Coastal Virginia Center for Cyber Innovation (COVA CCI)

Annual Report

Reporting Period: July 2022 – June 2023

July 31, 2023

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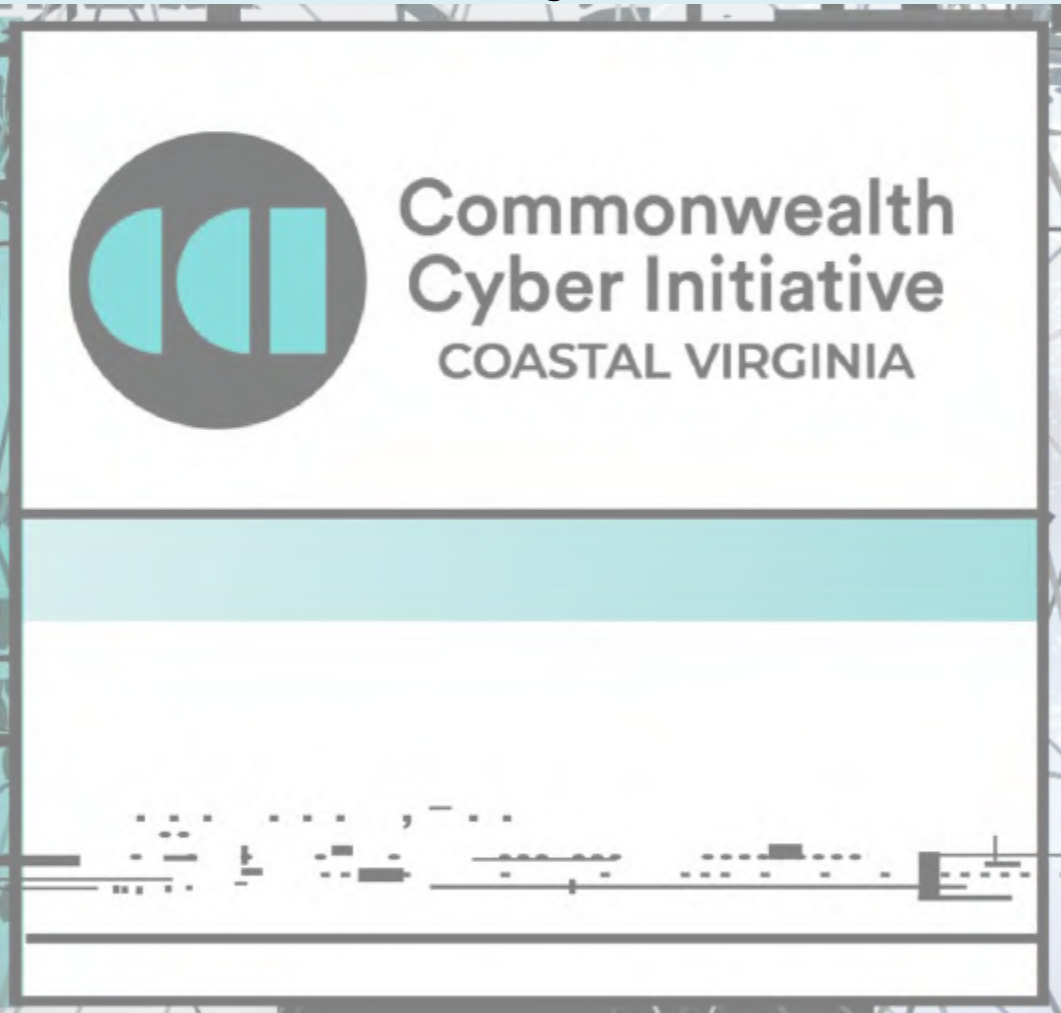

Commonwealth Cyber Initiative
COASTAL VIRGINIA

The Commonwealth Cyber Initiative CoVA CCI

Annual Update

Reporting Period: July 2022 – June 2023

About COVA CCI

Virginia's Commonwealth Cyber Initiative (CCI) aims to create a Commonwealth-wide ecosystem of innovation excellence in cyber-physical systems (CPS) with an emphasis on trust and security. Certified as one of the four nodes of CCI, the Coastal Virginia Center for Cyber Innovation (COVA) seeks to:

- conduct fundamental research in cyber physical systems security (CPSS), artificial intelligence, and 5G contributing to the CCI mission of establishing Virginia as a global leader in secure CPS and in the digital economy,
- foster and accelerate commercialization of CPSS innovation to grow and diversify the Virginia cyber economy,
- expand and diversify the cybersecurity talent pipeline through investments in research capabilities and commercialization efforts, and
- build a collaborative network within the region of educational institutions, businesses, and local, state, and federal agencies, and with the other CCI nodes.

Under these overarching goals, COVA CCI is developing and launching diverse programs, ranging from cybersecurity research and commercialization to the creation of the Cyber Innovation Park.

COVA CCI created a network of faculty and researchers representing the region's community colleges and universities. These educational partners include Christopher Newport University, Norfolk State University, Old Dominion University, William & Mary, Regent University, ECPI University, Eastern Shore Community College, Paul D. Camp Community College. Tidewater Community College, and Virginia Peninsula Community. COVA CCI is also partnering with industry and government agencies such as CISCO, G2Ops, Huntington Ingalls Shipbuilding, KBRWyle, MITRE, MI Technical Solutions, Peregrine Technical Solutions, Sentara Healthcare, US Navy, and 360IT.

Commonwealth Cyber Initiative
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Commonwealth Cyber Initiative
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Summary of Accomplishments for FY 2023

COVA CCI focus during the FY 2023 (July 2022 – June 2023) was on continuing the funded cybersecurity research projects, initiating selected CCI Collaboration Research projects, and supporting sponsored activities.

1. Awarded over $6.4 million dollars to COVA CCI academic institutions in cybersecurity grants from government and private industry.
2. Awarded seven projects under the COVA CCI Research programs in FY 2023 totaling $581,000 and continued to support the seven funded programs from FY 2022 in the amount of $880,000.
3. Received over $5.1 million dollars from CCI sponsored programs and research since 2020.
4. Hosted the inaugural COVA CCI CybER CON in September 2022 and supported the 2nd annual Coastal Virginia Cybersecurity Student Association (CVCSA) first Capture-the-Flag event, CyberForge in March 2023.
5. Selected sixteen (16) graduate students to participate in the Cyber Experiential Learning (CyberExL) program. A total of 53 students representing four institutions completed this program since January 2020.
6. Selected 35 students to participate in the Cybersecurity Undergraduate Research Program during the year (Fall 2022 and Spring 2023). A total of 82 students from 7 institutions have completed this program since January 2020.
7. Selected forty-five students from seven universities and colleges to participate in the Spring 2023 cohort of Innovate Cyber Challenge. A total of 143 students from 15 institutions have been supported since the inception of this program in January 2022.
8. Continued the use of the Shared Collaborative Research Computing Environment (COVA SHARE) and supported projects in this environment.
9. Developed a regional network of over 100+ researchers, faculty, and business partners working for eight colleges/universities and 20+ businesses.

FY 2023 ACCOMPLISHMENTS

$6.4 million in external research grants.

$5.1 million from CCI funded programs and research.

$581,000 in COVA CCI awarded research projects.

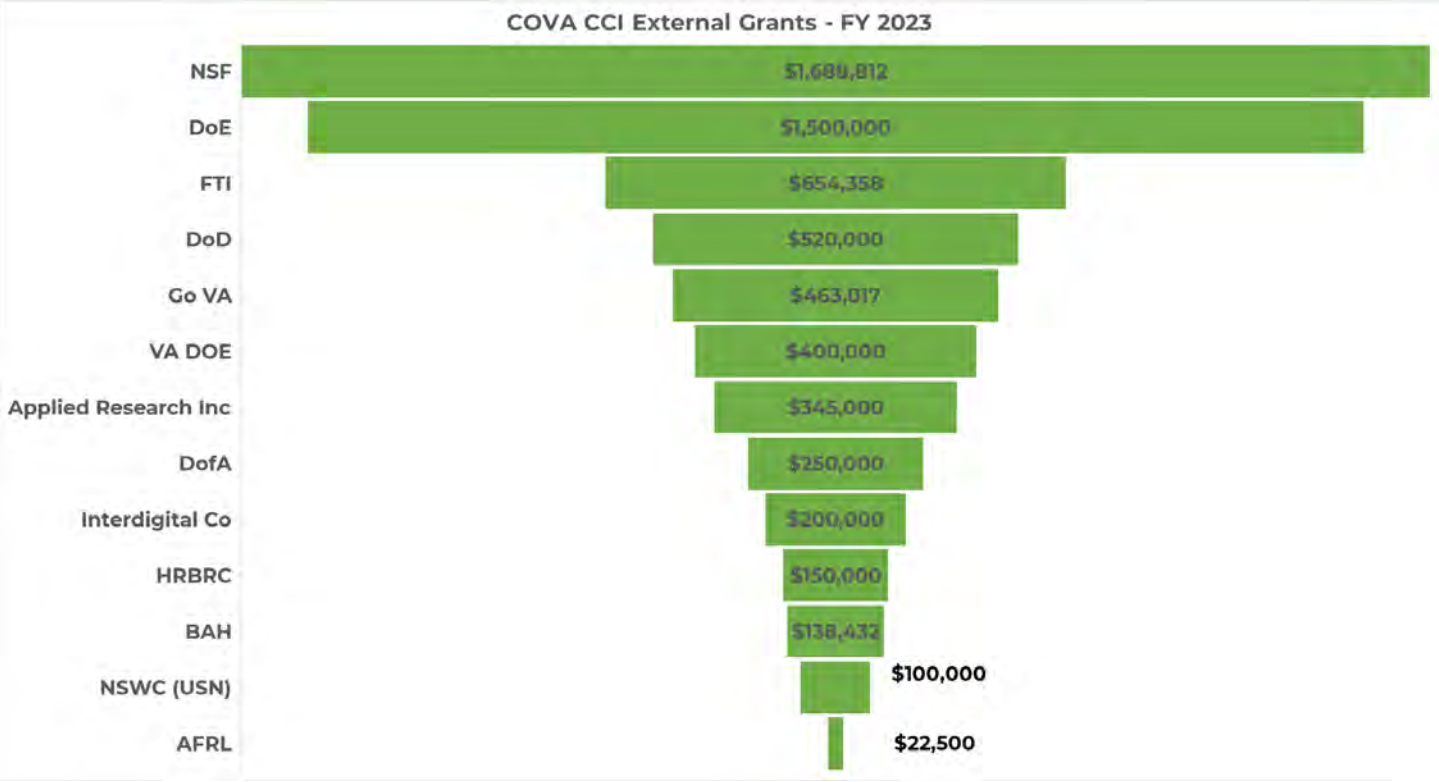
360+ students supported since

Update on the Seven Requirements

1. External Research Grants Attracted to Support the Work of CCI

During FY 2023, researchers associated with COVA CCI received $6,432,119 in external grant funding from multiple public and private organizations.

