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The views, opinions and/or findings contained in this report are those of the author(s) and should not contrued as an official Department of the Army position, policy or decision, unless so designated by other documentation.

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RPPR Final Report
as of 19-Dec-2019

Agency Code:

Proposal Number: 72040EGRIP **Agreement Number: W911NF-18-1-0190**
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Report Date: 23-Aug-2019 Date Received: 23-Aug-2019
Final Report for Period Beginning 28-May-2018 and Ending 23-May-2019
Title: Acquisition of a tomographic PIV system for enhancement of flow-structure interaction studies
Begin Performance Period: 28-May-2018 **End Performance Period:** 23-May-2019
Report Term: 0-Other

Submitted By: Ahmed Naguib Email: naguib@msu.edu
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Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees: 0 **STEM Participants:** 3

Major Goals: The primary goal of this equipment grant is to acquire, commission and train junior and senior researchers on the use of a tomographic Particle Image Velocimetry (tomo-PIV) system for volumetric measurements of three components of velocity within flow fields.

Accomplishments: The target tomo-PIV system was purchased and delivered before the end of 2018. The system, which was ordered from LaVision, was set up with the help of Dr. Douglas Neal from LaVision for use with a 15 cm x 15 cm water tunnel by March of 2019. Subsequently, the functionality of all components was checked by Dr. Neal in collaboration with two postdocs of the PIs. Dr. Neal also conducted a full-day training session in March 2019 on the use of the hardware and the software of the tomo-PIV system. A few graduate students, postdocs and the lead PI (Naguib) attended the training. Presently, the system is being used to measure the near-wake flow field of a cylinder with surface topology (see uploaded file for a brief description of the setup with images). These measurements are intended to enhance the outcome of an army-funded project that is motivated by understanding flow-induced vibrations of the suspension lines of Precision Air Drop Systems (Grant number W911NF-17-1-0153). This project is also partially funded by U.S. Army CCDC-Soldier Center.

Training Opportunities: Three PhD students, Two postdocs and the lead PI (Naguib) were trained on the use of the acquired state of the art velocity-field-measurement equipment. The system will enhance the learning of future graduate and undergraduate students through demonstrations in our experimental fluid mechanics course, and the use of the equipment in research.

Results Dissemination: This is an equipment acquisition grant that is not expected to lead to direct publications on the purchased equipment. However, publications are expected in the future of research enabled by the DURIP equipment. The DURIP support will be acknowledged in these publications.

Honors and Awards: Nothing to Report

Protocol Activity Status:

RPPR Final Report
as of 19-Dec-2019

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: PD/PI
Participant: Ahmed M. Naguib
Person Months Worked: 1.00 **Funding Support:**
Project Contribution:
International Collaboration:
International Travel:
National Academy Member: N
Other Collaborators:

Participant Type: Co PD/PI
Participant: Manoochehr M. Koochesfahani
Person Months Worked: 1.00 **Funding Support:**
Project Contribution:
International Collaboration:
International Travel:
National Academy Member: N
Other Collaborators:

Participant Type: Postdoctoral (scholar, fellow or other postdoctoral position)
Participant: Mark Feero
Person Months Worked: 1.00 **Funding Support:**
Project Contribution:
International Collaboration:
International Travel:
National Academy Member: N
Other Collaborators:

Participant Type: Postdoctoral (scholar, fellow or other postdoctoral position)
Participant: David Olson
Person Months Worked: 1.00 **Funding Support:**
Project Contribution:
International Collaboration:
International Travel:
National Academy Member: N
Other Collaborators:

Final Report Addendum
Description of the Tomo-PIV System

This addendum contains a brief description of the tomo-PIV system as currently installed for measurements in a 15 cm × 15 cm, closed-return water tunnel. The setup is designed to measure the three-dimensional velocity field in the near wake of a rectangular cylinder having surface topology. Figure 1 illustrates the experimental setup with focus on the imaging system and the test section of the water tunnel. Figure 2 provides details of the laser light shaping and steering to illuminate a rectangular volume downstream of the cylinder model. Figure 3 depicts the remaining components of the tomo-PIV system used for measurements in the water tunnel. There are additional system components that are acquired with the present DURIP grant's funding but are not seen in the figures. These components are required for measurements in air flows.

