PROJECT SUMMARIES *(As provided by ERDC)* **2020 SUMMER RESEARCH INTERNSHIP**			
Laboratory	**PWS Code**	**Discipline and Level**	**Summary**
Construction Engineering Research Laboratory (CERL) Champaign, Illinois	**1**	Electrical, Computer or Mechanical Engineering BS (Upper Level) MS-ME, PHD	**Digital signal processing, sensor data fusion, and machine learning:** Assist in development of methodologies to fuse multi-modal sensor data into a dynamic world view for path planning, navigation, obstacle detection and avoidance for robotic ground vehicles. **Agent-based modeling and simulation:** Assist in the development of an agent-based simulation environment in order to investigate methodologies that will enable the coordination and collaboration of multiple ground vehicle robots performing complex tasks within a controlled environment.
	2	Computer Engineering BS, MS-ME, PHD	The Soil and Water Team performs research and decision support related to sustainable range and environmental management for risk and impact analysis. This effort sustains the CERL mission of Sustainable Range Lands to support warfighter and training requirements. Research in this area includes developing, characterizing, and modeling training doctrine linkages to maneuver impacts from military vehicles on training lands. Tasks will be to utilize remotely sensed data to evaluate maneuver capability in relation to range land configuration, soil & vegetation resiliency, slope, vehicle dynamic properties, vegetation density, etc. The task involves analysis of remote data followed by field evaluations that will require travel and handling materials with weights of up to 30 pounds. This task will require that experiments be set up and executed by the end of June. Task 2 will be to process experimental and numerical data to develop and code a model into GIS using Python and R to rapidly evaluate the field conditions with training doctrine and vehicle physical/dynamic properties.
	3	Computer Engineering BS (Upper Level) MS-ME, PHD	The Engineering Processes Branch conducts research in support of the Army's Implementation of Autonomous Vehicles (AV) on Military Installations. Several installations are exploring this alternative as a pilot project, and ERDC-CERL integrates, identifies, and assess this transportation technology with its potential benefits, for example: lowering costs, improve safety and quality of life, and enhancing mission readiness and assurance. The research provided can be divided into the following lines of effort: Infrastructure & Operations, Energy & Economy, Data Architecture & Cyber Security, Data Analytics. Human Factors, Planning & Policy, and Program Integration. The Infrastructure & Operations research involves the AV interactions with built and natural structures and environment and data fusion for decision-making. For task performance the following is needed: skills in CAD & GIS software, and knowledgeable in road design, topography, signage, traffic lights, mass transit systems, and other transportation concepts. The task will require to generate figures, drawings, charts, tables, and write-ups that will be used in future technical reports. Also, as necessary, travel to an installation to perform assessments, take photographs, and conduct surveys, will be required.

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Coastal and Hydraulics Laboratory (CHL) Vicksburg, Mississippi	**4**	Civil Engineering MS-ME, PHD	ERDC Mission Area & Support to ERDC Mission: The effort sustains ERDC mission by conducting research to quantify the vulnerability of coastal areas to flooding hazards. Storm surge and waves typically represent the most significant sources of flooding in the coastal environment. Currently coastal flood hazard assessment is performed through the use of probabilistic storm surge models, such as the Joint Probability Method with Optimal Sampling (JPM-OS) which has become the standard-of-practice for quantifying flooding hazards of hurricane-prone coastal sites. Specific Tasks: The main objective of the proposed study is to evaluate existing methodologies and algorithms for probabilistic modeling of hurricane hazards, including the representation of vortex structure of historical tropical cyclones (TCs) in the North Atlantic basin. Student with computer programming skills on Python (required), FORTRAN and MATLAB languages.
