozzles, such as Multi-Aperture Rectangular Single Expansion Ramp Nozzle (MARS Nozzle) used in this study, primarily focus on reducing generated noise while preserving the efficiency of the nozzle. This study explores the use of optimization through a trained deep neural network as the design process of an aft deck plate, representing nozzle-aircraft integration, to minimize the effective sound pressure level of the nozzle. This is accomplished by the neural net acting as a surrogate model to predict sound levels based on aft deck geometries and flow conditions. Two non-gradient based optimization schemes were chosen to minimize the sounds levels: Nelder-Mead (traditional method) and Particle Swarm Optimization (evolutionary algorithm). Results from the optimization model are validated with experimental particle image velocimetry (PIV) results as well as computational simulations to verify the fidelity of the neural networks.

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