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14. ABSTRACT

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RPPR Final Report
as of 14-Mar-2023

Agency Code: 21XD

Proposal Number: 78123RTREP

Agreement Number: W911NF-21-1-0168

INVESTIGATOR(S):

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Report Date: 25-Jul-2022

Date Received: 17-Jan-2023

Final Report for Period Beginning 26-Apr-2021 and Ending 25-Apr-2022

Title: Acquisition of Instrumentation to Investigate Wake-Vortex Interactions

Begin Performance Period: 26-Apr-2021

End Performance Period: 25-Apr-2022

Report Term: 0-Other

Submitted By: Mohammad Khan

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Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees:

STEM Participants:

Major Goals: The project has the following major goals.

Procurement and installation of a four-camera VPIV system

Procurement and installation of a 1ft x 1ft x 2ft low speed open circuit wind tunnel

Accomplishments: The four-camera VPIV system was procured, installed, and commissioned. It is functional and is being used for research.

The 1ft x 1ft x 2ft low speed open circuit wind was procured and commissioned. It is currently being used for research and undergraduate instruction.

Training Opportunities: Two graduate students were trained in the VPIV system

Two undergraduate students were trained on the wind tunnel.

Results Dissemination: One research paper will be presented at the AIAA SciTech Conference in Jan 23-27, Baltimore, MD

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: PD/PI

Participant: Mohammad Javed Khan

Person Months Worked: 1.00

Project Contribution:

National Academy Member: N

Funding Support:

RPPR Final Report
as of 14-Mar-2023

Participant Type: Graduate Student (research assistant)
Participant: Antoine Smith
Person Months Worked: 12.00
Project Contribution:
National Academy Member: N
Funding Support:

Participant Type: Graduate Student (research assistant)
Participant: Hakeem Balogun
Person Months Worked: 12.00
Project Contribution:
National Academy Member: N
Funding Support:

Participant Type: Undergraduate Student
Participant: Khalil Escoe-Brown
Person Months Worked: 1.00
Project Contribution:
National Academy Member: N
Funding Support:

Participant Type: Undergraduate Student
Participant: Jonathan Dixon
Person Months Worked: 1.00
Project Contribution:
National Academy Member: N
Funding Support:

Partners

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I certify that the information in the report is complete and accurate:
Signature: Mohammad Javed Khan
Signature Date: 1/17/23 11:58PM

Final Report

W911NF-20-3-0010: DOD Research and Education Program for Historically Black Colleges and Universities and Minority Serving Institutions (HBCU/MSI) Equipment/Instrumentation

W911NF2110168 / 78123-RT-REP
Acquisition of Instrumentation to Investigate Wake-Vortex Interactions

January 17, 2023

PI: Dr. Mohammad Javed Khan

**Aerospace Science Engineering Department,
Tuskegee University**

Introduction

A four-camera VPIV system upgrade was procured under the grant. This instrumentation is being used for the study of wake-vortex interactions. Two specific phenomena are currently being studied using the procured instrumentation. The first phenomenon is the vortex breakdown over slender and non-slender delta wings and interactions with simulated thrust vectoring jets. The second phenomenon planned for study is a distributed propulsion configuration and its interaction with leading edge vortices on slender and non-slender delta wings. There is limited archival research available on such a closely coupled flow field using VPIV systems. The current thrust towards unmanned combat aerial vehicles (UCAV) which have delta wing configurations and distributed propulsion configurations further increases the need to understand this closely coupled phenomenon.

Procurement Timeline

The grant approval was received with the period of performance of April 26, 2021 - April 25, 2022.

The VPIV equipment procurement, receipt, installation, and commissioning timeline (documented via emails) is as follows:

- (a) Subsequent to administrative processing and establishment of the grant account and equipment quotes, the purchase order for the VPIV system upgrade was processed and provided to the vendor TSI Inc. on June 2, 2021.
- (b) Equipment delivery update was requested from the vendor on August 8, 2021. However, no delivery date was provided due to non-availability of certain parts/components.
- (c) The equipment was received on November 5, 2021. The vendor team was unable to travel to commission the equipment.
- (d) The vendor commissioning team finally arrived on March 3, 2022. It was realized by the vendor that one component of the system (synchronizer) was not compatible. The vendor commissioned the system using a loaner component which was retrieved by the vendor after the commissioning.
- (e) A new PO was raised to procure a compatible synchronizer unit. The vendor did not have a unit available in inventory. Finally, a loaner unit was provided on September 6, 2022, which did not work. Another loaner unit was provided on September 13, 2022.
- (f) The synchronizer unit was finally received on November 7, 2022.

The procurement, receipt, installation, and commissioning timeline (documented via emails) for the 1ft x 1ft x 2ft open circuit low speed wind tunnel is as follows:

- (a) Purchase order was received by the vendor (AeroLab) on June, 10, 2021
- (b) The equipment was delivered on October 27, 2021. Due to the pandemic, there were challenges in travel by the vendor.

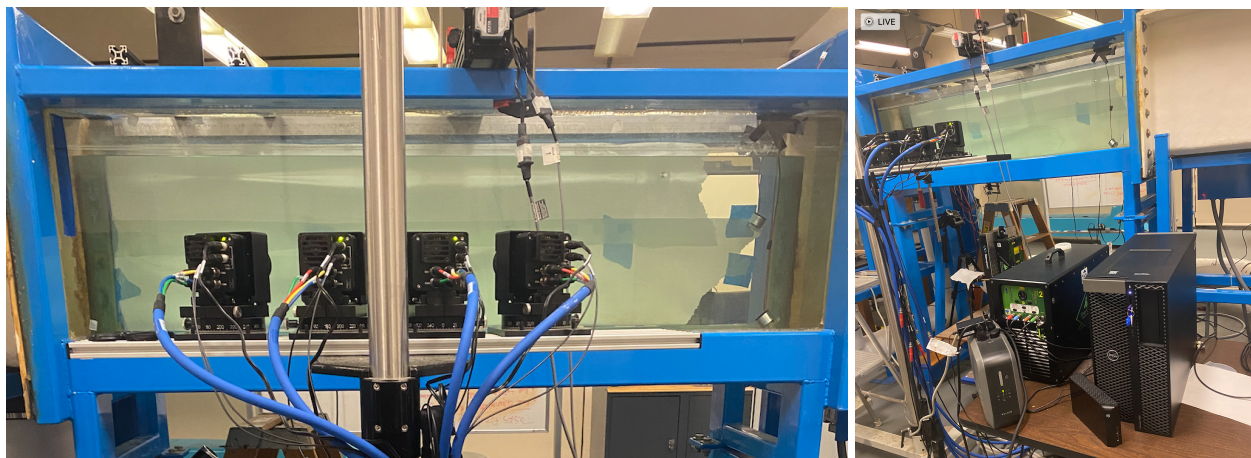
Current Status

The four-camera VPIV is currently fully functional and one graduate student is working on his master's thesis. A paper "Characterization of the flow field of slender delta wings with trailing edge jets using volumetric PIV" will be presented at the AIAA SciTech Conference in Baltimore, MD, January 23-27.

The wind tunnel is commissioned and is currently being used by the undergraduate students. A team of undergraduate students is using to conduct research on the wake of a surface-modified circular cylinder through wake-velocity surveys. This will be followed by VPIV measurements. The students will be presenting their work at the regional AIAA Student Conference.



Low Speed Open Circuit Wind Tunnel



Four-camera VPIV System