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RPPR Final Report
as of 22-Sep-2021

Agency Code: 21XD

Proposal Number: 74349CSREP

Agreement Number: W911NF-19-1-0441

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Report Date: 31-Aug-2021

Date Received: 20-Sep-2021

Final Report for Period Beginning 01-Sep-2019 and Ending 31-May-2021

Title: Acquisition of Advanced Robotics and Autonomous Vehicle Technology (ARAVT) for Research in Smart Grid Systems, Teaching, and K-12 Outreach at the University of the District of Columbia

Begin Performance Period: 01-Sep-2019

End Performance Period: 31-May-2021

Report Term: 0-Other

Submitted By: Jiajun Xu

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

STEM Degrees:

STEM Participants:

Major Goals: Background:

The University of the District of Columbia (UDC) is an urban land-grant/HBCU institution and the only public university in the nation's capital. The University offers associate, baccalaureate, and graduate degrees through its six colleges and schools: the UDC Community College (UDC-CC), the College of Arts and Sciences (CAS); the College of Agriculture, Urban Sustainability and Environmental Sciences (CAUSES); the School of Business and Public Administration; the School of Engineering and Applied Sciences (SEAS); and the David A. Clarke School of Law.

The total enrollment at UDC is approaching 6,000: nearly 80% are underrepresented minorities, 60% are women, 50% are non-traditional or part-time students, 15% are international students, and 10% are graduate or law students. The mission of the University is to provide affordable post-secondary education that prepares students—especially District of Columbia residents—for immediate entry into the workforce, the next level of education, specialized employment opportunities, and life-long learning. The vision of the University is to be a diverse,

RPPR Final Report as of 22-Sep-2021

selective, teaching, research, and service university in the land-grant tradition, serving the people of Washington, DC, the nation, and the world.

The acquisition of the ARAVT allows UDC to establish itself as:

- a) A lead HBCU institution in advanced robotics research and education
- b) A collaborator for novel research and educational development between aerospace, defense, and energy sectors.

For the past four years, the enrollment at UDC SEAS has increased over 100% and is expected to grow at this rate for the next 5 years. To prepare a more qualified future workforce, especially for the robotics and defense industry. UDC is requesting ARO support to acquire the proposed Advanced Robotics and Autonomous Vehicle Technology (ARAVT) system for various research and education activities.

The proposed equipment will allow UDC faculty researchers to meet the following objectives:

- a) Invest in state-of-the-art advanced robotics and autonomous vehicles research lab to allow UDC's faculty to conduct sophisticated research, train undergraduate and graduate students, conduct outreach activities, and disseminate the results through publications and conferences.
- b) Investigate and validate the methodology of battery-powered flying robots that are performing all types of non-lethal tasks such as flying over solar as well as onshore and offshore wind farms to look for maintenance issues, inspecting electric transmission lines especially for those lines which are stretched over untracked terrains like deserts and mountains, and monitoring threats at strategic observation areas.
- c) Investigate and jumpstart Autonomous Vehicle Research & Teaching Studio (AVRTS) which involves autonomous robotics research involving QDrone quadrotors and QBot 2 ground vehicles, stationary Gimbal validation platform for the Qdrone, ground control station, vision, and safety equipment.

Accomplishments: As soon as we received the grant in 2019, we worked on securing a safe and viable laboratory space. The University is committed to this project and allocated just before the COVID-19 pandemic, as an in-kind contribution, a 1200 sq. ft laboratory space for the Advanced Robotics and Autonomous Vehicle Lab. The Lab renovation work was completed by campus Facilities in June of 2021 and the IT completed the internet network in July 2021.

Further, work on equipment installation was disrupted and hampered from what was originally planned due to the COVID-19 outbreak, and due to suspension of physical access to the University campus. Since the lockdown in March 2020, the University reopened for face-to-face instructional mode on August 16, 2021. Since last month, we have been back on campus. The PI and other investigators are all anxious to deploy and move the project along, by planning and implementing every aspect of the activities in order to adhere to the terms of the grant.

Quanser company (equipment supplier from Canada), will be installing the major part of the Laboratory equipment and provide training to faculty and staff at UDC (as per the original contract). Quanser has faced travel restrictions from Canada to come to the United States. We are in frequent contact with the Quanser team. Quanser is providing guidance on the installation of the Robotic Arm, virtually, to incorporate control laboratory assignments for Junior and Senior Mechanical and Electrical Engineering students this academic year. They will be visiting us as soon as the travel restriction is lifted, to help us do the final installation.

Because of the above reasons, we were unable to show the complete progress report in the final format by August 31st, this has caused the delay. In light of the above and recent changes in the UDC campus, we expect speedy progress in the next month.

We are requesting DoD to grant us additional time till December 2021 so that the final report can be uploaded to the website by December 31st.

