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VCU Engineering

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ELECTRICAL AND COMPUTER ENGINEERING



VCU

College of Engineering

ELECTRICAL AND COMPUTER ENGINEERING (ECE)



Using control theory and A.I. to enhance human-robot interactions

*(Pictured above)
A robot built by the lab
of Patrick J. Martin, Ph.D.,
learns new motions from
its human dance partner and
assembles a performance.*



*Roboticians have much to
learn from dancers and
choreographers, who are
experts in expressive
motion and coordination.*

Patrick J. Martin, Ph.D., ECE assistant professor, uses control theory and A.I. to safely deploy distributed autonomous systems. He recently applied these concepts to a dance collaboration between a human and a robot.

In a recent Q&A, he explained:

Roboticians have much to learn from dancers and choreographers, who are experts in expressive motion and coordination. Architectural and algorithmic outputs from this research will inform how we integrate autonomous robots into situations where there are multiple humans and robots working together.

This research, in collaboration with VCUarts, focuses on two aspects: 1) learning new motions from humans and 2) assembling a performance from multiple robot behaviors. This algorithm uses machine learning to extract key parameters of demonstrated motions and allow the user to mix these parameterized motions to achieve different expressive motifs, such as tempo. Combining these two capabilities provides a framework for more flexible human-robot choreography.

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DEVELOPING INTELLIGENT TECHNOLOGIES

Making it [virtually] real, demonstrating the invisible physics behind everyday processes



ECE associate professor **Nathaniel Kinsey, Ph.D.**, noticed even strong math students missed the big picture behind Wi-Fi, EZ passes and other electromagnetic processes, so he created interactive computer simulations demonstrating advanced math and physics concepts.

These teaching methods were featured in an IEEE Spectrum magazine supplement. **Simon Woodruff, Ph.D.**, from SciVista, saw the article and offered to help turn the simulations into virtual reality (VR) experiences.

Woodruff and Kinsey prototyped a platform that takes electromagnetic simulations into VR. Future enhancements include virtual lecture rooms where participants' avatars can play with 3D models in real time.

Researchers develop 5G communications system to enable smart warehouse technology

Wireless technologies to help locate and inventory items are important for supply chain logistics. As facilities grow, "smart warehouses" using these technologies are essential.



Ruixin Niu, Ph.D., ECE associate professor, works to optimize these systems as principal investigator on a 5G smart warehouse project to design a distributed wireless system to enhance communications capabilities for smart warehouses.



Working with ECE associate professor **Yanxiao Zhao, Ph.D.**, their system design for wireless communications is based on distributed coherent multiple-input multiple-output (MIMO) technology, which increases overall performance.

Distributed systems are attractive in smart warehouse design because they are less expensive to scale if a facility is enlarged. They are also more reliable because they are made up of multiple nodes and don't experience disruptions if a single node fails.



The Dreams to Reality Incubator: open for business

The Dreams to Reality Incubator (D2Ri) is where students, faculty and local businesses develop partnerships for introducing new products to market. D2Ri opened its laboratory in the Engineering Research Building this year. Five companies were showcased at the ribbon cutting, two which are funded by the Commonwealth Cyber Initiative (CCI).

Erdem Topsakal, Ph.D., professor and interim senior associate dean, championed the D2Ri's formation. He dreamed of increasing innovation in Virginia by creating a space for faculty, staff and students to build and understand the steps in creating a successful business.

VCU Engineering professor leading National Science Foundation's Division of Undergraduate Education



The National Science Foundation appointed **Rosalyn Hobson Hargraves, Ph.D.**, to be Division of Undergraduate Education director.

Hargraves, an ECE professor, is a recognized leader in advancing equity, excellence and inclusion in STEM. She works to advance the division's mission to promote excellence in undergraduate science, technology, engineering and mathematics education for all students at two-year and four-year institutions.

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