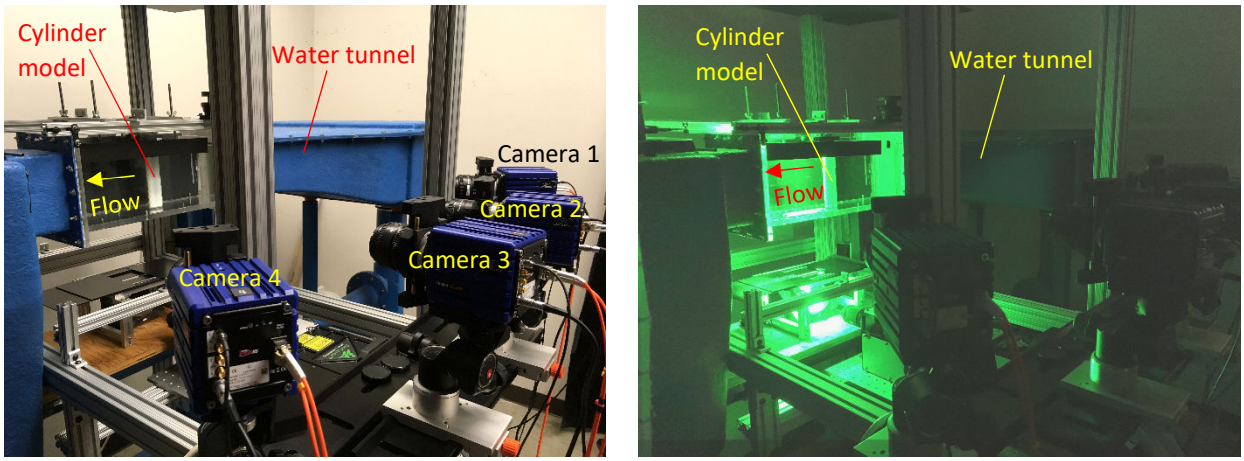

Fig 1. Images of the experimental setup for measurement of the three-dimensional velocity field in the near wake of a cylinder with surface topology using the tomo-PIV equipment acquired with DURIP funding. The image on the left shows the four-camera system used to capture images of particles within a laser-lit volume downstream of the cylinder (seen in the right image).

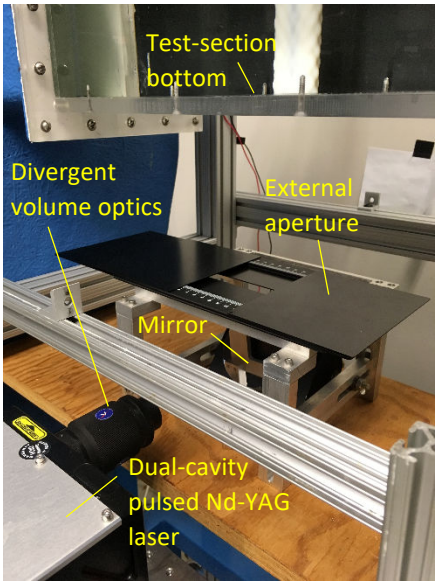

Fig 2. Setup image showing the laser light source, the optics used to create the divergent laser volume, the aperture employed to make the laser volume shape rectangular, and the mirror used to steer the laser light into the test section.

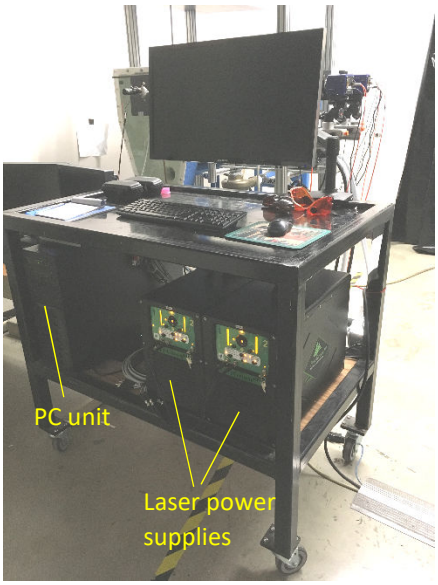

Fig 3. Steel cart used to carry the remainder of the tomo-PIV system components: the laser power supplies, the central timing unit (not shown in the image), and the PC unit hosting the data acquisition and analysis software.