



Minority University Research and Education Project (MUREP)

Institution: New Mexico State University

City/State: Las Cruces, NM

Award Name: MUREP Partnership Learning Annual Notification (MPLAN)

Award Number: N/A

Title: EXtreme Aerodynamics Over Small Air Vehicles/ ARMD: Strategic Thrust 4: Safe, Quiet, and Affordable Vertical Lift Air Vehicles

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Award Fiscal Year: FY2024

Summary:

With the surging development of materials and batteries, small air vehicles for transportation, delivery, and rescue in metropolitan areas become increasingly promising. These lower altitude flying vehicles often face challenges from weather variations and urban airsheds. So far, limited knowledge and research are in the literature in this emerging field. In this context, we propose systematic numerical simulations and modal analysis to study extreme aerodynamics over small air vehicles. The flow simulations will be conducted using the high-order spectral element CFD solver Nek5000, coupled with in-house modal and non-modal stability analyses. Extreme weather conditions will be simulated using three nominal disturbed flow conditions and combinations among them: 1) disturbance vortices, 2) wake shedding, and 3) nonuniform incoming velocity profiles. The analysis of each scenario will help us distill physical insights from extreme aerodynamics and provide potential control strategies to increase the safety margin for stable flight. The proposed work is scheduled for a seven-month performance period. Wind tunnel experiments are expected to be conducted after this phase of research.