	5	Civil or Coastal Engineering BS, MS-ME, PHD	The effort sustains ERDC mission by conducting research to assess the performance of coastal rubble mound structures that are part of the Nation's navigation infrastructure. Coastal structures play a central role within the USACE's mission to provide protection to waterborne transportation systems such as harbors and waterways. Specific Tasks: The main objective of the work is to develop generalized reliability computation tools for primary failure modes including wave run-up, overtopping, seaside stability, leeside stability, and damage progression for rubble mound structures. This information will improve design guidance and is essential for coastal structures asset management funding prioritization. Specific project tasks include extraction of cross sections from LIDAR data and Digital Elevation Models. Write and edit MATLAB and Python scripts to process wave and water level data, perform statistical analyses, and perform computation of failure modes previously described. Apply scripts at multiple locations. Tasks require proficiency in MATLAB and/or Python, ArcGIS or QGIS experience, basic knowledge of probability and statistical concepts, and familiarity with the application of coastal and/or hydraulic engineering design concepts in a coastal environment. • Conduct literature review about probabilistic methods for extreme value analysis, including stochastic simulation approaches such as Monte Carlo life-cycle. • Develop and review Python, FORTRAN and/or MATLAB scripts for TC wind and pressure profiles and fields. • Evaluate the estimation of characteristic TC parameters such as central pressure deficit, radius of maximum winds, and translational speed. • Conduct numerical experiments to evaluate the performance of different TC wind and pressure profile models through comparison with observed and hindcast TC data sets. • Evaluate various multivariate, spatial interpolation and regression techniques to characterize a TC wind and pressure fields.

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Environmental (EL) Vicksburg, Mississippi	**6**	Civil and Environmental Engineering, Environmental Geoscience, Biology, Applied Mathematics, or Statistics BS (Upper Level) MS-ME, PHD	ERDC is seeking to better understand the development of Harmful Algal Blooms in USACE water bodies to support our Civil Works mission area. The goal of this task is to assist ERDC researchers in the development and analysis of water quality time series for several USACE reservoirs. There is a need to organize, and conduct QA/QC, and plot historical datasets for key parameters such as hydrologic flows, meteorology, nutrient and geochemical measurements, biological characteristics, and operational management practices. This work will allow to learn about and create several types of regression and co-variance tests using the time series created. It is needed to integrate these products with qualitative information from the reservoir operators to summarize the Bio-Geo-Chemical evolution of the water bodies. In addition, it will be needed to attend project meetings, seminars and workshops; read relevant literature; and communicate with the project team. Comfort working in MS Excel is required and familiarity with VBA or R is preferred.
	7	Environmental and/or Civil Engineering MS-ME	The Environmental Laboratory's Applied Research Planning Center has the mission to develop and demonstrate innovative comprehensive planning solutions and capabilities for Department of Defense installations. From the research and development of these innovative plans and technologies to the beta testing of new planning processes, we are creating installations that can make information based decision in real-time. Resilient and sustainable approaches to mission, facility and resource planning is all about meeting the needs of DoD installations now while making sure that the future needs of your community are not jeopardized. It is a systems-based approach that incorporates many elements to avoid narrowly focused decision-making, wasted resources, missed opportunities, and reduced overall health and quality of life for communities, ERDC mission of this type of planning and engineering provides a roadmap for installations in achieving increased security, resilience, readiness, and mission assurance. Specific Tasks: The first task shall be accessing existing data sources and performing an integrated assessment to characterize the baseline conditions and risks with regard to energy and water security. That information will be integrated into a roadmap that the installation can use to actively pursue capital investments including but not limited to infrastructure improvements that increase the energy and water security and resilience and security of the installation. The task shall address best management practices and Operations and Maintenance (O&M) measures where applicable. Deliverables will document the installation requirements, risks, opportunities, projects, funding strategy, and performance metrics.
	8	Environmental and/or Civil Engineering MS-ME	The Environmental Laboratory's Applied Research Planning Center has the mission to develop and demonstrate innovative comprehensive planning solutions and capabilities for Department of Defense installations. From the research and development of these innovative plans and technologies to the beta testing of new planning processes, we are creating installations that can make information based decision in real-time. Resilient and sustainable approaches to mission, facility and resource planning is all about meeting the needs of DoD installations now while making sure that the future needs of your community are not jeopardized. It is a systems-based approach that incorporates many elements to avoid narrowly focused decision-making, wasted resources, missed opportunities, and reduced overall health and quality of life for communities, ERDC mission of this type of planning and engineering provides a roadmap for installations in achieving increased security, resilience, readiness, and mission assurance. Specific Tasks: The first task shall be accessing existing data sources and performing an integrated assessment to characterize the baseline conditions and risks with regard to energy and water security. That information will be integrated into a roadmap that the installation can use to actively pursue capital investments including but not limited to infrastructure improvements that increase the energy and water security and resilience and security of the installation. The task shall address best management practices and Operations and Maintenance (O&M) measures where applicable. Deliverables will document the installation requirements, risks, opportunities, projects, funding strategy, and performance metrics.