Dr. Sachin Shetty, Director of the Center for Secure and Intelligent Critical Systems, Virginia Modeling, Analysis, and Simulation Center, Old Dominion University and former CCI Fellow, has leveraged his work with COVA CCI and CCI to support his work in cybersecurity. Since 2020, Dr. Shetty and his team at the Center for Secure and Intelligent Critical Systems, received over $6 million in external funding. Two examples of these funded projects include a five-year, $1.75 million, collaboration with Howard University and the Department of Defense to establish a Center of Excellence in Machine Learning, and a five-year, $3 million project from Frontier Technology Inc. working on cyber resilience and analytics. Dr. Shetty leads a team of four research faculty, four post docs, three software engineers and five graduate assistants.



See the table below for the list of funded projects.

Project Name	PI/Co-PI	Lead Institution	Partner Institution	Funding Amount	Funding Agency
HRBRC collaboration Accelerator Fund, "Social Estrangement and Virtual Connectivity of Children in COVID Era"	Yan Yu (Co-PI)	NSU	ODU	$150,000	HRBRC
Learning based Dynamic Spectrum Sharing for NextG Networks	Sachin Shetty	ODU	VT	$250,000	Department of the Army
Distributed Secure Live, Virtual, and Constructive (LVC) Air Combat System Training Environment (SLATE)	Sachin Shetty	ODU		$170,000	DoD
Collaborative Research: CISE-MSI: DP: CNS: Efficient Data Communication and Processing for Intelligent Medical Systems with Edge-Cloud Interplay	Sachin Shetty Tan Le Rana Masud	ODU		$360,000	NSF
Center of Excellence in Machine Learning	Sachin Shetty	ODU	Howard Univ	$350,000	DoD
Cyber Risk and Resilience Analytics	Sachin Shetty	ODU		$654,358	Frontier Technology, Inc
Mission Analytics for Electronic Warfare by quantifying impact of RF-enabled Cyber-attacks	Sachin Shetty	ODU		$100,000	NSWC (USN)
Joint Semi-supervised conditional random field and graph attention network for power grid collateral damage	Tan Le	ODU		$22,500	AFRL
CyberCorps Scholarship for Service: Preparing Future Cybersecurity LeADERS through applied learning experiences	Brian Payne	ODU		$1,037,432	NSF

Supplemental Bridge Grant for CyberCorps Scholarship for Service: Preparing Future Cybersecurity LeADERS through applied learning experiences	Brian Payne	ODU		$116,380	NSF
Visiting Faculty Research Program Award at Air Force Research Lab, "Physics-informed image processing for battlefield building damage image processing"	Yan Yu	ODU		$18,757	AFRL
Visiting Faculty Research Program Extension Award, “"Learning a Hierarchical Multi-Scale Generative Adversarial Network for Building Damage Estimation and Disaster Recovery using Remote Sensing Images”	Yan Yu	ODU		$10,000	AFRL
Visiting Faculty Research Program Award at Air Force Research Lab, " Learning a Hierarchical Multi-Scale Generative Adversarial Network for Building Damage Estimation and Disaster Recovery using Remote Sensing Images"	Yan Yu	ODU		$22,464	AFRL
Naval Station Norfolk 5G Enhanced Infrastructure and Applications Prototype	PI: Oscar Gonzalez Co-PIs: Dimitrie Popescu, Otilia Popescu, and Murat Kuzlu	ODU	None	$138,432	Booz Allen Hamilton
Advanced Machine Learning Artificial Intelligence	Jiang Li (ODU) Hongyi Wu (UA)	ODU	University of Arizona	$345,000	Applied Research LLC. (STTR from DOE)
Pursuing Interpretability in Utilitarian Online Learning Models	Yi He	ODU		$175,000	NSF

Facilitate the Convergence of the Next-Gen AI and Wireless	Yi He	ODU		$100,000	Interdigital Co
Blockchain based AI/ML Management to Enable Multi-modal Federated Learning	Rui Ning	ODU		$100,000	Interdigital Co
Smart Grid Digital Twin Based on Physics-Informed Reinforcement Learning Model	Masud Rana	ODU		$1,500,000	Department of Education (DOE)
ODU/NNPS COLLEGE PARTNERSHIP LABORATORY SCHOOL PLANNING GRANT	Karen Sanzo (PI)	ODU	Newport News Public schools	$200,000	VDOE
ODU/CPS COLLEGE PARTNERSHIP LABORATORY SCHOOL PLANNING GRANT	Karen Sanzo (PI)	ODU	Chesapeake Public schools	$200,000	VDOE
GO VA: GREATER OPPORTUNITES IN TECH	Karen Sanzo (PI)	IALR	ODU	$463,017	GO VA

2. Summary of Research Grants and Programs Awarded

COVA CCI is providing research funding for several initiatives. This support has proven to be instrumental in enhancing research efforts through collaboration with fellow researchers across the CCI network.

One example of how the CCI funds supported these research efforts is provided by Dr. Murat Kuzlu, Associate Professor, Department of Engineering Technology, Old Dominion University.

Dr. Murat Kuzlu, Associate Professor, Department of Engineering Technology, Old Dominion University

"The funding from CCI has significantly contributed to my career, particularly as a tenure-track assistant professor. It has provided the necessary financial resources to conduct advanced research in the fields of next-generation communications (5G and beyond), the Internet of Things (IoT), Explainable AI (XAI), Trustworthy AI, and smart cities. Collaboration with professors from other universities in Virginia (i.e., VCU and VT), leading experts, and industry partners has been facilitated, fostering knowledge exchange and creating opportunities for advanced solutions and external grants. Additionally, the funding from CCI has supported participation in conferences, workshops, and networking events, enhancing visibility, and establishing valuable

connections within the academic and industry communities. Overall, this funding has played a vital role in promoting me to Associate Professor (with Early Tenure), fueling research endeavors, and enabling significant contributions to the development of emerging technologies, such as next-generation communications (5G and beyond), the Internet of Things (IoT), Explainable AI (XAI), Trustworthy AI, and smart cities."

Research Programs	Funding
FY 2023 COVA CCI Cybersecurity Research and Innovation Funding Program	$581,000
FY 2022 COVA CCI Cybersecurity Research and Innovation Funding program	$880,000 (Funds expended both FY 22 and FY 23)
FY 23 CCI Funded Research Programs	$594,370
FY 22 and FY 21 CCI Funded Research Programs	Remaining funds carried over from FY 22 and FY 21
Research Scientists	$782,500
Cybersecurity Dissertation Fellowship Program	$50,000
Cybersecurity Undergraduate Research Program	$98,000

a) **FY 2023 COVA CCI Cybersecurity Research and Innovation Funding program**. COVA CCI is providing funding through the COVA CCI Cybersecurity Research and Innovation Funding program. This program supports diverse and inclusive CPSS research efforts. The focus of research for FY 2023 is Maritime Cybersecurity and an RFP entitled "Addressing Cybersecurity Compliance Challenges to Technology Adoption for the Maritime Industry" was released in September 2022. A total of seven projects were selected as a result of this RFP for a total of $581,000. These projects will be completed in January 2024. Visit the COVA CCI/Research website for additional information on each project.

COVA CCI Funded Research Projects – FY 2023

Project Title	PI	Co-PI	Amount
Enhancing the RiverScout Autonomous Maritime Platform with cyber-hardened 5G capabilities within the constraints of CMMC	Yiannis Papelis (ODU)	Ahmet Saglam (ODU) Casey Batten (SimIS, Inc.)	$100,000
Automated CMMC Compliance for Shipbuilding	Safdar Bouk (ODU)	Andrew Mixon (Chitra)	$100,000
Spotlighting and Mitigating Cyber-Attacks in AIoT-enabled Maritime Transportation Systems	Yi He (ODU)	Rui Ning (ODU) Yuhong Li (ODU) Peng Jiang (ODU) Leigh Armistead (Peregrine Tech Solutions)	$100,000

Machine-learning enabled Dependency Network Analysis for Quantifying Risks and Ripple Effects stemming from Cybersecurity Non-Compliance Issues	Rafael Diaz (ODU)		$37,033
Maritime Cybersecurity Maturity Model Certification Domain Handbook	Sachin Shetty (ODU)	Warren Bizub (SimIS, Inc) Michael Himprey (SimIS, Inc)	$92,650
Exploring Challenges and Adoption Enablers of Cybersecurity Maturity Model Certification in Maritime Industries	Chon Abraham (WM)	Tracy Gregorio (G2Ops)	$52,129
Navigating Cybersecurity Compliance Challenges for the Maritime Industry in Southeast Virginia	Mohammad Almalag (CNU)	Michael Lapke (CNU) Christopher Kreider (CNU) Leigh Armistead (Peregrine Tech Solutions)	$99,296

See Appendix 1: Funded Research for additional details on these projects including abstracts.

b) **FY 2022 COVA CCI Cybersecurity Research and Innovation Funding program**. COVA CCI provided funding through the COVA CCI Cybersecurity Research and Innovation Funding program in FY 2022 for seven total projects totaling $880,000. Five projects were approved in June 2021 for a total of $750,000. These projects will be completed in December 2022. See the article "ODU-Led Cybersecurity Projects Grant Funded for more information." Two additional projects were funded during the fourth quarter of FY 2022 for a total of $130,000. These projects are Cybersecurity & Barriers to Technology Adoption Among Maritime Activities and 5G-BEACON: Blockchain Enhanced Architecture and Coding for Orchestrated Networks.

See all project proposals and presentations on the COVA CCI Cybersecurity Research website.

COVA CCI Funded Research Projects – FY 2022

Project Title	PI	Co-PI	Amount	Project Dates
Toward Trustworthiness in Autonomous Vehicles	Evgenia Smirni (W&M)	H. Alemzadeh (UVA)	$150,000	7/1/2021 – 6/30/2023 (Completed)
A Real-Time Dependency Network Approach to Quantifying Risks and Ripple Effects from Cyberattacks in Shipbuilding and Repair Supply Networks	Rafael Diaz (ODU)	H. Shen (UVA)	$150,000	7/1/2021 – 6/30/2023 (Completed)

Comprehensive Assessment and Diagnostics for Federated AI Algorithms in Cyber Physical Systems	Rui Ning (ODU)	J. Le (ODU) C. Xin (ODU) X Deng (VT) Y. Hong (VT) L Freeman (VT)	$150,000 (ODU-$100000) (VT-$50000)	7/1/2021 – 5/31/2023 (Completed)
CIVIIC: Cybercrime in Virginia: Impacts on Industry and Citizens	Randy Gainey (ODU)	T. Vandecar-Burdin (ODU) J. Albanese (VCU) J. Hawdon (VT) K. Parti (VT) T. Dearden (VT)	$149,683 (ODU-$50723) (VT-$39267) (VCU-$59693)	7/1/2021 – 12/31/2022 (Completed)
Developing a Smart City Virtual Lab to Support CPS Experiential Learning	Murat Kuzlu (ODU)	S. Abdelwahed (VCU)	$150,000 (ODU-$75000) (VCU-$75000)	7/1/2021 – 6/30/2023 (Completed)
Cybersecurity & Barriers to Technology Adoption Among Maritime Activities	Mike Robinson (ODU)		$100,000 (ODU)	1/15/2022 – 11/30/2022 (Completed)
5G-BEACON: Blockchain Enhanced Architecture and Coding for Orchestrated Networks	Sachin Shetty (ODU)		$30,000 (ODU)	7/1/2022 – 6/30/2022 (Completed)

c. **FY 2023 CCI Funded Research Programs.** COVA CCI was awarded several projects from CCI and CCI NOVA during FY 2023 totaling $594,370.

