

**STAFF SUMMARY SHEET**

	TO	ACTION	SIGNATURE (Surname), GRADE AND DATE		TO	ACTION	SIGNATURE (Surname), GRADE AND DATE
1	USAFA/DFAN	sig	<i>Robert M. Cuning</i> HEAD 24 APR 2014	6			
2	USAFA/DFER	approve	S-LT-I, AD-22, 25 APR 14	7			
3	USAFA/DFAN	action	(Author / Originator)	8			
4				9			
5				10			

SURNAME OF ACTION OFFICER AND GRADE	SYMBOL	PHONE	TYPIST'S INITIALS	SUSPENSE DATE
Coley, O-3	USAFA/DFAN	333-9223	cjc	20140502

SUBJECT	DATE
Clearance for Material for Public Release USAFA-DF-PA- 297	20140424

**SUMMARY**

1. **PURPOSE.** To provide security and policy review on the document at Tab 1 prior to release to the public.

2. **BACKGROUND.**

Authors: Michael Young, Christopher Coley, Andrew Lofthouse

Title: DAAC Gallery Project Writeup

Circle one: Abstract    Tech Report    Journal Article    Speech    Paper    Presentation    Poster

Thesis/Dissertation    Book    Other: \_\_\_\_\_

Check all that apply (For Communications Purposes):

CRADA (Cooperative Research and Development Agreement) exists

Photo/ Video Opportunities     STEM-outreach Related     New Invention/ Discovery/ Patent

Description: Description of CFD research and visualizations developed using the DoD HPCMP's secure remote desktop utility


Release Information: Dod HPCMP Data Analysis and Assessment Center (<https://devdaac.arl.hpc.mil/index.html>)

Previous Clearance information: None

Recommended Distribution Statement: Distribution A, Approved for Public release, distribution unlimited.

3. **DISCUSSION.** N/A

4. **RECOMMENDATION.** Sign coord block above indicating document is suitable for public release. Suitability is based solely on the document being unclassified, not jeopardizing DoD interests, and accurately portraying official party.

CHRISTOPHER J. COLEY, Capt, USAF  
Deputy Director, High Performance Computing Research Center

1 Tabs  
DAAC Gallery Project Writeup

## Simulation Details:

The US Air Force Academy, alongside organizations from nations partnering in a NATO Task Group, contributes to evaluating the state-of-the-art of computational aerodynamics by applying computational fluid dynamics to a generic UCAV configuration known as SACCON (Stability And Control CONfiguration). The objective of the task group is to determine an overall strategy for creating stability and control databases for vehicle simulation at full-scale conditions, including the deflection of control surfaces, throughout the operational envelope of the vehicle. The aim of these simulations was to validate the CFD results against wind tunnel data obtained by DLR, the German Aerospace Center. Available experimental data included force and moment coefficients, and surface pressure coefficients at various cuts through the fuselage and wings.

The SACCON model has a reference chord length of 0.479m and a wingspan of 1.538m. It is a swept wing flying wing configuration typical of the next generation UCAVs currently under development. The tests were conducted at approximately 50 m/s giving a Reynolds number of 1.57 million. The flowfield for this configuration at even moderate angles of attack is dominated by the vortices shed from the leading edge.

The full-span grid has up to ~150 million cells, with very high resolution close to the leading edge--in order to resolve the initiation of the vortices, and downstream of the wing--in order to resolve the off body vortices that arise at higher angles of attack.

The CFD codes applied to this problem include Cobalt and Kestrel. The HPCMP resource used was the ERDC's Garnet machine. Typical simulations of the full-span configuration run on 5120 nodes over 24 hours to generate 0.2 seconds of flight time.

## Visualization Details:

Visualization is the key to understanding the phenomena that occurs in the flowfield about the air vehicle. In particular, we are interested in the distribution of pressure across the surface, but also understanding how vortices form off the leading edge of the wing and evolve and interact downstream, affecting the pressure distribution and therefore the forces and moments experienced by the air vehicle.

Several visualization techniques have been used. One of the images at right shows an isosurface of vorticity-magnitude colored by velocity-magnitude. The plan view images show contours of surface pressure coefficient along with streamtraces seeded close to the leading edge. This allows one to get a sense of the behavior of the vortices. Such visualizations are repeated at different angles of attack to help explain the observed changes in forces and moments.

This project has both large grids and a large number of flight conditions to analyze: static angle of attack and angle of sideslip sweeps, and dynamic motion about the pitch and yaw axes. All this adds up to a large quantity of data to post-process. The secure remote desktop (SRD) system supported by DAAC has been critical in enabling efficient post-processing of this large volume of data. Rather than downloading

the data down to a local machine, it can be passed to the utility servers and post-processed “in the cloud” via the SRD interface. While there are many software options for providing visualization available on SRD, we chose to use Tecplot for the majority of our visualizations in order to be consistent with visualizations provided by other institutions from partner nations.