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Laboratory	**PWS Code**	**Discipline and Level**	**Summary**
Geotechnical and Structures laboratory (GSL) Vicksburg, Mississippi	**9**	Civil Engineering BS	This task supports ERDC's Mission on Force Projection. Research will be related to airfield pavements, site characterization, temporary airfield surfaces, and/or rapid pavement repair. Tasks will include both laboratory and full-scale tests of backfill materials and surface capping techniques in support of Airfield Damage Repair and expedient surfacing. Testing may include a variety of civil engineering materials such as soil, Portland cement concrete, asphalt concrete, rapid setting materials, expandable urethane foams, fiber reinforced polymer matting systems, and/or stabilized soil. TDY may be required to support full-scale demonstrations of methods and materials. Field work on the Vicksburg campus is expected. Field work will require manual labor, data collection, project management, and exposure to heat and outdoor conditions.
	10	Chemical Engineering, Chemistry, Physics MS-ME, PHD	This research is pertaining to the synthesis of novel composite materials for use in military engineering applications. The research will support in work in an ongoing 6.1 basic research project. The main research tasks are centered around the synthesis and characterization of stimuli-responsive polymer grafted carbon nanotube (CNT) composite materials. The goal of this work will be to develop structure-property relationships using controlled synthesis methods and the role various applied stimuli (temperature, pH) on properties and processing. Characterization and evaluation of materials will range from thermal and structural analysis (DSC, Raman, NMR) to mechanical properties (DMA, Rheology).
	11	Mathematics or Engineering (good background in statistics and data analysis) BS (Upper Level)	ERDC Mission Area(s) & Support to ERDC Mission: This research focus is on the Forensic Encyclopedia Project which encompasses several efforts involved with the evaluation of weapon signatures against various armor targets or witness items to provide a better post-attack assessment of the actual threat. Specific Tasks: • Data analysis and interpretation • Database input and evaluation • Analysis of photographs using photogrammetric software tools • Assisting with experiment preparation and execution • Collection of field data
	12	Mathematics, Physics, Electrical or Computer Engineering (statistical analysis, image processing, and programming experience) BS, MS-ME, PHD	This research is relevant to the ERDC mission on Evaluation of Manned and Unmanned Ground Vehicle Performance for the research Thrust Areas of Environmental Effects on Sensor Performance. Relation of This Project: Line of experimentation used to amplify the quantity of training images available to improve the robustness of unmanned systems that utilize image based machine learning in order to achieve autonomy. Results will allow more realistic and better M&S performance, and an increased capability to support autonomous ground system development. Analyze, evaluate, and revise the research plan proposed by the PI. • Collect and label training imagery relevant to desired environmental conditions. • Build machine learning algorithms to generate synthetic images. • Perform analysis on synthetic images obtained. • Write the necessary documentation of the experiment and results, including the deliverables described below and potentially: abstracts, conference submissions, journal article submissions, etc.

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Laboratory	**PWS Code**	**Discipline and Level**	**Summary**
Geotechnical and Structures laboratory (GSL) Vicksburg, Mississippi	**13**	Mathematics, Physics, Electrical or Computer Engineering (statistical analysis, programming experience and CAD experience) MS-ME	The research relevance to the ERDC missions include evaluate sensor performance and ensure superior situational awareness in the research thrust areas of Environmental Effects on Sensor Performance, Terrain Analysis for Signal and Sensor Phenomenology. Line of experimentation used to both quantify LiDAR performance under prescribed circumstances and relate these results to ERDC's current modeling and simulation technologies. Results will allow more realistic and better M&S performance, as well as a better physical understanding of LiDAR system performance. Tasks include: • Analyze, evaluate, and revise the research plan proposed by the PIs • Conduct LiDAR experimentation according to mutually agreed upon plan • Build experimental set-up, run exhaustive tests, perform analysis of results obtained • Write the necessary documentation of the experiment and results, including the deliverables described below and potentially: abstracts, conference submissions, journal article submissions, etc.