FY 2023 CCI Research Projects	**Awards**	**Total Funding awarded to COVA CCI**
Experiential Learning Programs (FY 2024)	2	$199,370
Arts and Design	1	$25,000
Securing Interactions between Humans and Machines	2	$120,000
Totals	**5**	**$344,370**

FY 2023/2024 CCI NOVA Research Projects	**Awards**	**Total Funding awarded to COVA CCI**
2023 CATAPULT (Cyber Acceleration, Translation, and Advanced Prototyping for University Linked Technology	3	$150,000
2024 CATAPULT (Cyber Acceleration, Translation, and Advanced Prototyping for University Linked Technology	2	$100,000
Totals	**5**	**$250,000**

See Appendix 1: Funded Research for list of awarded projects.

d. **FY 2022 CCI Funded Research Programs.** COVA CCI received multiple projects in FY 2022, and they extended into FY 2023 with three continuing into the first quarter of FY 2024, totaling $386,874.

FY 2022 CCI Research Projects	**Awards**	**Total Funding awarded to COVA CCI during FY 2022**

Securing NextG	2	$125,000
Cybersecurity Challenge	1	$12,500
Cybersecurity Research Collaboration (FY 2022)	1	$50,000
Scalable Experiential Learning Programs (FY 2022)	2	$199,374
Totals	**6**	**$386,874**

See Appendix 1: Funded Research for list of awarded projects.

e. **FY 2021 CCI Funded Research Programs.** COVA CCI was awarded multiple projects to the amount of $1,927,195, in response to requests for proposal sponsored by CCI in FY 2021. Most of these projects were completed by December 2022. See the CCI website for details on these projects.

FY 2021 CCI Research Projects	**Awards**	**Total Funding awarded to COVA CCI during FY 2021**
Collaborative Research Funds (FY 21/22)	7	$1,119,666
Building Bridges: Arts and Design	2	$37,500
Experiential Learning	2	$300,000
Experiential Research in CCI Testbeds	3	$249,906
Role of Cybersecurity in the Spread of Disinformation and Misinformation	3	$147,790
Cybersecurity Innovation Bridge Funds	3	$71,333
Totals	**17**	**$1,927,195**

See Appendix 1: Funded Research for list of awarded projects.

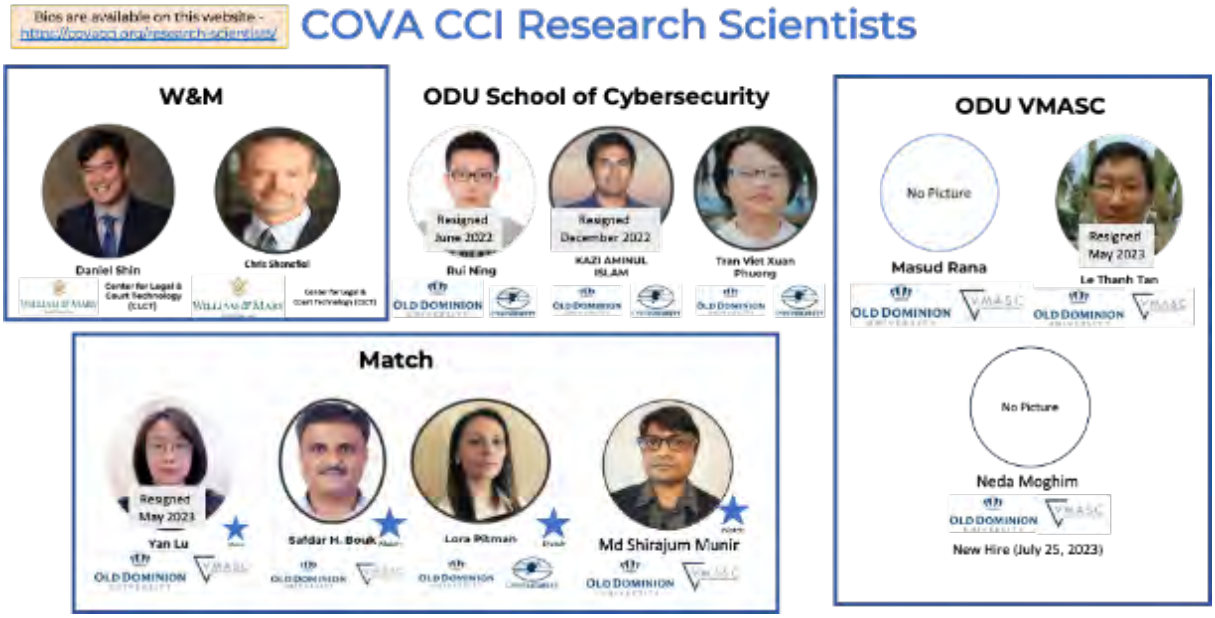
f. **Research Faculty Recruited.** COVA CCI continues to support research scientists at William & Mary and Old Dominion University (School of Cybersecurity and Virginia Modeling, Analysis, and Simulation Center) and one ITS engineer with ODU. These research scientists are hired on an initial two-year contract with an option to extend for one-year. Bios for these research scientists are found on the COVA CCI website/People/Research Scientists. You can also watch a short YouTube video, Meet the COVA CCI Research Scientists, where several of the research scientist provide an introduction.

The supported research scientists and ITS Engineer are.

- Chris Shenefiel, William & Mary, hired in November 2022.
- Daniel Shin, William & Mary.
- Tran Phoung, ODU School of Cybersecurity.
- Masud Rana, ODU VMASC.
- *Le Thanh Tan, ODU VMASC. Resigned in May 2023 and hired at Hampton University.*
- *Kazi Aminul Islam, ODU School of Cybersecurity. Resigned in December 2022 to work in industry.*

- *Rui Ning, ODU School of Cybersecurity. Resigned in June 2022 to assume position in ODU Computer Science Department.*
- Match Hires: Lori Portman (ODU School of Cybersecurity), Safdar Bouk (ODU VMASC) and *Yan Lu (ODU VMASC. Resigned May 2023 and hired at Christopher Newport University).*
- Yogesh Sur, ODU. Hired as an ITS engineer to support COVA SHARE.

COVA CCI has hired two additional research scientists to replace Le Thanh Tan and Yan Lu at VMASC. They are Neda Moghim and Shirajum Munir and started July 25, 2023. COVA CCI will also hire at least one additional research scientists for the ODU School of Cybersecurity during FY 2024.



g. **CCI Supply Chain Cybersecurity Cluster.** In addition to these research scientists, COVA CCI provided funding in FY 2023 to hire three professors/research professors as part of a cluster hire in conjunction with George Mason University. The ODU cluster will focus on supply chain and maritime cybersecurity and will work with GMU faculty to pursue large government projects related to these research areas. They will start in July 2023 (First Quarter FY 2024).

- Rafael Diaz, ODU, Director Supply Chain Cybersecurity Research
- Bikash Chandra Singh, ODU Research Assistant Professor
- Lida Haghnegahdar, ODU Research Assistant Professor

CCI Supply Chain Cybersecurity Cluster

Rafael Diaz
Director Supply Chain Cybersecurity Research
rdiaz@odu.edu

COVA CCI provided funding in FY 2023 to hire three professors/research professors as part of a cluster hire in conjunction with George Mason University. The ODU cluster will focus on supply chain and maritime cybersecurity and will work with GMU faculty to pursue large government projects related to these research areas.

Bikash Chandra Singh
rdiaz@odu.edu

Lida Haghnegahdar
rdiaz@odu.edu

Visit the Research Scientist page on the COVA CCI website to view their profile.

h. **COVA CCI Cybersecurity Dissertation Fellowship program** supported two cybersecurity Ph.D. students, from William & Mary. They are both continuing their Ph.D. programs and were part of this program in FY 2022. These students are using the funds to further develop their Ph.D. dissertations and research.

Woosub Jung earned his Ph.D. in Computer Science from William & Mary and accepted a position as a tenure-track Assistant Professor with the Department of Computer and Information Sciences, Towson University. He also received the Distinguished Dissertation Award and the Stephen K. Park Graduate Research Award upon graduation.

Amit Ami is continuing his work towards completing his Ph.D. in Computer Science from William & Mary in May 2024. He has published several research papers and presented at multiple conferences.

WOOSUB JUNG, SUMMED UP HIS EXPERIENCE WITH THIS SUPPORT FOR THE PAST TWO YEARS.

"I have been fortunate to receive financial support from the CCI dissertation fellowship for the past two years. The support provided by this fellowship has not only helped me meet my financial needs until graduation but has also contributed to enhancing my research productivity. Initially, my dissertation began as a course project, but thanks to the recognition and financial support, both my advisor and I were convinced to explore further. As a result, I achieved several notable accomplishments, including three research papers, two research patents, two prestigious research awards, and two commercialization grants. It is undeniable that without the CCI fellowship, these achievements would have not been possible. Based on these outcomes, I am eager to pursue further research projects at Towson University."

i. **Cybersecurity Undergraduate Research Program**. COVA CCI supported the Cybersecurity Undergraduate Research Program in Fall 2022 and Spring 2023 program. A total of 35 students from Christopher Newport University, Norfolk State University, Old Dominion University, and William & Mary, completed the program during the year. This program leverages the strength of research-extensive institutions to support active research participation by undergraduate students around cybersecurity. Students will have opportunities to explore a variety of cutting-edge research topics, including but not limited to: Blockchain Security, Cyber Law & Policies, Human Behavior Security, Online Scams, Mobile Protection, Secure Digital Printing, Secure Internet of Things, Secure Machine Learning, Social Engineering, and Wireless Security. The student research is found on the COVA CCI/Innovation/Undergraduate Research website.

ODU Cybersecurity Student on the value of this program.

"This program pushed me to do independent research and create a final research product, which is a great thing to list on the resume and provides the chance to learn one aspect of cybersecurity more in-depth. I found this Program to be a great complement to my coursework in cybersecurity at ODU, and I value the connections to other educational institutions (e.g., William & Mary) that the Program provided. My research project could very well end up factoring into my future career directions in cybersecurity and law."

3. Results of Entrepreneurship and Workforce Programming Innovation, Workforce Development and Experiential Learning Programs

COVA CCI is supporting several programs in innovation, workforce development, and student experiential learning. These include the INNOVATE Cyber Challenge and the Graduate Student Experiential Learning Program (CyberExL).

Program	Funding
Innovate Cyber Challenge	$105,000
CyberExL	$100,000

a) **Innovate Cyber Challenge.** COVA CCI expanded the scope of the Innovate Cyber Challenge to include students from all state public 2- and 4-year institutions. The summer and fall were spent recruiting students for spring 2023 cohort with a total of 45 students from 7 universities & colleges selected to start the program in January 2023. These included Laurel Ridge Community College, Tidewater Community College, Christopher Newport University, George Mason University, Old Dominion University, Virginia Military Institute, and William & Mary.

