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 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

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