	14	Mechanical Engineering, MS-ME, PHD	ERDC Mission Area(s) & Support to ERDC Mission: The Structural Mechanics Branch is analyzing High Strength Concrete components subjected to impulsive loadings. This effort sustains the ERDC mission to solve our Nation's most challenging problems in military engineering. Specific Tasks: The proposed plan is to support and develop numerical models (Finite Element Analysis, and Single Degree of Freedom) of High Strength Concrete components subjected to impulsive loadings to predict the structural response and damage. Test results will be used for calibration and to assess the numerical models ability to capture the structural response, and damage.
	15	Civil Engineering BS	ERDC Mission Area(s) & Support to ERDC Mission: The Structural Mechanics Branch is analyzing High Strength Concrete components subjected to impulsive loadings. This effort sustains the ERDC mission to solve our Nation's most challenging problems in military engineering. Specific Tasks: The proposed plan is to support and develop numerical models (Finite Element Analysis, and Single Degree of Freedom) of High Strength Concrete components subjected to impulsive loadings to predict the structural response and damage. Test results will be used for calibration and to assess the numerical models ability to capture the structural response, and damage.
	16	Civil Engineering (background on structures, interest statistics and some programming [e.g. Python, R]) BS, MS-ME	ERDC's Bridge Safety Team supports the Installation Management Command's (IMCOM) Army Dams and Transportation Infrastructure Program (ADTIP) with the management and execution of the Army's bridge inspection program. This supports ERDC mission by providing technical expertise in multiple disciplines applied to bridges with the purpose of facilitating mission readiness and mobilization of the nation's troops while maintaining public safety. The first task of this scope is to perform the load rating of a series of bridges to develop a data base with variables of interest. This requires collecting as-built drawings of the superstructure of concrete bridges from multiple sources, performance of the load rating calculations by hand, programming of the load rating using Python, and recording the data of each bridge. The second task will be to compare the load ratings performed to a previously developed statistical model. The third task will be to develop a statistical model using the data from the load ratings collected and compare its performance to the previously developed model.

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Laboratory	**PWS Code**	**Discipline and Level**	**Summary**
Geotechnical and Structures laboratory (GSL) Vicksburg, Mississippi	**17**	Civil/Structural Engineering BS, MS-ME	ERDC's Bridge Safety Team supports the Installation Management Command's (IMCOM) Army Dams and Transportation Infrastructure Program (ADTIP) with the management and execution of the Army's bridge inspection program. This supports ERDC mission by providing technical expertise in multiple disciplines applied to bridges with the purpose of facilitating mission readiness and mobilization of the nation's troops while maintaining public safety. The main objective of the research is to evaluate the predictive capabilities of different analytical methods to estimate bridge foundation dimensions such as reverse engineering, inference from site conditions, and artificial neural networks. Specific tasks include: • Collection of relevant data about bridges with known foundation dimensions. A variety of documentation that will be used to collect this information includes, but is not limited to, routine bridge inspection reports, as-built foundation plans, and boring logs among other construction documents. These documents will help with the calibration of the predictive methods. • Estimate bridge design loads. • Determine the foundation dimensions using the proposed procedures. • Validate the predictive processes by comparing the estimated foundation dimensions with real embedment dimensions.
