Living Lab #5 Creativity + Innovation District LLC. October 2021. Professor Edward Becker's students visiting the Makerspace at Creativity + Innovation District LLC construction site.

IIHCC

Solving problems that exist at, and along, the interdependencies between humans, community, and infrastructure to ultimately improve quality of life.

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What's Inside

Calendar

11/06 | ICAT Virtual Playdate with Rodrigo Sarlo: A Clinical and Social Adoption Study of Frailty Diagnosis through Passive, In-Situ Gait Monitoring

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CLUSTER HIRE SPOTLIGHT

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Multiscale Modeling

Uncertainty Quantification

Design Optimization

Materials Engineering

Machine Learning

How do you see your work contributing to the goals and vision of IIHCC?

Our ultimate goal is to improve the current infrastructure that human-centered communities are using by modeling and designing materials (I am mainly working on metals and metallic alloys that are used in aerospace structures and energy harvesting mechanisms). The best way to do that, in my opinion, is to start by improving our knowledge in fundamental sciences as well as in computational modeling. We are dealing with design problems in very high dimensions that traditional trial and error approach cannot fully encompass, as one cannot try every possible combination, and that is why computational techniques are essential to designing materials.

My work is mainly contributing to multi-scale computational materials modeling as well as approaches to design optimization (an engineering design methodology using a mathematical formulation to find the optimum design of a system among many alternatives), uncertainty quantification, an umbrella term that refers to the diverse probabilistic mathematical methods and tools that are appropriate for the critical assessment of measurements, models, and simulations), and machine learning (an application of artificial intelligence (AI) that develops computer programs having the ability to learn from data and improve from experience) so that we can achieve and accelerate the design and discovery of many different materials. This investment in cutting-edge methods will make it possible to have more functional and more energy-efficient material systems in our products and our infrastructure.

What other areas outside of your discipline would you entertain for future research and proposal work?

I've always considered myself quite multi-disciplinary. My entire educational history is based on aerospace engineering but at the same time, starting with my Ph.D., I was involved in research on materials science, and now I am a faculty member in mechanical engineering and we collaborate with lots of people and disciplines because of the way we are implementing various computational concepts. For instance, when I say, "design optimization" and "uncertainty quantification", these involve generic concepts and methods that are already utilized in other fields, not specific to materials. Therefore, it helped me coming from a different discipline because aerospace engineering and materials science have different visions, which is why I can develop novel computational tools and apply them to materials research.

CLUSTER HIRE SPOTLIGHT

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How do you see your work contributing to the goals and vision of IIHCC?

Part of what I'm doing right now is looking at "smart cities" and "smart environments", which ties into these goals because we are looking at environments that are inclusive. When I say inclusive, I'm not necessarily talking about diversity. I'm talking about cars interacting with and understanding people, vehicles understanding people, and people understanding people, and being able to embed intelligence into environments and into human-centered communities. We are also looking into the construction environment specifically where we have what is called "smart design and construction," which pulls intelligent infrastructure into the physical creation of human-centered communities.

Some of my work in the area of future workforce development surrounded embedding and implementing various sciences into the construction site to reduce issues regarding safety, cost leaks, productivity losses, etc. All of this goes into teaching students how to implement sciences into environments to make those environments intelligent. Typically, construction sites are very dynamic environments, so the people making administrative decisions need real-time information in order to make quick decisions that protect and improve the quality of life for their construction workers.

What other areas outside of your discipline would you entertain for future research and proposal work?

One proposal I'm working on right now that is totally outside of my discipline (construction and what goes on at the job site) -actually in the area of education- is looking at what is happening with the skill gaps in the construction industry and other industries. Some instructors may not be able to talk about, for example, bidding procedures because they do not engage with current bidding procedures as part of what they do, which means that teaching a topic like that would require someone from the industry to teach that topic effectively to the students. Unfortunately, access to those experts can be limited. Even when there is access, there may be conflicts in the time requirements. This is a huge challenge for under-resourced institutions and minority-serving institutions. Thus, we are trying to make access to industry standards easier to achieve by developing a cyber infrastructure that links all the institutions in the nation to architectural, engineering, and construction companies. Ultimately, our goal will again be to improve mental health and wellbeing of the people, within the context of smart cities and communities while being cognizant of their technology acceptance.

Cyber-Physical Systems

Workforce Development

Workforce Health and Safety

Project Performance

Monitoring and Control

GLOBAL FORUM ON URBAN AND REGIONAL RESLIENCE (GFURR): LIVING LABS

The Big Sticky Living Labs are being designed at the Global Forum for Urban and Regional Resilience (GFURR).

Two years ago, Enric Ruiz-Geli, Professor of Practice in Architecture, together with members of the Global Forum on Urban and Regional Resilience (GFURR) set out to advance research by empowering faculty and increasing experiential learning at Virginia Tech. From his professional experience at the 22@Barcelona innovation district, Mr. Ruiz-Geli brings a unique approach, which connects College of Architecture + Urban Studies (CAUS) faculty, administrative offices, and students to foster greater collaboration within the university and with industry partners, positioning our campus as a design and build living lab.