This program groups students into teams and each team is assigned a cybersecurity problem/challenge. Over the course of the semester the teams use design thinking to produce unique solutions for the problem and present their final product during a Showcase event in April 2023.

Visit the COVA CCI/Innovation/Innovate Cyber Challenge webpage to see this and previous years projects.

Jacob Hornug, Old Dominion University, Spring 2023 Innovate Cyber designer.

"Through INNOVATE Cyber, you get the opportunity to work with a diverse group of individuals spanning different universities and majors across the commonwealth. I fostered new relationships and connections with peers within my team and throughout the cohort. The spring of 2023's program tackled pertinent issues, specifically cyber hygiene, which served as both challenging and rewarding. Cyber hygiene can be broad and complex, meaning everyone presents their own unique way of solving core issues, which allows for innovative and effective collaboration. This experience opened my eyes to the design thinking approach to problem-solving, which has provided me with a new skill set for completing tasks at school, work, and in everyday life. Innovate Cyber is a great opportunity for anyone looking to challenge themselves and gain valuable experience through leadership and teamwork."

b. **Graduate student experiential learning program (CyberExL).**

COVA CCI's graduate student experiential learning program is managed by Dr. Stephanie Blackmon, William & Mary School of Education. The program was rebranded as CyberExL in 2021 and the first cohort of graduate students started working with their respective organizations in January 2022. In FY 2023, sixteen students representing Norfolk State University, Old Dominion University, and William & Mary completed this program. Additional information can be found on the COVA CCI/Talent Development & Experiential Learning Program website. To learn more about the programs and students selected for the Spring 2022 cohort see this article – CCI's CyberExL Program is giving graduate students hands-on experience.

Cyber ExL Testimonials:

DIPIN GADAMSETTI, ODU M.S. COMPUTER SCIENCE CYBEREXL STUDENT	DR. FARYANEH POURSARDAR, ODU COMPUTER SCIENCE PROFESSOR CYBEREXL PLACEMENT PROVIDER
"My placement experience with the CyberExL program was an incredibly positive one, and I feel grateful for the opportunity to participate in it. It allowed me to gain valuable hands-on experience with cybersecurity and the latest technologies like Cloud, Open Source, Virtualization, and Automation. One of the most significant benefits of the program was that it gave me a chance to	*"I have participated in the CyberExL program as a faculty mentor for two years now. In addition, the program is very beneficial for the students to get hands-on experience in cybersecurity research, I appreciated having an extra graduate student research helper in the lab, especially when it brings multi-disciplinary challenges to the project. I have worked with students from William*

showcase my skills and demonstrate my aptitude for the field. This was a valuable confidence boost, and I feel that it will serve me well in my future career pursuits. Additionally, the program helped me to supercharge my skill set, allowing me to develop my abilities to a much higher level than I could have achieved through classroom learning alone. Overall, I consider the CyberExL program to be a fantastic opportunity, and I feel fortunate to have been able to participate in it."	*& Mary and Old Dominion University with various backgrounds and skills in International Economy, Business Analytics, Electrical Engineering, and Mechanical Engineering. At the end of the program, we even got results and published it."*

4. Collaborative Partnerships and Projects

COVA CCI is working with academic institutions from across the state on Cybersecurity Research projects previously mentioned in this report. Researchers are also working with business partners on potential federal funding opportunities and current research. Some of these partners include CivilianCyber, G2Ops, MIBE, MITRE, MI Technical Solutions, Port of Virginia, and Peregrine Technical Solutions.

All the research projects funded through COVA CCI are collaborative efforts with researchers from multiple institutions and/or business partners.

5. Correlated Economic Outcomes (Jobs and New Business Formation)

a. **Cybersecurity Workforce Development.** One goal of CCI and COVA CCI is to grow the cybersecurity workforce in the Commonwealth. COVA CCI is working with university researchers and business partners to achieve this goal. Below are two examples from our business partners on how working with CCI/COVA CCI has benefited their business.

Leigh Armistead, President, Peregrine Technical Solutions

"Peregrine Technical Solutions, LLC. is a small business located in Yorktown, VA. We were started in 2011, and focus primarily on cybersecurity, as well as IT support services. Our staff has collaborated with the Hampton Roads based academic groups for the last seven years, and we are also on the Coastal Virginia (COVA) Commonwealth Cyber Initiative (CCI) CybER Con committee which is very focused on experiential learning. In 2022-2023, we had five CyberExL graduate students who served as interns with our company, mainly researching business development opportunities. Our experience with Hampton Roads based academic organizations, CCI and CyberExl in particular, have been very favorable, and we highly recommend other corporate entities to take advantage of this opportunity."

Tracy Gregorio, CEO, G2Ops, Inc

"G2Ops has received numerous direct benefits from our partnership with the Commonwealth Cyber Initiative and COVA CCI. These include collaboration on a common goal across industries, coalition of the commonwealth's most capable cyber warriors, creation of a network of resources to collaborate with on innovations and proposals, and access to future employees. As a result of this partnership, G2Ops hired six cybersecurity students as employees directly tied to our work with CCI. Finally, I have gotten to know other CEOs and CCI/COVA CCI has given us a sense of comradery where we can partner on initiatives, help each other out and bounce ideas off each other, to name a few."

Student Workforce Development. Since inception in 2020, COVA CCI supported 369 students in various programs listed in this report. These students worked as research assistants for research projects and participated in the undergraduate research and Innovate Cyber programs. All of them gained valuable workforce skills which they will use in their future careers.

Undergraduate Research Program – 82 students from seven institutions.

Institutions	Total per Institution	Spring 2023	Fall 2022	Spring 2022	Fall 2021	Fall 2020	Spring 2020
Christopher Newport University	12	1	5			3	3
Norfolk State University	8		5	3			
Old Dominion University	44	11	5	6	12	5	5
Regent	1						1
Tidewater Community College	2			1			1
Thomas Nelson Community College	1			1			
William & Mary	14	4	5	2	3		
Grand Total	**82**	**16**	**20**	**13**	**15**	**8**	**10**

Innovate Cyber Program – 143 students from 15 institutions.

Institution	Total by Institution	Spring 2023	Spring 2022	Fall 2020	Spring 2020
Christopher Newport University	16	2	2	5	7
ECPI University	3				3
George Mason University	20	1	19		
Laurel Ridge Community College	3	3			
Norfolk State University	8		5	1	2
Northern Virginia Community College	3		3		

Old Dominion University	62	31	12	10	9
Paul D. Camp Community College	3		2	1	
Thomas Nelson Community College	5		5		
Tidewater Community College	9	1	3	3	2
Virginia Commonwealth University	1		1		
Virginia Military Institute	3	3			
Virginia Tech	1		1		
Virginia Western Community College	1		1		
William & Mary	5	4			1
Grand Total	**143**	**45**	**54**	**20**	**24**

Graduate Student Experiential Learning Program (CyberExL) – 53 students from 4 institutions.

Institution	Total per Institution	Spring 2023	Spring 2022	Spring 2021	Fall 2020	Spring 2020
Christopher Newport University	1					1
Norfolk State University	11	5	4	2		
Old Dominion University	22	8	2	4	5	3
William & Mary	19	5	8	3	3	
Grand Total	**53**	**18**	**14**	**9**	**8**	**4**

Research Assistants – 91 students from multiple institutions at the Post Doctorate, Graduate, and Undergraduate levels.

Education Level	Total per Education Level
Post Doc	11
GRA	50
UG	30
Total	**91**

b. **Startup Companies.** A key indicator of achieving the goal of growing the cybersecurity business ecosystem in Virginia is the ability to create new cybersecurity businesses from work associated with CCI. Listed below are two examples of startups coming out of COVA CCI.

NetTech Warriors.

As part of the CCI supported Arts and Design Collaboration program, Dr. Kevin Moberly, ODU, and his team, created a cybersecurity game – NetTech Warriors. This game is designed to be used by educators at the K-12 levels to teach students about cybersecurity through an interactive board game. This game has been tested at multiple conferences and at the Art of Cybersecurity exhibit held in the Taubman Museum of Art, Roanoke, Virginia, November 4-5, 2022. NetTech Warriors is still in the early stages of business development, but they plan to develop this game into a fully marketable prototype which can be turned into a commercialized business in the near future.

Dr. Kevin Moberly, Program Director, IDS Game Design, Development and Criticism Major, Old Dominion University

"To date, we have made a considerable amount of progress towards the commercialization of the NetTech Warriors board game we developed based on funding we received from a Commonwealth Cyber Initiative (CCI) Building Bridges grant. In Spring 2023, we met with the Strome Entrepreneurial Center at Old Dominion University about putting together a business canvas and marketing plan. We also conducted a considerable amount of market research as part of our ongoing efforts to secure additional grant funding for the project. We are currently in the process of locating and applying for other grants opportunities. In the meantime, our development team is working to fine tune the game. To that end, we have made it the focus of one of the student intern teams taking part in ODU's Game Design and Development's summer internship program. This team of interns is working to finalize the game mechanics, to produce additional art and malware cards, a formal rulebook, and to develop a website to showcase the project."

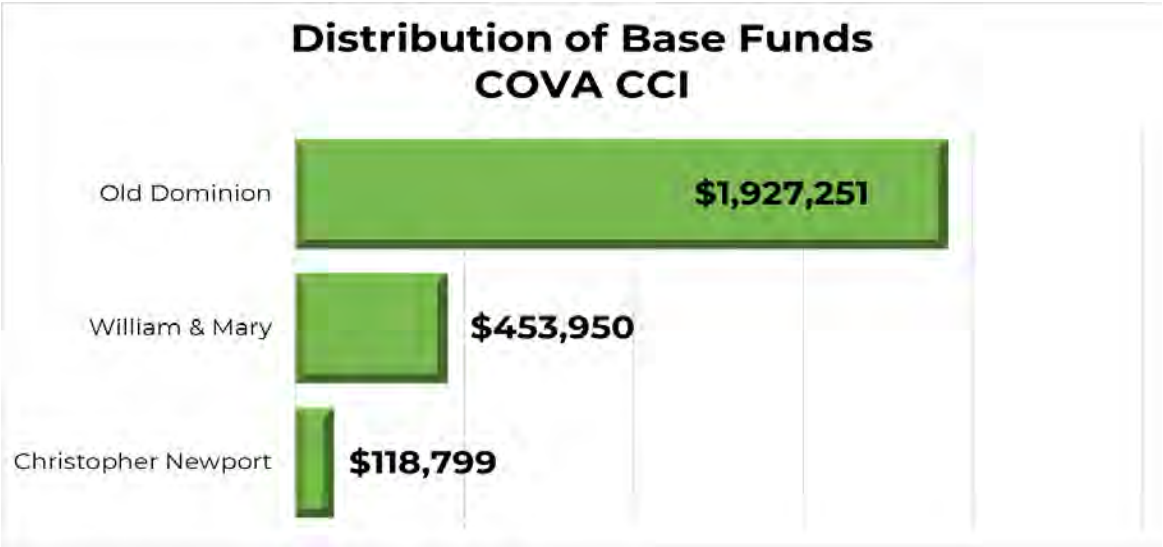
Solutions TBD, LLC.

