

VIPR-GS Technical Status Report

Diversity, Inclusion, and Education Initiatives

Reporting period: through 30 June 2023

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Motivation

The research objectives of the VIPR-GS collaboration are built of increasing maturation in science and engineering research to adopt next-generation paradigms and toolsets. These developments are immediately driven by the community of scientists and engineers and supported by the contributions of GVSC into the VIPR-GS center. However, ensuring the availability of technical expertise requires continual investment into the diversity and education of each upcoming generation of researchers. Due to this, significant efforts have been made to expand the benefits of VIPR-GS research into promoting diversity, inclusion, and educational provisions. These initiatives provide pre-career individuals opportunities to develop into the advanced academic expertise required of sustained innovation.

Project goals

- Develop a diverse community of thought, discourse, and experiences that engenders inclusivity and promotes academic excellence.
- Increase participation of underrepresented students in advanced research.

Virtual Prototyping of Autonomy-Enabled Ground Systems

- Provide technical resources to collegiate students including access to software and facilities of usage.
- Prepare collegiate students to expertly utilize modern scientific principles and tools.

Background and Supporting Programs

Two programs highlight recruitment and inclusion initiatives: STEM ALL IN and the Bridge-to-Doctorate (CUBD) program. These two programs, championed by Tonyia Stewart, focus on providing opportunities to underrepresented graduate students to obtain degrees in technical fields from Clemson University.

PEER & WISE (Programs for Educational Enrichment and Retention & Women in Science and Engineering) is a program focused on providing educational enrichment, recruitment, and retention of underrepresented populations in technical programs at Clemson University. Directed by Serita Acker, it works with both undergraduate and graduate students, as well as performing outreach to primary and secondary school students.

The Product Lifecycle Management Center (PLMC) at Clemson University focuses on providing technical resources and education on digital engineering technologies and serves as a repository for many software tools provided to Clemson University by external vendors. The PLMC supports VIPR-GS educational mission through by extending VIPR-GS research platforms into undergraduate education activities.

Overview of Initiatives

Recruitment

The annual STEM ALL IN event brings undergraduate students from across the country to Clemson to engage with Clemson faculty and current graduate students. During the event facilitators engage the participating students to apply for and attend graduate school. STEM ALL IN focuses on underrepresented students, helping spread awareness of postgraduate degrees in Science, Technology, Engineering and Mathematics (STEM) fields. Though hosted by Clemson University, STEM ALL IN encourages applications to a variety of graduate schools. 17 students (shown in Figure 1) attended the event in 2023, of whom six chose to attend Clemson for postgraduate studies. These six students all accepted a STEM ALL IN fellowship from Clemson. Three students who had participated in STEM ALL IN additionally graduated with master's degrees following the Spring semester (shown in Figure 2).

Recruitment is also benefitted by the Clemson University Bridge to Doctorate program (CUBD), which is supported by the nationwide Louis Stokes Alliance for Minorities Participation (LSAMP) program



Figure 1: STEM ALL IN recruitment participants in 2023

and partially funded by the National Science Foundation (NSF). CUBD provides full financial support to cohort of 12 underrepresented doctoral students at Clemson University. Six of the students from the 2022-23 cohort also attended the STEM ALL IN on-campus event. Another STEM ALL IN student previously worked as a US Army GVSC intern during the summer of 2023.

Inclusion

One of the main initiatives of the PEER & WISE center is a robust mentoring and tutoring program for students in the College of Engineering, Computing and Applied Sciences (CECAS). Mentors are assigned to an incoming undergraduate student and help them transition to the academic environment at Clemson. Mentors may host professional and academic events, offer support, and help students navigate the complexities of the university. Most mentors are upper-level students from similar programs. More than 30 students volunteered as mentors during the reporting cycle. In addition to mentoring, PEER & WISE coordinates group-tutoring services within CECAS ran by upper-level students who have previously taken the course they tutor for.

The PEER & WISE program supplements its efforts with postsecondary students with outreach in elementary, middle, and high schools (primarily in South Carolina). These efforts include STEM DAY, which brought 162 middle-school students to campus for STEM related activities, and Project WISE, a weeklong summer camp for more than 50 7th and 8th-grade students who engage with Clemson faculty and students in a variety of technical activities (shown in Figure 3). Many attendees of these two initiatives were underrepresented students.

Student Experiences

Current efforts to provide students with valid experiences teaching them next-generation digital engineering concepts have focused on a one-credit hour, extracurricular research project for undergraduate students. The project has been offered continuously for four semesters and has involved 18 students. The objective of the project is to prepare a digital twin (high fidelity, synchronized, multiphysics representation) of a simplified tracked vehicle. Creating a digital twin provides a wide range of tasks associated with Industry 4.0 and modern engineering, such as systems integration, automation, data analytics, and simulation. Additionally, the research can contribute back to VIPR-GS research



Figure 2: Recent STEM ALL IN graduates (from left): Cornelius Walker (MS, Civil Engineering); Jonathan Bolanos (MS, Mech. Engineering); Presley Ihezue (MS, Auto. Engineering).



Figure 3: Project WISE students on campus in computer laboratory.

Virtual Prototyping of Autonomy-Enabled Ground Systems

focuses on scaling digital models and twins. Participating students are trained on digital software such as Siemens NX (CAD) and Teamcenter (PDM), as well as attend trainings on other PLM concepts. The experience culminates in a poster presentation by the students (see Figure 4).

Technical Training

The PLM Center has prepared a selection of 16 modules addressing fundamental concepts in PLM such as data security, additive manufacturing, CAx software (such as CAD and CAE), Model-Based Systems Engineering (MBSE), change management, and other related concepts. These modules are presented weekly throughout the semester to students and faculty via a series of one-hour presentations (as shown in Figure 5). In addition to these theoretical concepts, the PLM Center hosts workshops training students on using digital engineering software.

This technical training also integrates with the Deep Orange (DO) program at the CU-ICAR campus. DO is a specialized two-year program where Automotive Engineering students develop a full-scale prototypical tracked vehicle in collaboration with VIPR-GS applied research. Facilitators have worked with DO to set up PDM solutions using Siemens Teamcenter, which is intended to maintain the models, configurations, and other product information during the design process. The initial setup took place during the reporting period, with further evaluation and possible expansion planned for 2023-2024.

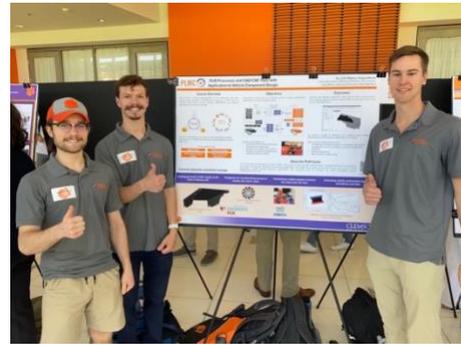


Figure 4: Students present research at undergraduate poster forum.



Figure 5: Presentation to Mechanical Engineering undergraduates.

Project publications

- Procopio, D., Morris, J., Wagner, J. (2023, June), *Application of Product Lifecycle Management in the University Classroom and Laboratory* Paper presented at 2023 ASEE Annual Conference and Exposition, Baltimore, MD.
- Morris, J., Wagner, J., Mocko, G. (2023, June), *Application of Extracurricular Course Teaching Product Lifecycle Management Concepts to Undergraduates* Paper presented at 2023 ASEE Annual Conference and Exposition, Baltimore, MD.