RPPR Final Report

as of 22-Sep-2021

Training Opportunities:

The onsite equipment set-up and training will be provided by the vendor (Quanser) based on the contract 1718-3241-D issued February 13th, 2020, for the following:

- 1- Qdrone UAV
- 2- Qbo2 UGV
- 3- Gimbal Platform for Qdrone
- 4- Optitrak Localization Camera System
- 5- Quanser 6 DOF JCR Robot Manipulator
- 6- QUARC real-time software
- 7- Pre-configured ground control station comprised of pre-configured PC with software, wifi router, monitors.

Because of the COVID-19, we have not started setting up the equipment and having the training yet. As soon as the travel restriction is removed, the vendor will send the trainers to UDC to do the installation and provide training for the faculty.

All the equipment shipments have been received from the vendor.
The reference on contract 1718-3241-D is uploaded.

Results Dissemination: Nothing to Report

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: PD/PI

Participant: Amir Shahirinia

Person Months Worked: 1.00

Project Contribution:

National Academy Member: N

Funding Support:

Participant Type: Co PD/PI

Participant: Devdas Shetty

Person Months Worked: 1.00

Project Contribution:

National Academy Member: N

Funding Support:

Participant Type: Co PD/PI

Participant: Esther Ososanya

Person Months Worked: 1.00

Project Contribution:

National Academy Member: N

Funding Support:

Participant Type: Co PD/PI

Participant: Wagdy Mahmoud

Person Months Worked: 1.00

Project Contribution:

National Academy Member: N

Funding Support:

RPPR Final Report
as of 22-Sep-2021

Participant Type: Co PD/PI

Participant: Jiajun Xu

Person Months Worked: 1.00

Project Contribution:

National Academy Member: N

Funding Support:

Partners

,

I certify that the information in the report is complete and accurate:

Signature: Amir Shahirinia

Signature Date: 9/20/21 1:40PM

QUOTATION

Number: 1718-3241-D

Date of Issue: February 13, 2020



Quanser Consulting Inc.

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ALL PRICES IN USD UNLESS SPECIFIED OTHERWISE

Prepared for:

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SALESPERSON	DOCK DATE (From receipt of P.O.)	SHIPPING VIA	SHIPPING TERMS (Exclusive taxes, duties and brokerage)	PAYMENT TERMS
Arian Panah	100-120 days	FedEx	FCA	Net 30

QTY	DESCRIPTION	UNIT COST	TOTAL USD
Turnkey Autonomous Vehicles and Robotics Research & Teaching Laboratory			
1	Turnkey Autonomous Vehicles Research and Teaching Studio with open architecture software environment This turnkey package comes with everything required to do indoor autonomous vehicles research & teaching out of the box. STUDIO INCLUDES: - 10x QDrone - The Quanser QDrone autonomous air vehicle, is a midsized quadrotor equipped with a powerful on-board Intel® Aero Compute Board, multiple high resolution cameras and built-in WiFi. This open-architecture research-grade drone is tuned to accelerate research and is ideal for innovative multi-agent, swarm and vision-based applications. (\$15,500/unit price) - 10 Gimble platforms to mount and test drone before full flight (\$7200/unit price) - 10x QBot2 - The Quanser QBot 2 is an innovative open-architecture autonomous ground robot, equipped with built-in sensors, and a vision system. (\$4800/unit price) - 1x Ground Control Station (High performance computer, 3x Monitors, High performance router, USB flight controller) (\$6840) - 10x QUARC Licenses - Real Time Control Software with blocksets (\$1200/unit price) - 12 x Natural Point Optitrack Flex 13 Localization Cameras (\$33160) - Protective Netting, matts package (\$1200) * Nominal Space required in meters: 7x7x2 *2 years extended warranty provided	\$328,200.00	\$328,200.00
2	6DOF - Quanser Joint Control Robot (Q-JCR 6D) Package includes: - 6 DOF serial manipulator with 2-finger gripper - Torque and Joint Control Capabilities for Research Applications - RS-485 serial card - 1x single-user license QUARC 2.6 Real Time Control Software with Kinova Blockset - resources: Quick Start Guide, User Manual, Laboratory Guide, pre-designed controllers for simulated and actual robot arm.	\$76,450.00	\$152,900.00
1	Quanser engineer to come onsite and conduct training/commissioning of equipment Quanser engineer to come onsite for 2 days to assist with start-up and commissioning of equipment and provide training.	\$3,300.00	\$3,300.00
SUB-TOTAL			\$484,400.00
SPECIAL EDUCATIONAL DISCOUNT (20%)			-\$102,160.00
SUB-TOTAL			\$382,240.00

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QUOTATION

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SHIPPING AND INSURANCE	\$9,556.00
TOTAL	\$391,796.00
	E.&E.O.