Solutions TBD, LLC, is a woman owned, disabled veteran business formed in October 2022 as a business-to-business solutions organization dedicated to maximizing its customer's strategic value. Solutions TBD founder, Teresa Duvall, is a retired naval officer and retired federal employee with years of experience in cybersecurity. She started Solutions TBD after seeing a need within the region and after working with COVA CCI and Old Dominion University on workforce development issues related to growing the cybersecurity workforce in Virginia.

6. Geographic Distribution of Funds

Distribution of COVA CCI Allocated Funds across the node region.

Distribution of Funds Across the Node Region	
Institution	Amount
Christopher Newport University	$118,799
Old Dominion University *(Note 1)*	$1,927,251
William & Mary	$453,950
Total Committed Funds	**$2,500,000**
Note 1: Funding under ODU includes funds managed by the ODU Research Foundation, Virginia Space Grant Consortium (VSGC), Research Scientists Salary, and other Operations Costs	
Research Scientist Salaries	*$545,500*
Research Scientist Cluster Hire	*$220,000*
Research Projects	*$429,683*
COVA Share	*$85,000*
COVA CCI Cyber Conference	*$10,179*
CODE VA Sponsorship	*$15,000*
COVA CCI Staff Salaries	*$247,000*
VSGC Managed Projects Admin Support	*$5,000*
CoVA Cybersecurity Student Association	*$10,403*
UG Research (Includes payments to students from multiple institutions.)	*$100,000*
Innovate Cyber Challenge (Includes payments to students from multiple institutions.)	*$105,000*
Operations and other funds	*$154,486*
Total ODU Funds	*$1,927,251*



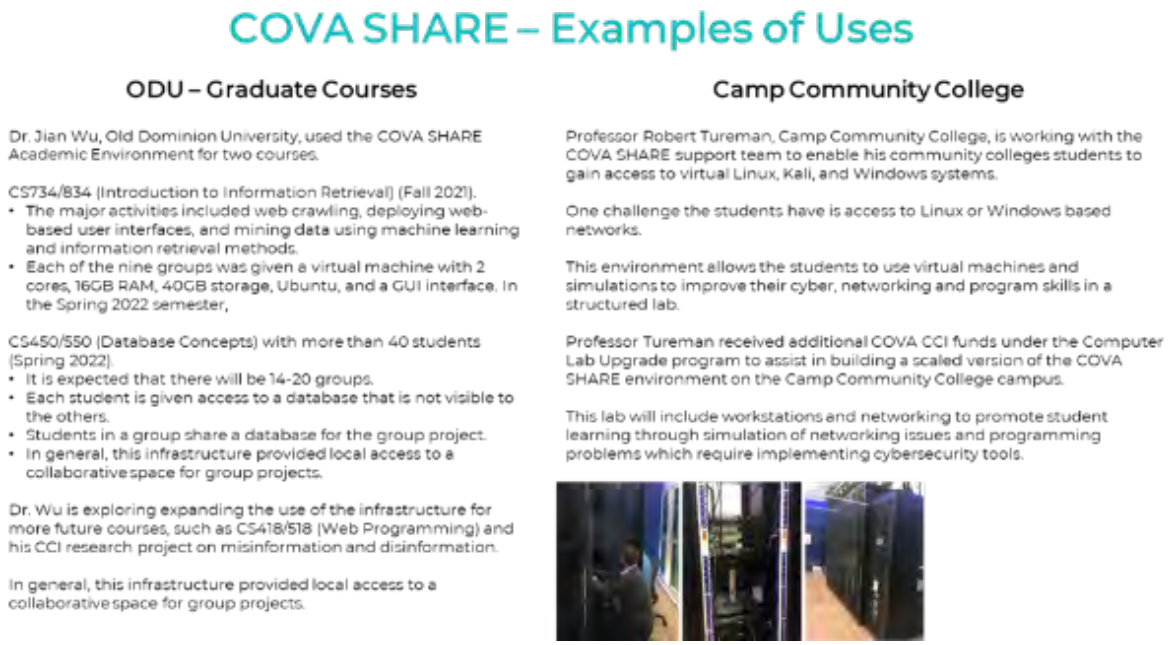
7. Other initiatives.

a) COVA Shared Research Environment

COVA CCI continues to invest in our shared collaborative research computing environment, known as COVA Share, to support the growing cybersecurity programs, academic and research collaboration opportunities, and industry partnerships. During FY 2023 a total of $95,000 was invested in supporting this environment - $20,000 in direct support to hire two students as technical experts and to provide a stipend to a faculty member at Christopher Newport University to be the COVA SHARE Faculty Advisor. An additional $75,000 was used to purchase additional equipment to update the computer hardware.

The COVA SHARE Academic Environment hosted 13 courses and 852 students during the 2022-2023 Academic Year.

Visit the COVA CCI/Research/COVA SHARE website for additional information on COVA SHARE and watch a short overview YouTube video – What is COVA Share? – to learn more about this resource.



COVA SHARE – Examples of Uses

ODU – Graduate Courses

Dr. Jian Wu, Old Dominion University, used the COVA SHARE Academic Environment for two courses.

CS734/834 (Introduction to Information Retrieval) (Fall 2021).
- The major activities included web crawling, deploying web-based user interfaces, and mining data using machine learning and information retrieval methods.
- Each of the nine groups was given a virtual machine with 2 cores, 16GB RAM, 40GB storage, Ubuntu, and a GUI interface. In the Spring 2022 semester,

CS450/550 (Database Concepts) with more than 40 students (Spring 2022).
- It is expected that there will be 14-20 groups.
- Each student is given access to a database that is not visible to the others.
- Students in a group share a database for the group project.
- In general, this infrastructure provided local access to a collaborative space for group projects.

Dr. Wu is exploring expanding the use of the infrastructure for more future courses, such as CS418/518 (Web Programming) and his CCI research project on misinformation and disinformation.

In general, this infrastructure provided local access to a collaborative space for group projects.

Camp Community College

Professor Robert Tureman, Camp Community College, is working with the COVA SHARE support team to enable his community colleges students to gain access to virtual Linux, Kali, and Windows systems.

One challenge the students have is access to Linux or Windows based networks.

This environment allows the students to use virtual machines and simulations to improve their cyber, networking and program skills in a structured lab.

Professor Tureman received additional COVA CCI funds under the Computer Lab Upgrade program to assist in building a scaled version of the COVA SHARE environment on the Camp Community College campus.

This lab will include workstations and networking to promote student learning through simulation of networking issues and programming problems which require implementing cybersecurity tools.

b) COVA CCI Cybersecurity Experiential & Research Conference (CybER Con.

COVA CCI hosted its inaugural Cybersecurity Experiential & Research Conference (CybER Con), September 28-29, 2022, at William & Mary. This conference highlighted multiple presentations focused on cybersecurity experiential learning programs and research. A total of 79 participants attended this conference and they reported a satisfaction score of 4.44 out

of five on the conference survey. To learn more about CybER Con visit the website - [https://covacci.org/cybercon/.](https://covacci.org/cybercon/)

COVA CCI will host the 2nd annual CybER Con on September 20-21, 2023, at Old Dominion University.

c) Cyber Forge.

The Coastal Virginia Cybersecurity Student Association hosted its 2nd Annual capture the flag event, known as Cyber Forge, at Christopher Newport University, March 18-19, 2023. This event allowed students from across the region to hear from cybersecurity experts, participate in a Capture-the-Flag competition, and network with fellows students.

d) Williams & Mary Symposium.
On February 10, 2023, COVA CCI and William & Mary's Law School, Center for Legal & Court Technology, co-hosted a symposium focused on Problematic AI: Finding the Best Way Forward. Thirteen panelists, representing Law, Government, Academia and Industry from the US, Canada and the United Kingdom gave their respective insights about these three questions:

1. What is AI, how is it used and how can it produce erroneous results?
2. How to detect and manage AI errors and risks?
3. How well do current regulations and/or policies address these challenges?

To see the full agenda and read the biographies of the speakers visit the symposium website - https://legaltechcenter.net/a-i/2023-winter-cci-hybrid-conference/.

Cybersecurity Newsletter: In addition to these symposiums, William and Mary Law School, Center for Legal & Court Technology, publishes a monthly "Cybersecurity Newsletter." This newsletter written by Daniel Shin, COVA CCI Research Scientist, contains information and analysis on multiple legal issues related to cybersecurity such as Lawsuits against AI, White House 2023 National Cybersecurity Strategy, and mandatory reporting of cybersecurity and data breaches by all Virginia state and local government bodies. As of June 2023, there are 26 published newsletters. To see all of the Cybersecurity Newsletters visit its website - https://www.legaltechcenter.net/a-i/cybersecurity-newsletter/.

e) Other events supported by COVA CCI.

COVA CCI hosted or supported other events during the year, including Undergraduate Research Showcases (Fall 22 and Spring 23), Innovate Cybersecurity Challenge Showcase and Pitch Event (April 2023) and the

CVCSA Lecture Series. See the [COVA CCI Events website] for more details regarding these events.

e) COVA CCI is Moving. In fall 2023, COVA CCI will be moving from the main campus of Old Dominion University to the Virginia Beach Town Center. This new facility will be the home of COVA CCI, ODU School of Data Science. The facility will also house faculty from ODU School of Cybersecurity and VMASC.

Virginia Beach Town Center

8. COVA CCI Node in the News

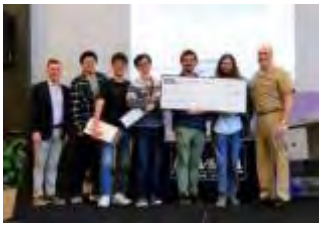
COVA CCI has been activity promoting the success of its various activities through local news sources. You can view these articles and others on the COVA CCI website – [News.]

[ODU Receives Two Lab School Planning Grants from the State's Department of Education]

[Spring Tack Faculty Lecture to challenge our notions of AI]

[Two NSF CAREER awards in 2023 recognize W&M Leadership in computer science]

[TCC Students take first place in cyber competition]



[WM students won third place in MSWCDD Artificial Intelligence and Machine Learning Innovation Challenge]

[ODU Researchers Receive Grants to Address Maritime Cybersecurity Needs]

[CyberForge 2023 draws students from CCI Coastal Virginia area]

[ODU Class of 2022: Ivan Santiago Finds His Calling for Leadership Through Cybersecurity]

10. For additional information contact John Costanzo, Chief Administrative Officer, COVA CCI, jcostanz@odu.edu, or visit the COVA CCI website (https://covacci.org) and the Commonwealth Cyber Initiative website (https://cyberinitiative.org/).

COVA CCI Website
www.covacci.org

Appendix 1. Funded Research

Summary of Funded Research Grants and Programs Awarded

COVA CCI provides funding under the research category for several initiatives.