	18	Mechanical or Civil Engineering, BS, MS-ME	The Survivability Engineering Branch is engaged in research for Modeling Failure of Urban Materials. This effort sustains the ERDC mission by pursuing the development and demonstration of Force Protection solutions to enable the soldier in the Urban Environment. Research in this area includes developing, characterizing, modeling, and testing of urban materials for protection against air blast, fragmentation, and penetration. Primary task of this scope is to perform computational modeling and process all ensuing data to validate against a material's experimental response to blast and ballistic threats. The task might require travel and handling materials with weights of up to 50 pounds. The research deals with the following fields/areas: Finite Element Analysis and Numerical Modeling Knowledge, Python Programming, and HPC computing in a Linux environment.
	19	Electrical Engineering, Physics MS-ME	The Survivability Engineering Team is engaged in multi-disciplinary research and decision support related to providing research and applications of unconventional countermeasures to enhance the protection of military assets and personnel. This effort sustains the ERDC mission of Unconventional Counter-measures for Force Protection. Research in this area includes developing, characterizing, modeling, and testing various materials for protection against detection in the electromagnetic spectrum. The first task of this scope is to familiarize with the objectives of Coatings Research for Signature Management (CRSM) work unit. The task involves field and laboratory evaluations that will include handling materials with weights of up to 50 pounds. The second task will be to process and analyze all the experimental and numerical data. An understanding of the data will allow the team to determine the behavior of the materials tested in the first task under diverse conditions. The results would be used to develop a technical report on the project in task 1.

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Laboratory	**PWS Code**	**Discipline and Level**	**Summary**
Geotechnical and Structures laboratory (GSL) Vicksburg, Mississippi	**20**	Mechanical, Structural or Civil Engineering MS-ME	The Survivability Engineering Branch has as a mission the development and demonstration of force protection solutions to enable the soldier in the urban environment. This effort sustains the ERDC mission by increasing the knowledge of ballistic and fragmentation resistance of common urban and protective materials. Research in this area includes the development, characterization, modeling, and testing of urban materials for protection against air blast, fragmentation, and penetration of conventional weaponry. The primary task of this scope is to conduct laboratory and field testing to characterize the material response against fragmentation and small arms threats. The task involves field evaluations that will require travel and handling materials with weights of up to 50 pounds. This task will require that experiments be set up and executed by the end of June. The second task focuses in the analysis of the data which will be utilized for the validation of fast-running algorithms. The fast running algorithms will allow the quick calculation of residual velocities and depth of penetration as a function of striking velocity.
	21	Civil Engineering, Structural or Mechanical Engineering PHD	The Survivability Engineering Branch has the mission to develop and demonstrate innovative force protective solutions and capabilities against most current threats in the urban environment. From the research and development of these innovative protection systems, survivability decision aids have been developed to not only allow for rapid assessment of current protection postures, but also to provide enhanced designs to increase defense against attacks. This particular expertise in engineering solutions is shared through algorithms, software, manuals, and other means to form an expedient connection between researchers developing the latest protection methods and guidelines and the soldier in the field. This effort sustains ERDC mission by developing efficient methods to evaluate current urban materials/structures performance against air blast effects of conventional weapons. Specific Tasks: The first task of this scope is to develop a Finite Element Model (FEM) in LS-DYNA of a unitary wall panel to evaluate blast performance. The task involves structural dynamic basic knowledge and understanding of explicit FEM setup. This task will require a FEM in LS-DYNA to be set up and executed by the end of June. The second task is to perform a parametric study to evaluate the ratio of residual kinetic energy to total energy at failure moment using FEM developed in Task one under diverse loading conditions and different unitary panel configurations. From Task two, the student will develop the conversion coefficient chart as a function of unitary panel periods of vibration (Ts).

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Laboratory	**PWS Code**	**Discipline and Level**	**Summary**
Information Technology laboratory (ITL) Vicksburg, Mississippi	**22**	Computer Science; Computer Engineering BS, MS-ME, PHD	The Computational Analysis Branch is involved with supporting the use of High Performance Computing resources as platforms for machine learning applications. Machine learning algorithms are able to extract information from large quantities of data that would be difficult or impossible to accomplish with traditional computational methods. As such, HPC-enabled machine learning is a capability that supports multiple ERDC business and mission areas. Research in this area involves identifying and adapting specific machine learning implementations for HPC, removing barriers for the use of such algorithms, and working with teams to adapt or implement the algorithms for specific projects. There are currently application case studies for this initiative from the Engineered Resilient Systems, Military Engineering, Water Resources, and Geospatial Research and Engineering missions. Specific Tasks: The first task is to determine a reproducible process for machine learning applications involving data integration and automated labeling of data for machine learning. This task involves evaluating the quality of rules for integrating data sources and assessing the overall methodology for labeling events within integrated data sets. The second task is to implement one or more analytics algorithm and demonstrate their use as part of the data integration and labeling workflow.