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TERMS & CONDITIONS

1. Payment: Payment terms are as described in the quotation under consideration, time to be of the essence.

2. Entire Agreement: It is agreed that should the Purchaser use its own form of purchase order for ordering items from Quanser, all sales to the Purchaser shall be subject to all provisions of this Agreement and to the trade terms of Quanser then in effect. Any provision of such purchase order which is inconsistent with the provisions of this agreement or such trade terms, or which imposes any greater burden upon Quanser than the obligations set forth in this document, or which confers on the Purchaser additional rights shall be of no effect whatever unless expressly accepted by Quanser in writing specifically referring to the inconsistency, added burden or additional rights and specifically stating that such provision will govern. If any provision herein is deemed unenforceable for any reason, the remainder of these Terms & Conditions shall continue in full force and effect as if the unenforceable provision had not been included.

3. Purchaser Stipulations: PURCHASER ACKNOWLEDGES TO QUANSER THAT PURCHASER HAS STIPULATED THE SPECIFICATIONS FOR THE PRODUCTS TO BE SUPPLIED BY QUANSER TO THE PURCHASER (" P R O D U C T S ") AND THE PURCHASER IS NOT RELYING ON QUANSER WITH RESPECT TO THE FITNESS OR SUITABILITY OF THE PRODUCTS FOR THE PURCHASER'S INTENDED PURPOSES. Purchaser specifically agrees to indemnify, defend, and save harmless Quanser, its parents, subsidiaries, and affiliated companies, and their respective officer, directors, employees and agents ("Indemnified Parties") against any claims of any kind or nature, including any claims in contract, by tort or under any statutory provisions, by any person, for any cause or matter in any way referable to Purchaser's use of the Products, including any claims for damages to persons or property or for consequential or economic losses or damages and whether or not such damages are attributable to negligence or gross negligence by Quanser or any other Indemnified Party, or for any other reason.

4. Purchaser Acceptance: Purchaser acknowledges and agrees with Quanser that by accepting delivery of the Products, Purchaser has inspected the Products and confirmed that they meet the Purchaser's specifications in all respects and have been delivered in good order and condition in accordance with the purchase order and the invoice.

5. Proper Use of Products: Purchaser warrants and represents that it: (a) is familiar with the proper operating instructions for the Products, as well as all federal, state, provincial, and local laws and regulations relating to the operation and safe and proper use of the Products; and (b) will comply at all times with all such instructions, laws and regulations. Purchaser acknowledges and agrees that, in the event of any failure to so comply: (a) any warranty on the Products is voided; and (b) Purchaser will indemnify, defend, and hold harmless the Indemnified Parties from and against any and all losses, costs, expenses, or damages, including but not limited to reasonable attorneys' fees, incurred as result of such failure.

6. Limited Warranty/Liability: Quanser warrants its Products for a period of 1 calendar year from the date of this invoice to be free of defects in workmanship and materials. Quanser's only liability under this warranty shall be to repair, and if necessary, in Quanser's sole discretion, to replace the defective product. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED (INCLUDING ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR NON-INFRINGEMENT), OR CONDITIONS WHETHER STATUTORY OR OTHERWISE, ARE EXPRESSLY EXCLUDED. In any event, the Quanser's liability, and the liability of any other Indemnified Party, for any cause or damage relating in any way to the Products, and regardless of the form of action, whether in contract or in tort including negligence or gross negligence, shall be limited to the LESSER of the Purchaser's direct damages and the amount paid by the Purchaser in respect of the applicable Product. This exclusion of liability and limitation of liability is an essential part of these Terms and Conditions without which Quanser would not be willing to sell Products to Purchaser, and it shall apply regardless whether (a) such damages may be characterized as arising from a breach of a fundamental term or otherwise, or (b) the remedies herein otherwise would be deemed to fail of their essential purpose. In no event shall Quanser be liable for any consequential damages or damages for loss of profits or other economic losses of any kind or nature whatsoever, even if advised of the possibility of such damages or losses.

7. Delay, etc.: The failure to take any action with respect to, nor the waiver of, any default by either Quanser or the Purchaser shall not affect such person's rights nor obligations with respect to such default nor any other default. Quanser shall not be liable for delay or failure in performance resulting from acts beyond the control of Quanser, unless by reason of Quanser's own negligence provided that where Quanser claims to be excused by reason beyond Quanser's control Quanser shall, however, use reasonable diligence to put Quanser again in a position to carry out the Quanser's obligations.

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8. Disputes: These Terms and Conditions, along with any disputes of any kind whatsoever between Quanser and Purchaser are governed by the internal laws of the Province of Ontario, Canada, without regard to principles of conflicts of laws, and specifically excluding the United Nations Convention on the International Sale of Goods. Any disputes shall be resolved solely via commercial arbitration to be conducted in Toronto, Ontario, Canada.

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