Research Programs	Funding
FY 2023 COVA CCI Cybersecurity Research and Innovation Funding Program	$581,000
FY 2022 COVA CCI Cybersecurity Research and Innovation Funding program	$880,000 (Funds expended both FY 22 and FY 23)
FY 23 CCI Funded Research Programs	$594,370
FY 22 and FY 21 CCI Funded Research Programs	Remaining funds carried over from FY 22 and FY 21

a) **FY 2023 COVA CCI Cybersecurity Research and Innovation Funding program**. COVA CCI is providing funding through the COVA CCI Cybersecurity Research and Innovation Funding program. This program supports diverse and inclusive CPSS research efforts. The focus of research for FY 2023 is on Maritime Cybersecurity and a RFP entitled "Addressing Cybersecurity Compliance Challenges to Technology Adoption for the Maritime Industry" was released in September 2022. A total of seven projects were selected for a total of $581,000. These projects will be completed in January 2024. Visit the COVA CCI/Research website for additional information on each project.

COVA CCI Funded Research Projects – FY 2023

Project Title	PI	Co-PI	Amount
Enhancing the RiverScout Autonomous Maritime Platform with cyber-hardened 5G capabilities within the constraints of CMMC	Yiannis Papelis (ODU)	Ahmet Saglam (ODU) Casey Batten (SimIS, Inc.)	$100,000
Automated CMMC Compliance for Shipbuilding	Safdar Bouk (ODU)	Andrew Mixon (Chitra)	$100,000
Spotlighting and Mitigating Cyber-Attacks in AIoT-enabled Maritime Transportation Systems	Yi He (ODU)	Rui Ning (ODU) Yuhong Li (ODU) Peng Jiang (ODU) Leigh Armistead (Peregrine Tech Solutions)	$100,000
Machine-learning enabled Dependency Network Analysis for Quantifying Risks	Rafael Diaz (ODU)		$37,033

and Ripple Effects stemming from Cybersecurity Non-Compliance Issues			
Maritime Cybersecurity Maturity Model Certification Domain Handbook	Sachin Shetty (ODU)	Warren Bizub (SimIS, Inc) Michael Himprey (SimIS, Inc)	$92,650
Exploring Challenges and Adoption Enablers of Cybersecurity Maturity Model Certification in Maritime Industries	Chon Abraham (WM)	Tracy Gregorio (G2Ops)	$52,129
Navigating Cybersecurity Compliance Challenges for the Maritime Industry in Southeast Virginia	Mohammad Almalag (CNU)	Michael Lapke (CNU) Christopher Kreider (CNU) Leigh Armistead (Peregrine Tech Solutions)	$99,296

(1) **Enhancing the RiverScout Autonomous Maritime Platform with cyber-hardened 5G capabilities within the constraints of CMMC**

Project team: Yiannis Papelis, ODU, Ahmet Saglam, ODU, and Casey Batten, SimIS, Inc.

Project Abstract: SimIS Inc., a Portsmouth-based company, designs and develops a family of marine autonomous vehicles. One of these vehicles is the RiverScout, a two-man portable autonomous surveillance platform equipped with sensors for surveillance and autonomous operations. To meet expanding DOD operational mission requirements, the RiverScout requires a high-bandwidth, long-range, cyber-encrypted data link using the new global wireless 5G standard. VMASC is an enterprise research center engaged in multidisciplinary applied research to integrate new technologies into maritime platforms and develop novel maritime autonomy solutions. SimIS' RiverScout system consists of hundreds of micro-electronic assets (components and subcomponents) which are vulnerable to threats that could have an adverse effect on a RiverScout mission. CMMC guides the implementation of a "zero-trust" framework in system design and production to validate the security of system assets (components). We will apply the SP 800-30 Risk Assessment process in RiverScout data-link design and extend it to support maritime systems. Our Tidewater maritime partner Fairlead Boatworks provides commercial vessel system design and integration expertise that will enable the maturation and extension of a RiverScout-based risk assessment framework to support maritime industry-wide risk assessment/CMMC requirements. Additionally, the commercialization of the RiverScout capability must ensure CMMC cybersecurity Risk Assessment (RA) compliance – a core SimIS competency. The VMASC R&D capabilities teamed with SimIS maritime platform development and SP 800-30 Cyber Risk Assessment expertise, and FairLead commercial maritime

manufacturing skills establishes an experienced team for the COVA-CCI project. The goal of this joint project is to design and integrate an autonomous communications system for the RiverScout that implements SP 800-171R2 and SP 800-30 Risk Assessment processes that assess maritime platform asset threat vulnerability (through supply chain activities and external service providers) and supports the accelerated commercialization and SP 800-30 compliance of Tidewater maritime industry products and services.

(2) **Project: Automated CMMC compliance for shipbuilding**

Project team: Safdar Bouk, ODU and Andrew Mixon, Chitra

Project Abstract: Shipbuilding companies supporting Department of Defense (DOD) contracts with controlled unclassified information (CUI) will require certification under Cybersecurity Maturity Model Certification (CMMC) 2.0. The current lack of standard cybersecurity practices for DOD contractors inhibits cyber readiness for all DOD organizations. CMMC 2.0, a process managed and controlled by the DOD, ensures contractors are compliant with requisite cybersecurity requirements. There is currently a lack of effective tools, technology, and training to assist companies in their effort to achieve certification under CMMC 2.0. The existing tools and training services lack inherent simplicity of use and require operating personnel to have a strong cybersecurity background through the CMMC process. Chitra Productions, LLC (CHITRA), a woman-owned small business founded in 2008 in Virginia Beach, Virginia, has supported several shipbuilding, ship modernization, and ship maintenance initiatives in the Coastal Virginia area, including cybersecurity, maintenance, training, and engineering support. Chitra has recently developed and engineered a software tool that facilitates cybersecurity compliance within the Risk Management Framework (RMF) for systems and software in DOD organizations. Chitra is currently developing similar software to facilitate efficiency within the CMMC process for contract companies that support shipbuilding, ship modernization, and ship maintenance within the DOD and maritime industry. We will collaborate with the ODU cybersecurity research team and ManTech Advanced System International Inc.'s shipbuilding cybersecurity team to develop the CMMC compliance tool for the shipbuilding industry.

(3) **Project: Spotlighting and mitigating cyber-attacks in AIoT-enabled maritime transportation systems.**

Project Team: Yi He, ODU, Rui Ning, ODU, Yuhong Li, ODU, Peng Jiang, ODU, and Leigh Armistead, Peregrine Technical Solutions LLC

Project Abstract: The increasing adoption of Artificial-Intelligence-of-Things (AIoT) in maritime transportation systems (MTS) has the potential to bring significant benefits, including increased efficiency and safety. However, the integration of AIoT also introduces new vulnerabilities that can be exploited by the unprecedentedly evolving cyber threat actors. In this project, we strive to help ensure the safe and secure integration of AIoT in the maritime transportation industry, enabling it to realize the full potential of this technology without exposing itself to undue risks. To that end, we will spotlight the specific cybersecurity challenges faced by AIoT-enabled MTS and propose strategies for mitigating these risks. A comprehensive set of penetration tests will be tailored and performed on an MTS testbed to enable experiments and analyses of real-world cyberattacks on AIoT-enabled maritime transportation. Based on the experimental results, we will develop two defense models for improving the cybersecurity of the AIoT-enabled MTS: one can defend against the neural backdoor attacks that target on its multi-modal data inputs, and the other can detect the malicious signals hidden behind the background traffic of a complex communication network. These defense models will be designed to be practical and achievable for industry stakeholders, with a focus on the alignment with the Cybersecurity Maturity Model Certification (CMMC) program to ensure their implementation has minimal disruption to current maritime operations. Future proposals will be developed based on the project outcomes to solicit federal fundings from NSF and DoD to sustain the research topic.

(4) **Project: Maritime cybersecurity maturity model certification domain handbook.**

Project team: Sachin Shetty, ODU, Warren Bizub, SimIS, Inc., and Michael Humprey, SimIS, Inc.

Project Abstract: SimIS Inc., a Portsmouth, VA-based Capability Maturity Model Integrated (CMMI) level 3 accredited IT services and maritime platform production company, is implementing the Cybersecurity Maturity Model Certification (CMMC) 2.0 controls to support our existing customers. We deliver technology solutions for land and sea autonomous platforms. CMMC compliance goals and best practices require a thorough analysis and implementation of secure IT controls for existing maritime IT network capabilities. Maritime autonomous industry cybersecurity staff lack experience in the elevated standards prescribed by CMMC. The subject matter experts for compliant CMMC deployment are mid to high level cybersecurity engineers – not the front-line Cyber-IT technician. The experience gap between cybersecurity engineers and front-line Cyber-IT technicians' results in compliance challenges for many of the current

generation of Cyber IT technicians (System Admins, Network Engineers, etc.). The SimIS proposed project goal is to create a Maritime CMMC Domain Handbook based on the CMMC version 2.0 level 2 published system controls (levels most applicable to maritime industry) with implementation guidelines for the 14 individual control domains. Each domain playbook will provide detailed analysis, planning, and implementation roadmaps for each of the 14 domains and will be written in language suitable for maritime staff with technical level implementation knowledge. We will collaborate with our ODU cybersecurity partners coupled with Fairlead to provide translation from maritime engineering to cybersecurity engineering vocabulary by leveraging our extensive CMMC experience to translate the considerable nesting of cybersecurity and CMMC governance into a clear, scalable and standards based Maritime CMMC Domain Handbook.

(5) **Project: Exploring challenges and adoption enablers of cybersecurity maturity model certification in maritime industries**

Project team: Chon Abraham, W&M, Tracy Gregorio, G2Ops

Project Abstract: Implementation of cybersecurity guidance and governance is as complex as cyber threats themselves. This research builds on prior research funded by the CCI Experiential Learning Grant that resulted in preliminary systems analysis and design (SA&D) of the Cybersecurity Maturity Model Certification Assessment Assistant (CyMMCAA) tool for meeting Cybersecurity Maturity Model Certification (CMMC) compliance requirements. Research conducted utilized the NIST SP 800-171, NIST SP 800-171A, and other related documents that define CMMC assessment. The SA&D prior effort involved process analysis and a case study approach to map and refine manual CMMC assessment performed by G2 Ops Inc. and Registered Provider Organization (RPO) as a prime vendor for ship modernization and a real client of G2 Ops as an Organization Seeking Certification (OSC). The process illuminated the challenges of compliance by metrics of time and cost. The RPO in the prior study is the project partner for this current proposal to continue development and refinement of the CyMMCAA tool, consolidate insight for its use in CMMC compliance via a cyber roadmap, and provide guidance for cyber risk valuation costs.

(6) **Project: Navigating cybersecurity compliance challenges for the maritime industry in southeast Virginia**

Project team: Mohammad Almalag, CNU, Michael Lapke, CNU, Christopher Kreider, CNU, and Leigh Armistead, Peregrine Technical Solutions, LLC

Project Abstract: This project intends to develop a screening process to help the Maritime Industry in Hampton Roads to ensure compliance with a variety of cybersecurity requirements. It is led by Christopher Newport University and is teamed with Dr. Leigh Armistead at Peregrine Technical Solutions. To facilitate this work, the team will reach out to many shipbuilding, ship repair, and ship modernization industries in Tidewater, to perform requirements gathering all the required cybersecurity regimes to include but limited to:

- DoD-mandated Cybersecurity Maturity Model Certification (CMMC).
- National Institute of Standards and Technology (NIST) controls
- International Maritime Organization – MSC-FAL.1/Circ.3 Guidelines on maritime cyber risk management and Resolution MSC.428(98) – Maritime Cyber Risk Management in Safety Management Systems.