	23	Computer Science; Computer Engineering BS, MS-ME, PHD	The Computational Analysis Branch is involved with supporting the use of High Performance Computing resources as platforms for machine learning applications. Machine learning algorithms are able to extract information from large quantities of data that would be difficult or impossible to accomplish with traditional computational methods. As such, HPC-enabled machine learning is a capability that supports multiple ERDC business and mission areas. Research in this area involves identifying and adapting specific machine learning implementations for HPC, removing barriers for the use of such algorithms, and working with teams to adapt or implement the algorithms for specific projects. There are currently application case studies for this initiative from the Engineered Resilient Systems, Military Engineering, Water Resources, and Geospatial Research and Engineering missions. Specific Tasks: The first task is to determine a reproducible process for machine learning applications involving data integration and automated labeling of data for machine learning. This task involves evaluating the quality of rules for integrating data sources and assessing the overall methodology for labeling events within integrated data sets. The second task is to implement one or more analytics algorithm and demonstrate their use as part of the data integration and labeling workflow.
	24	Computer Science; Computer Engineering BS, MS-ME, PHD	The Computational Analysis Branch is involved with supporting the use of High Performance Computing resources as platforms for machine learning applications. Machine learning algorithms are able to extract information from large quantities of data that would be difficult or impossible to accomplish with traditional computational methods. As such, HPC-enabled machine learning is a capability that supports multiple ERDC business and mission areas. Research in this area involves identifying and adapting specific machine learning implementations for HPC, removing barriers for the use of such algorithms, and working with teams to adapt or implement the algorithms for specific projects. There are currently application case studies for this initiative from the Engineered Resilient Systems, Military Engineering, Water Resources, and Geospatial Research and Engineering missions. Specific Tasks: The first task is to determine a reproducible process for machine learning applications involving data integration and automated labeling of data for machine learning. This task involves evaluating the quality of rules for integrating data sources and assessing the overall methodology for labeling events within integrated data sets. The second task is to implement one or more analytics algorithm and demonstrate their use as part of the data integration and labeling workflow.

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Laboratory	**PWS Code**	**Discipline and Level**	**Summary**
Information Technology laboratory (ITL) Vicksburg, Mississippi	**25**	Computer Science; Computer Engineering BS, MS-ME	Research conducted in the development of a prototype of the deployable high performance computing hardware that will be used for the optimization of photogrammetric terrain software and real physics data integration into commercial software in support of synthetic training environment. Deliver augmented reality and virtual reality training environments. Conduct research in machine learning. • Perform computer programming using software development languages such as Python, C#, C++, and/or Type Script within IDEs such as Visual Studio and Unreal. • Perform setup and configure network devices. • Prepare software documentation for network assurance of networthiness. • Perform installation and configuration of information technology equipment.
	26	Computer Science; Computer Engineering BS, MS-ME	Engineering Resilient Systems Army Data Analytics team is leveraging the power of HPC and Data Analytics to improve Reliability, Availability, and Maintainability of vehicle platforms of all types. We are developing workflows that ingest time series data and produce useful, timely answers for maintainers and decision makers regarding the health and RAM metrics of vehicles and families of vehicles. These answers also inform other work areas, such as fleet sustainment or the Next Generation Combat Vehicle. Prospective candidates should be comfortable learning concepts like high performance computing, containerization, and data science, using languages like R or Python, and applications like Singularity (containerization). Work will be utilizing these tools to develop new models and workflows in a sensor to high performance data analytics to web portal/dashboard system.