The Big Sticky Living Labs were born inside GFURR, which was created by President Charles Steger to facilitate conversations about patterns and processes of urbanization and regional development, with a special emphasis on the long-term resilience of places and communities. Through GFURR research projects and university planning initiatives, the team seeks to address "big sticky problems"–societal issues which are complex, multi-faceted, and necessitate transdisciplinary collaboration. The Living Labs pursue, create, and implement projects that are aligned with faculty's research. "The same way a student of medicine has the ability to go into a hospital and be there on-site, a student of Architecture, Design, Construction, Visual Arts or Urban Policy has the potential to be on-site learning experientially." Ruiz-Geli says. Similar to the professional world, students are tasked to work in transdisciplinary teams and complete project deliverables.

The Virginia Tech Campus Master Plan includes a vast expansion of the university, including many new buildings under construction. Additionally, the Innovation Campus in Northern Virginia and the Falls Church smart design and construction campus are in the process of development and expansion. In the eyes of GFURR, these initiatives provide many opportunities for VT faculty, administration, and students to collaborate. GFURR team works with CAUS faculty to align their interests and knowledge with building projects on campus and to aid in the design and construction process. The Facilities Department will draw upon faculty's expertise to see these designs to fruition while abiding by construction regulations and policies. As Ruiz-Geli states, "What the GFURR team aims to do is build a bridge between the academic and construction industry workflow and cultures by empowering faculty and making the university campus a real living lab of experiential learning."

Despite the wealth of ideas, innovation does not readily come with the right resources. CAUS is working diligently to provide students and faculty with the spaces and tools required to carry out their work. One such example is the Research + Demonstration Facility (RDF), an 11,000 sqft space at the end of Plantation Road, which has been an integral part of the College's academic and research programs since 1994.

The GFURR team seeks to foster an environment in which faculty can empower and encourage students to take charge of their projects, research, and design proposals. "I can tell [students] where

Living Lab #5: Creativity + Innovation District LLC. Render of the Makerspace with research projects and furniture design by faculty members, accomodating experiential learning for up to 80 students. Image courtesy of GFURR and VMDO Architects.

we have been, but [the student] must tell me where we are going," states Luis Borunda Monsivais, Senior Research & Project Associate for GFURR. The GFURR team encourages students from different fields to not only take part in the initiatives but become leaders and innovators in their fields who learn by challenging themselves and the status quo.

As Dr. Dorotea Ottaviani, GFURR Senior Project Manager, explains, "The idea is that if the living lab is successful, we can evaluate it over time. The 'living' aspect of Living Learning Labs refers to the team's vision that these initiatives, even after completion, will continue to spur research, innovation, and learning and progress public policy, regulation, and society's perception to address 'big sticky problems."

Some examples of experiential learning include the Ray Kass and Jerry Pike Living Lab, a faculty-and student-led initiative to construct a residential art and agriculture community on the estate of the Emeritus Professor and his partner. The concept for this project was designed by a transdisciplinary group from across the university, whose designs are now submitted and are awaiting approval for the next phase of the project – bidding and construction.

Since its establishment the concept of Big Sticky Living Labs has been applied in the following projects: Canopy at the Corporate Research Center; Ceramic Hallway at the Media Building; renovation of Research + Demonstration Facility; interior of the the School of Public and International Affairs Richmond office; Faculty Apartment, MakerSpace and Lounge of the Creativity + Innovation District

Living Learning Community; and Ray Kass and Jerry Pike Living Lab.

Projects like these accentuate that no matter the size and scope of a project, the team seeks to iterate, ideate, and change the meaning of learning and collaboration at Virginia Tech by providing students and faculty alike with opportunities to become creators of profound change.

Living Lab #2: Media Building ceramic hallway installation commissioned by ICAT. October 2019 installation of the mockup.

ICAT/IIHCC VIRTUAL PLAYDATE WITH RODRIGO SARLO

This year, IIHCC is partnering with ICAT to host talks by our 2020/21 IIHCC grant awardees. The first of the three presentations is by Dr. Rodrigo Sarlo. Please join us in his talk on November 6 from 9:00 to 9:30 at this link

A Clinical and Social Adoption Study of Frailty Diagnosis through Passive, In-Situ Gait Monitoring

Frailty is characterized by the functional decline of various physiological systems and is strongly associated with an increased vulnerability to stressors, such as illnesses or surgical procedures. Risk of frailty increase as we age. However, due to its complex influences, identifying frailty is challenging. Common methods, often based on surveys or visual observations, can vary by as much as 4 to 59% for similar populations of older adults. Recent research on older adults suggest that gait can serve as a predictor of frailty and associated adverse outcomes, such as reduced mobility, functional dependence, and mortality. In this presentation, we describe our efforts to build deployable, sensor-based techniques for monitoring several dimensions of gait. These techniques are passive, as they do not monitor the patient directly. This design is intended to create less privacy and intrusion concerns for older adults, thus improving the potential for adoption.

PI: **Rodrigo Sarlo** (IIHCC cluster hire), Assistant Professor, Civil & Environmental Engineering
Team: **Tiffany Drape**, Assistant Professor, Dept. of Agricultural, Leadership, & Community Education
Joseph Scarpa, Jr., New York Presbyterian Hospital-Weill Cornell Medical Center
Sriram Malladi, Mechanical Eng., Michigan Technological University
Robin Queen, Associate Professor, Biomedical Eng. and Mechanics, Virginia Tech

Rodrigo Sarlo and Rafael Gonçalves test gait monitoring via floor vibrations.