This will be done by a series of surveys to the maritime industry partners and the result will be a recommendation of actions that they should take to become compliant.

b) **FY 2022 COVA CCI Cybersecurity Research and Innovation Funding program**. COVA CCI provided funding through the COVA CCI Cybersecurity Research and Innovation Funding program in FY 2022 for seven total projects totaling $880,000. Five projects were approved in June 2021 for a total of $750,000. These projects will be completed in December 2022. See the article "ODU-Led Cybersecurity Projects Grant Funded for more information."

Two additional projects were funded during the 4th quarter of FY 2022 for a total of $130,000. These projects are Cybersecurity & Barriers to Technology Adoption Among Maritime Activities and 5G-BEACON: Blockchain Enhanced Architecture and Coding for Orchestrated Networks.

See all these project proposals and presentations on the COVA CCI Cybersecurity Research website.

COVA CCI Funded Research Projects – FY 2022

Project Title	PI	Co-PI	Amount	Project Dates
Toward Trustworthiness in Autonomous Vehicles	Evgenia Smirni (W&M)	H. Alemzadeh (UVA)	$150,000	7/1/2021 – 6/30/2023 (Completed)
A Real-Time Dependency Network Approach to Quantifying Risks and Ripple Effects from Cyberattacks in Shipbuilding and Repair Supply Networks	Rafael Diaz (ODU)	H. Shen (UVA)	$150,000	7/1/2021 – 6/30/2023 (Completed)

Comprehensive Assessment and Diagnostics for Federated AI Algorithms in Cyber Physical Systems	Rui Ning (ODU)	J. Le (ODU) C. Xin (ODU) X Deng (VT) Y. Hong (VT) L Freeman (VT)	$150,000 (ODU-$100000) (VT-$50000)	7/1/2021 – 5/31/2023 (Completed)
CIVIIC: Cybercrime in Virginia: Impacts on Industry and Citizens	Randy Gainey (ODU)	T. Vandecar-Burdin (ODU) J. Albanese (VCU) J. Hawdon (VT) K. Parti (VT) T. Dearden (VT)	$149,683 (ODU-$50723) (VT-$39267) (VCU-$59693)	7/1/2021 – 12/31/2022 (Completed)
Developing a Smart City Virtual Lab to Support CPS Experiential Learning	Murat Kuzlu (ODU)	S. Abdelwahed (VCU)	$150,000 (ODU-$75000) (VCU-$75000)	7/1/2021 – 6/30/2023 (Completed)
Cybersecurity & Barriers to Technology Adoption Among Maritime Activities	Mike Robinson (ODU)		$100,000 (ODU)	1/15/2022 – 11/30/2022 (Completed)
5G-BEACON: Blockchain Enhanced Architecture and Coding for Orchestrated Networks	Sachin Shetty (ODU)		$30,000 (ODU)	7/1/2022 – 6/30/2022 (Completed)

c. **FY 2023 CCI Funded Research Programs.** COVA CCI was awarded several projects from CCI and CCI NOVA during FY 2023 totaling $594,370.

FY 2023 CCI Research Projects	**Awards**	**Total Funding awarded to COVA CCI**
Experiential Learning Programs (FY 2024)	2	$199,370
Arts and Design	1	$25,000
Securing Interactions between Humans and Machines	2	$120,000
Totals	**5**	**$344,370**

Experiential Learning Programs (FY 2024)		**Total Funding Awarded: $199,370**		
Project Title	PI / Univ	Co-PI / Univ	Funding	Project Dates
From Experiential Learning to Practice: A pre-apprenticeship program. **(Click to view website)**	Stephanie Blackmon (WM)		$99,370	6/1/23 – 6/30/24
Expanded Scalable Pilot Program for Experiential Learning in CCI Through the Commonwealth STEM Industry Internship Program **(Click to view website)**	Chris Carter (ODU/VSGC)		$100,000	6/1/23 – 6/30/24

Arts and Design		Total Funding Awarded: **$25,000**		
Project Title	PI / Univ	Co-PI / Univ	Funding	Project Dates
Unveiling Invisible Sight: Exploring AI Perception and Privacy in IoT Devices through Interactive Art	Rui Ning (ODU)		$25,000	6/1/23 – 6/30/24

(Click to view website)				

Securing Interactions between Humans and Machines (Click to view website)		**Total Funding Awarded: $120,000**		
Project Title	PI / Univ	Co-PI / Univ	Funding	Project Dates
From Gap to Gain: Counter Human Smuggling by Identifying Deceptive Advertisements in social media	Faryaneh Poursardar (ODU)	Vikas Ashok (ODU) Erika Frydenlund (ODU	$60,000	5/12/23 – 5/31/24
Trust AI: Enhancing Human Confidence and Trust in Deep Learning Models	Rui Ning (ODU)	Xiao Yang (ODU) Lusi Li (ODU) Xinwei Deng (VT)	$60,000	5/12/23 – 5/31/24

FY 2023/2024 CCI NOVA Research Projects	**Awards**	**Total Funding awarded to COVA CCI**
2023 CATAPULT (Cyber Acceleration, Translation, and Advanced Prototyping for University Linked Technology	3	$150,000
2024 CATAPULT (Cyber Acceleration, Translation, and Advanced Prototyping for University Linked Technology	2	$100,000
Totals	**5**	**$250,000**

2023 CATAPULT (Cyber Acceleration, Translation, and Advanced Prototyping for University Linked Technology)		**Total Funding Awarded: $150,000 (Funds provided by CCI NOVA)**		
Title	PI / Univ	Co-PI / Univ	Funding	Project Dates
Generative Adversarial Network for Deep Learning-based Malware Detection Intellectual Property (IP) and Commercialization (FY 2023)	Yan Lun (CNU)	Sachin Shetty (ODU)	$50,000	5/12/23 – 5/31/24
A Holistic Evaluation Framework for Multi-Modal AI Security and Trustworthiness on Federated IoE (FY 2023)	Rui Ning (ODU)	Peng Jiang (ODU)	$50,000	5/12/23 – 5/31/24
Distributed Online Intrusion Detection System for IoT devices via Power Side-channel Auditing (FY 2024)	Gang Zhou (WM)	Chunsheng Xin (ODU)	$50,000	7/1/22 - 6/30/23

2024 CATAPULT (Cyber Acceleration, Translation, and Advanced Prototyping for University Linked Technology)		**Total Funding Awarded: $100,000 (Funds provided by CCI NOVA)**		
Title	PI / Univ	Co-PI / Univ	Funding	Project Dates
Extended Reality empowered 5G Telemedicine mentoring	Sachin Shetty (ODU)	Peter Foytik (ODU)	$50,000	7/1/22 - 6/30/23
Algorithm Evaluation for Backdoor Detection and	Jiang Li (ODU)		$50,000	7/1/22 - 6/30/23

Mitigation in Remote Sensing Systems				

d. **FY 2022 CCI Funded Research Programs.** COVA CCI received multiple projects in FY 2022, and they extended into FY 2023 with three continuing into the 1st quarter of FY 2024, totaling $386,874.

FY 2022 CCI Research Projects	**Awards**	**Total Funding awarded to COVA CCI during FY 2022**
Securing NextG	2	$125,000
Cybersecurity Challenge	1	$12,500
Cybersecurity Research Collaboration (FY 2022)	1	$50,000
Scalable Experiential Learning Programs (FY 2022)	2	$199,374
Totals	**6**	**$386,874**

Securing NextG (Click to view website)		**Total Funding Awarded: $125,000**		
Title	PI / Univ	Co-PI / Univ	Funding	Project End Date
Radio Access Network Slicing Security for NextG Networks	Laura Freeman (VT)	Sachin Shetty (ODU)	$25,000 (ODU) $75,000 (VT)	12/31/2022 (Completed)
Blockchain-based Deep Learning Management to Enable Smart NextG Wireless Networks	Rui Ning (ODU)	Hongyi Wu (ODU) Hongzhi Guo (NSU)	$100,000	8/31/2023 (Ongoing)

Cybersecurity Challenge		**Total Funding Awarded: $12,500**		
Title	PI / Univ	Co-PI / Univ	Funding	Project End Date
The Legacy and Sensitive Device IoT Passive Connection Project	Robert Tureman (Camp Community College)	NA	$12,500	2/25/2022 (Completed)

Cybersecurity Research Collaboration FY 2022		**Total Funding Awarded: $50,000**		
Title	PI / Univ	Co-PI / Univ	Funding	Project End Date
Deep Resilience for Multifaceted Federated Learning in IoT (Click to view website)	Cho (VT)	Hongyi Wu (ODU)	$50,000 (ODU) $75,000 (VT)	12/24/2022 (Completed)

Scalable Experiential Learning Programs FY 2022		**Total Funding Awarded: $199,374**		
Title	PI / Univ	Co-PI / Univ	Funding	Project End Date
Disinformation as Data Poisoning (Click to view website)	Daniel Runfula/W&M	NA	$99,374	9/30/2023 (Ongoing)
Expanded Scalable Pilot Program for Experiential	Mary Sandy ODU/VSGC	NA	$100,000	9/30/2023 (Ongoing)

Learning in CCI Through the Commonwealth STEM Industry Internship Program" (Click to view website)				

e. **FY 2021 CCI Funded Research Programs.** COVA CCI was awarded multiple projects to the amount of $1,927,195, in response to requests for proposal sponsored by CCI in FY 2021. Most of these projects were completed by December 2022. See the CCI website for details on these projects.

