Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2020-858

Topic # N182-110

Development and Validation of a Computational Tool for Missile Flight Through Rain

CFD Research Corporation

WHO

SYSCOM: NAVAIR

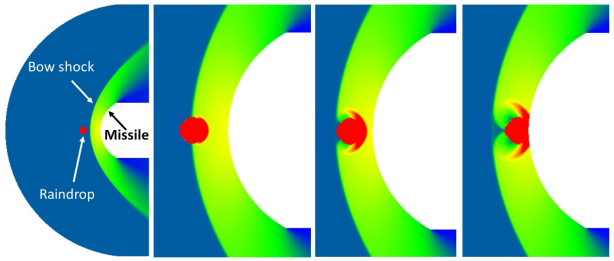
Sponsoring Program: PMA-259 Air-to-Air Missiles

Transition Target: All missile programs

TPOC:
(760)939-1649

Other transition opportunities: Navy, Army, MDA Missile programs
Major missile primes, including Lockheed Martin, Raytheon, Boeing, Northrop Grumman

Notes: Rain drop deformation near missile cone hypersonic flow field.



WHAT

Operational Need and Improvement: The ability of a tactical missile to operate in all weather conditions is limited by the ability of its seeker dome to survive flight through rain without fracturing. The biggest unknown in predicting whether the dome will survive in flight is the degree of raindrop distortion caused by the flow field around the missile in flight. A computational raindrop prediction capability will help in analysis of existing nose cone and dome configurations, as well as in the design of new systems.

Specifications Required: Predict the time dependent shape of a drop as it traverses the atmospheric flow field around a missile in supersonic flight. Conduct a parametric computational study for representative conditions of speed and altitude with hemispheric and aerodynamic missile forebodies. Conduct detailed experiments to validate the computer predictions.

Technology Developed: CFD Research Corporation plans to develop and fully validate a first-principles based, high-fidelity CFD tool to predict raindrop distortion and demise in the flow field around a missile in supersonic flight in order to understand both the impact event and the associated material damage mechanisms.

Warfighter Value: Navy missile programs have requirements to fly through rain. Our software tool predicts survival of missiles flying through weather, and can be used to optimize existing and future missile nose cone/dome configurations.

WHEN

Contract Number: N68936-20-C-0035 **Ending on:** February 5, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Develop Computatonal Capability	Med	Successfully develop various computational algorithms	3	August 2020
Conduct Experiments	Med	Experimental data for missile relevant flight speeds, elevations, and missile configurations	3	August 2021
Validate Computational Capability	Med	Computational results successfully compare against experimental results	4	November 2021
Perform Parametric Simulations	Low	Demonstrate predictive capability on relevant Navy missile platforms	5	February 2022
Option: Perform simulations on Ogive forebody	Med	Successfully assess probability of failure as a function of rain drop parameters (size, velocity, distortion, and angle of incidence)	5	February 2023

HOW

Projected Business Model: CFD Research Corporation plans to transition this technology to DoD government labs and primes by licensing of our software tools. CFD Research provides consulting services as well, i.e. use software to analyze missile designs on behalf of third parties.

Company Objectives: CFD Research Corporation specializes in engineering simulations, advanced prototypes, and innovative designs for aerospace, defense, life sciences, materials, energy, and other industries. Using our software and experimental capabilities, we develop new hardware concepts, innovative designs, and superior solutions for our customers with lower risk, reduced costs, and less time.

Potential Commercial Applications: Developed software tools can be used to predict the ability of commercial rockets to survive launch through adverse weather conditions.

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