DISTINGUISHED
STAFF FELLOWS
AT ORNL

Nishanth

Alvin M. Weinberg Fellow

Where and when did you earn your PhD?

I earned my PhD in electrical and computer engineering from the University of Wisconsin–Madison in 2023. I was advised by Prof. Eric Severson and was part of the Wisconsin Electric Machines and Power Electronics Consortium, one of the largest research groups in our field with over 60 industry sponsors.

What was the subject of your dissertation?

My dissertation focused on developing torque-dense and power-dense axial flux electric machines to electrify off-highway vehicles.

What was your dissertation's major contribution to your field?

My dissertation research developed a novel integrated electro-hydraulic machine and investigated additive manufacturing and multi-harmonic control as techniques to improve electric machine power density for electrifying off-highway vehicles. The major contributions of my dissertation research include development of one of the first high-power, high-speed integrated electro-hydraulic machines; a multi-physics optimization technique for co-design of the electro-hydraulic machine; one of the earliest additively manufactured electric machine stators with complex lamination-emulating geometry and 6.5% silicon steel, including performance characterization; and a technique to design electric machine windings capable of controlling any spatial harmonics in the airgap, including demonstration of the torque density improvements using these controlled harmonics.

Who is your ORNL mentor, and which group and division are you working in?

My ORNL mentor is Dr. Burak Ozpineci, Vehicle and Mobility Systems section head in the Buildings and Transportation Sciences Division in the Energy Science and Technology Directorate. I work in the Electric Drives Research Group within the Vehicle and Mobility Systems Section.

What will your fellowship research focus on?

My fellowship research will focus on investigating and developing methods to realize high-performance electric machines without critical rare-earth materials. Today's high-performance and power-dense electric machines nearly always use permanent magnets with critical rare-earth materials such as neodymium, dysprosium, and cobalt to achieve high power density and torque density, making them critical to the nation's energy security. However, these materials are not abundantly available, and their global supply chain is extremely volatile and sensitive to geopolitical issues. My work connects with efforts of the US Departments of Energy and Defense to secure a domestic supply chain for these materials and identify alternatives to these materials.

What is your project's expected contribution to your field?

Primarily, my project is expected to demonstrate a new and promising pathway to realize high-performance electric machines without critical rare-earth materials. Other expected contributions include quantifying the performance capabilities of a range of machine topologies free from these materials and developing methods to design, optimize, manufacture, and control the machines.

What are your research interests?

My research interests are in the broad area of high-performance and sustainable electro-mechanical energy conversion. I work on investigating and developing devices and systems that can efficiently and sustainably convert energy between electrical (e.g., currents, voltages) and mechanical forms (i.e., speed, torque, force). My research finds applications in electric cars and trucks, off-highway vehicles, airplanes and ships, manufacturing industries, building HVAC (heating, ventilation, and air conditioning) equipment, semiconductor manufacturing, energy storage using flywheels, and power generation.

What led you to science and your specific discipline?

As a child, I was captivated by the inner workings of electronics, often disassembling devices at home, albeit without fully understanding how to reassemble them. My father, an electrical engineer, provided invaluable guidance as we collaborated on repairing our home computer and various electronic devices, which sparked my interest in the field of electrical engineering. Meanwhile, my mother, a professor of medical microbiology, inspired my passion for research. Through her perspective, I recognized the intellectual stimulation and fulfillment that a career in scientific research could offer. This dual influence has shaped my academic and professional aspirations, driving me to pursue scientific research and electrical engineering.

What did you do before coming to ORNL?

After my PhD, I continued as a postdoc at the University of Wisconsin–Madison for 6 months and then worked as a research engineer at the GE Research Center in Niskayuna, New York, for a year.

Could you share an interesting fact or two about yourself?

I am into philately and numismatics: I collect stamps and coins. I recently completed my state quarter collection—50 quarters, 1 for each state—and started my National Parks quarters collection at the Great Smoky Mountains National Park.

What nonscience topic or activity is important to you and why?

STEM outreach is an important topic for me, especially in the context of diversity, equity, and inclusion. During my PhD, I engaged in STEM outreach through my research group and the Wisconsin 4-H program, fostering collaboration and understanding within diverse groups. I am eager to continue these efforts to help address systemic barriers and promote equitable access to STEM fields.

OAK RIDGE National Laboratory