CCI Research Projects	**Awards**	**Total Funding awarded to COVA CCI during FY 2021**
Collaborative Research Funds (FY 21/22)	7	$1,119,666
Building Bridges: Arts and Design	2	$37,500
Experiential Learning	2	$300,000
Experiential Research in CCI Testbeds	3	$249,906
Role of Cybersecurity in the Spread of Disinformation and Misinformation	3	$147,790
Cybersecurity Innovation Bridge Funds	3	$71,333
Totals	**17**	**$1,927,195**

Collaborative Research Funds (FY 21/22) Projects were awarded in January 2021. See this article for more details - **cci-funds-22-cybersecurity-grants**.		**Total Funding Awarded: $1,119,666**		
Title	PI / Univ	Co-PI / Univ	Funding	Project End Date
A Systematic Evaluation of Smart City Security and Privacy	Adwait Nadkarni (WM)	Yuan Tain (UVA)	$194,850 WM - $95,460 UVA – $99,390	12/31/2021 (Completed)
Virginia State Investments in Port of Virginia: A simulation-based framework for identifying, assessing, and mitigating systemic cybersecurity at the operational technology layer	Rafael Diaz (ODU)	H. Shen (UVA)	$200,000 ODU – $77,761 UVA – $122,239	6/30/2022 (Completed)
Backdoor Detection and Mitigation in Deep Neural Networks	Hongyi Wu (ODU)	Chunsheng Xin (ODU) Jiang Li (ODU) Rui Ning (ODU) Jin-Hee Cho (VT) Leigh Armistead (Peregrine)	$184,816 ODU – $136,532 VT – $48,284	8/30/2022 (Completed)
Secure and Privacy Preserving 5G Network for Connected Vehicles	Sachin Shetty (ODU)	Tan Le (ODU) Jeff Reed	$200,000 ODU – $57,523	12/31/2022 (Completed)

		(VT) Cong Shen (UVA) Duminda Wegesekera (GMU) Kai Zend (GMU)	VT – $35,976 UVA – $35,500 GMU – $71,001	
DeepPOSE: Securing Transportation Systems from GPS Spoofing Attack	Chunsheng Xin (ODU)	Danella Zhao (ODU) Yanxiao Zhao (VCU) Kevin Kefauver (GCAPS)	$200,000 ODU – $101,175 VCU – $50,000 VT – 48,825	12/31/2022 (Completed)
Sensor Degradation Detection Algorithm for Automated Driving Systems	Michelle Chaka (VT)	Chunsheng Xin (ODU)	ODU - $75,000	3/30/2022 (Completed)
Developing an Open Architecture Testbed and Learning-based Management for Smart Cities (OpenCity)	Sherif Adbelwahed (VCU)	Murat Kuzlu (ODU)	ODU - $65,000	6/30/2022 (Completed)

CCI Arts and Design Collaboration Project (Click to view website)		**Total Funding Awarded: $37,500**		
Title	PI / Univ	Co-PI / Univ	Funding	Project End Date
Develop a Gamified Mobile Application for Cybersecurity Education and Assessment via a User Centered Design Process	Kevin Moberly (ODU)	Ryan Patton (VCU) Deri Draper (ODU) Jeff Pittges (Radford) Bobby Keener (CivilianCyber)	ODU - $25,000	8/31/2021 (Completed)
Moving Choreography to a New Universe: an AI-Driven Privacy Automation Approach	Kate Sicchio (VCU)	Sachin Shetty (ODU) Yan Lu (ODU)	ODU - $12,500	8/31/2021 (Completed)

The Arts and Design Collaboration challenges the community of researchers to reimagine and depict the results of cybersecurity research either for scientific purposes, or for creative arts practice purposes. In response to this RFP, COVA CCI was awarded two projects which were completed in FY 2022. An exhibition was held at the Taubman Museum of Art in Roanoke, Virginia, November 2-5, 2022, showcasing all the five CCI funded projects. You can learn more about this exhibit and these projects by visiting the CCI Art of Cybersecurity webpage.

CCI Experiential Learning Project		**Total Funding Awarded: $300,000**		
Title	PI / Univ	Co-PI / Univ	Funding	Project End Date
Cyber Risk Management and Analytics: An Interdisciplinary Approach in Experiential Learning	Chon Abraham (W&M)		$150,000	5/30/2022 (Completed)
Cybersecurity Monitoring and	Sachin	Saltuk Karahan (ODU)	$150,000	12/31/2022

Assurance Training Program for Safe and Secure Port Operations	Shetty (ODU)	Sarada Prasad (ODU) Jim Haug (Longwood) Darrell Carpenter, (Longwood) Jennifer Maeng (UVA) Thomas Polmateer (UVA) Lessie Oliver-Clark (VSU) Wei-Bang Chen (VSU) Wookjin Choi (VSU) Rich Ceci (VIT)		(Completed)

CCI Experimental Research in CCI Testbeds		**Total Funding Awarded: $249,906**		
Title	PI / Univ	Co-PI / Univ	Funding	Project End Date
Experimental Research: Investigating Robustness and Uncertainty of AI Algorithms in Cyber Physical Systems	Rui Ning (ODU)	Jiang Li (ODU) Xinwei Deng (VT) Laura Freeman (VT) Yili Hong (VT)	$49,906	12/31/2022 (Completed)
Beamforming Optimization for 5G and Beyond	Chunsheng Xin (ODU)	Hongyi Wu (ODU)	$50,000	12/31/2022 (Completed)
Building a THz Testbed to Expand CCI 5G Testbed for 6G Research	Hongyi Wu (ODU)	Chunsheng Xin (ODU)	$150,000	6/30/2023 (Ongoing)

Role of Cybersecurity in Spread of Disinformation and Misinformation		**Total Funding Awarded: $147,790**		
Title	PI / Univ	Co-PI / Univ	Funding	Project End Date
The Acceptance and Effectiveness of Explainable AI-Powered Credibility Labeler for Scientific Misinformation and Disinformation	Jian Wu (ODU)	Jerimiah Still (ODU) Jiang Li (ODU)	$63,790	8/31/2023 (Ongoing)
Question Under Discussion Framework to Analyze Misinformation targeting Security Researchers	Sachin Shetty (ODU)	Teresa Kissel (ODU)	$65,000	12/31/2022 (Completed)
Artificial Intelligence Based Analysis of Misinformation and Disinformation Efforts from Mass Media and Social Media in Creating Anti-U.S. Perceptions	Kavak Hamdi (GMU)	Saltuk Karahan (ODU) Hongyi Wu (ODU) Kim Perez (TCC)	$64,996 (ODU - $20,000)	3/30/2023 (Completed)

See these two articles, CCI Researchers Meet to Discuss How Cybersecurity Can Combat Misinformation and Disinformation and Professors Study Cybersecurity's Role in Curbing the Spread of Disinformation to learn more about this program.

Cybersecurity Innovation Bridge Fund		**Total Funding Awarded: $71,333**		
Title	PI / Univ	Co-PI / Univ	Funding	Project End Date

A Minimum Viable Product to Secure IoT Devices through Power Auditing and Privacy Preserved Convolutional Neural Networks	Gang Zhou (WM)	Chunsheng Xin (ODU) Danella Zhao (ODU)	$50,000 (ODU - $21,333)	5/30/2022 (Completed)
GINDAR - Generative Adversarial Networks (GAN)-based Internet-of-Medical-Things (IoMT) Network Detection and Response	Tamer Nadeem/VCU	Sachin Shetty (ODU)	$50,000 (ODU - $0)	5/30/2022 (Completed)
A Platform for Improving AI Trust in 6G Networks	Murat Kuzlu (ODU)		$50,000	8/31/2022 (Completed)

Research

$21.15 million
External Research since 2020 to COVA CCI affiliated researchers

$5.1 million
CCI Funded Research since 2020 to COVA CCI affiliated researchers

6 Research Scientists
4 – ODU
2 - W&M

$786,000
Cybersecurity Lab Infrastructure Upgrades to COVA CCI academic partners since 2020

3 ODU Faculty hired as Supply Chain/Maritime Cybersecurity Cluster with GMU

Dr. Murat Kuzlu, Associate Professor, Department of Engineering Technology, Old Dominion University

"The funding from CCI has significantly contributed to my career, it has provided the necessary financial resources to conduct advanced research in the fields of next generation communications (5G and beyond), the Internet of Things (IoT), explainable AI (XAI), Trustworthy AI, and smart cities. Collaboration with professors from other universities in Virginia (i.e., VCU and VT), leading experts, and industry partners has been facilitated, fostering knowledge exchange and creating opportunities for advanced solutions and external grants. Overall, this funding has played a vital role in promoting me to Associate Professor (with Early Tenure), fueling research endeavors, and enabling significant contributions to the development of emerging technologies, such as next-generation communications (5G and beyond), the Internet of Things (IoT), Explainable AI (XAI), Trustworthy AI, and smart cities."

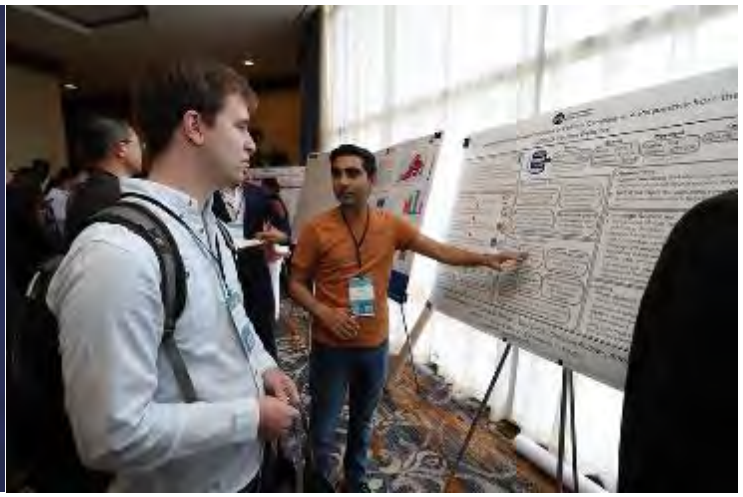
https://covacci.org/research/cybersecurity-research/

Workforce and Talent Development

$1.1 million
COVA CCI Funding to support workforce and talent development with COVA CCI academic partners since 2020

360+
Students from COVA CCI and other CCI academic partners since 2020

Workforce Development funded programs
- Cybersecurity Undergraduate Research
- Innovate Cyber Challenge
- Cybersecurity Internships
- Graduate Student Experiential Learning
- Graduate Research Assistants



Commonwealth Cyber Initiative

--- CCI Mission ---

Research, **innovation**, and **workforce development** at the intersection of cybersecurity, autonomy, and intelligence

320+
researchers

41
higher ed institutions

$114.5m
Total sponsored programs

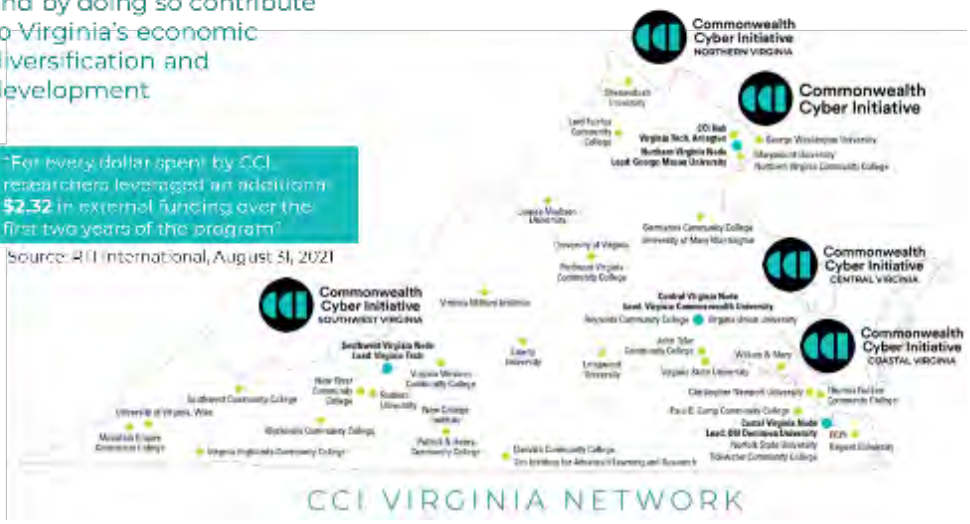
--- CCI Goal ---

To make Virginia a globally recognized center of excellence in cybersecurity, and by doing so contribute to Virginia's economic diversification and development

Commonwealth Cyber Initiative

"For every dollar spent by CCI researchers leveraged an additional **$2.32** in external funding over the first two years of the program"

Source: RTI International, August 31, 2021



Commonwealth Cyber Initiative
COASTAL VIRGINIA

COVA CCI Website
www.covacci.org