

## December 2022

# **AFWERX SBIR M-PAV Hybridization Award**

DARcorporation has been awarded an SBIR Phase I contract by AFWERX to expand the design of the Multi-Purpose Aerial Vehicle (M-PAV) by exploring the feasibility of hybrid-electric propulsion. The M-PAV preliminary design and proof of concept flight testing of a SubScale Demonstrator (SSD) vehicle was completed as a part of the AF Explore 1.0 project sponsored by the U.S. Air Force Research Laboratory (AFRL) Transformational Capabilities Office (TCO), in coordination with the Air Force Warfighting Integration Capability (AFWIC).

The M-PAV design is intended as an attritable UAV capable of short take-off and landing (STOL) and vertical take-off and landing (VTOL) operations in austere or degraded environments near the front lines. The M-PAV is designed to be a family of aircraft scaled to meet different missions including ISR, resupply and weapons loft (a mission conceptualized by the TCO as the emplacement of munitions on an airborne platform, in- or near-theater, for agile combat employment). Phase I activities will be aimed at defining, developing and designing a hybrid electric propulsion system as an option for the smaller scale M-PAV aircraft.



# **4-Axis CNC Hot Wire Cutter**



DARcorporation has recently upgraded our 4-axis CNC hot wire foam cutter machine with new hardware and industry-leading software for G-code generation, greatly expanding the capabilities of prototyping and manufacturing both foam wings and fuselages. Utilizing new stepper motor driver modules, DARcorporation can now run a higher range of speeds and select from a larger array of foam densities. Software upgrades to 3D cutting simulations allow for the real-time viewing of line by line G-code while simulating the cutting process, increasing time efficiency and providing for virtual manufacturing prior to cutting actual foam prototypes. New options also include cutting a wider variety of wing shapes (including wing taper, twist and sweep) from a library of thousands of airfoil configurations and combinations. Material savings are streamlined with foam block area optimization allowing for manufacturing multiple wing sections in a single pass. The ability to cut a wider variety of fuselage contours from CAD models allows for the complete manufacturing of a custom foam R/C aircraft with room for on-board instrumentation. These capabilities and improvements allow DARcorporation to rapidly prototype aircraft and proceed to real-time flight testing of designs with greater efficiency.



## **Propeller Fabrication and Testing**

DARcorporation can fabricate custom propellers from birch wood to best match operating condition for selected electric motors. A higher thrust propeller can be fabricated without increasing blade count. Typical Commercial Off The Shelf (COTS) designs are not optimized for the operating conditions and motor performance. A custom solution is ideal to fit the desired requirements, while maintaining high performance. Structural analysis is performed prior to fabrication to verify design viability. Combined structural and aerodynamic optimization for the desired operating point yields a ~30% weight reduction for similar thrust performance for significantly reduced shaft power. Performance testing shows that a custom designed propeller has a significantly higher Figure of Merit (FOM) when compared to an APC propeller with the same number of blades, equivalent blade diameter and thrust vs. RPM profile, the required power input is reduced.

# Advanced Aircraft Analysis (AAA)

Advanced Aircraft Analysis (AAA) 5.0 can Design and Analyze:

- Distributed Electric Propulsion (DEP) aircraft
- Tilt-wing VTOL configurations
- Uncrewed very small aircraft
- Uncrewed large aircraft
- Mixed propulsion aircraft (propeller or jets, hybrid-electric)



Three-surface aircraft

You can bypass AAA calculations and use data from Computational Fluid Dynamics (CFD) tools or wind tunnel-flight test data and use this higher fidelity data in trim, flying qualities analyses in AAA.

AAA is an excellent aircraft data organizer with detailed tracking of configuration setup. All data is organized by flight condition dependent and flight condition independent data. The user can change the default settings for flight condition dependency. This makes analyzing different conditions such as cruise at forward center of gravity, aft center of gravity, landing condition, climb condition very straight forward and organized.

You can recalculate a series of calculations in the Recalculate Window and export selected data to spreadsheets or text files.

The AAA 5.0 Reader is now available! The Reader is free and allows the user to view a AAA file for review.

AAA 5.0 Reader

**Request Software Pricing** 

**On-line** Training

## **Special Visitor from the Consulate General of the Netherlands**



During his official visit to Kansas, the Consul General of the Netherlands, Bart Twaalfhoven, stopped at the DARcorporation office to speak with Dr. Willem Anemaat, the President and Co-founder of DARcorporation. More than 6,000 jobs have been supported by the Dutch-American trade and investment in Kansas.

Read more on our News Page

### Join us at AIAA SciTech 2023 National Harbor, MD January 23-27

#### DARcorporation will be presenting a paper at SciTech

**Title:** Multhopp's Method for the Pitching Moment of Bodies Revisited

Authors: Bruno Moorthamers, Willem Anemaat

**Session:** ACD-01, Aero-Propulsive Analysis Methods, January 23, 2023 from 9:30 AM to 11:10 AM Eastern Time, Woodrow Wilson A

## **Consulting Support Engineers**

We understand the current engineering job market is tight and finding engineering talent can be difficult. DARcorporation engineers can temporarily fill open jobs until a permanent solution can be found or the job is finished.

DARcorporation engineers are experienced in:

- Aircraft Conceptual and Preliminary Design
- Computational Fluid Dynamics
- Structural Analysis and Structural Dynamics
- Propulsion System Design
- Propeller, Rotor and Ducted Fan Design
- 3D CAD
- Propulsion System Testing (Performance and Acoustics)
- Flight Testing

Contact DARcorporation



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