NETL-RUA
Regional University Alliance

E NEWS

Shared Intellect • Shared Laboratories • Shared Resources

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Cutting Edge Advanced Turbine Testing Lab at Penn State

The country's most advanced turbine testing laboratory was inaugurated in a March 19 ceremony at Penn State. Supported by Pratt & Whitney (a United Technologies Corporation company) and the National Energy Technology Laboratory (NETL), the lab will allow researchers to simulate and test a new generation of high pressure turbine systems to achieve greater fuel efficiency and reduced emissions.

A large compressor in the Steady Thermal Aero Research Turbine (START) lab that will provide the continuous air flow for the turbine test facility.

Gas turbines power both aircraft and electric power plants; though these applications have differing demands, many of the challenges facing both aircraft and stationary turbines are substantially similar. As fuel efficiency will always be a crucial concern, one key to increasing fuel efficiency is higher operating temperatures. These temperatures are already above the melting point of crucial hot-path turbine parts. Solutions have included advanced cooling strategies as well as specialized thermally resistant coatings for critical components.

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NETL-RUA
Metrics Snapshot

PRODUCTS			
	FY2011	FY2012	FY2013
Publications	194	195	**50**
Patents Issued	11	12	**4**
Licenses	9	4	**0**
Students Graduated	20 PhD	23 PhD	8 PhD
	8 MS	19 MS	1 MS

Product data is updated quarterly.

RESEARCH PERSONNEL

Total = 596

- Graduate Students - 151
- Undergraduate Students - 19
- University Researchers - 197
- URS Researchers - 80
- NETL Researchers - 149

E News is your monthly source for the latest information about NETL-RUA's research, activities, and other important news. If you have information that you would like to feature in future newsletters, send that information to

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Mr. Al Brockett from Pratt & Whitney expressing the importance of the turbine research that will be conducted in the START lab.

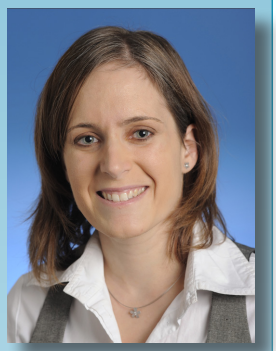
The new Steady Thermal Aero Research Turbine (START) facility will focus on thermal management approaches, leakage, and gas-path flows. Karen Thole, head of mechanical and nuclear engineering at Penn State, explained in an article[1] on the ***Penn State News*** website that existing experimental facilities do not have the ability to evaluate new sealing designs to curb the leakage flows that occur at gaps between stationary and rotating airfoil components. "Current rigs are not able to simulate the rotational speeds and air-flow speeds that engineers need to simulate the complex flows that result in gap leakages between airfoil stages in operating turbines," she is quoted as saying.

The START lab, which will be fully operational in January 2014, includes a continuously flowing turbine that will operate at realistic engine conditions that have not been possible in any laboratory in the United States. It will give NETL-RUA researchers the opportunity to simulate and test the next generation of fuel-efficient gas turbine engines while also educating the next generation of turbine engineers.

Support for Penn State turbine research from both NETL and Pratt & Whitney is longstanding. Thole's Experimental and Computational Convection Laboratory (ExCCL) has received funding from the Department of Energy (DOE) University Turbine Systems Research program and is a Pratt & Whitney center of excellence in gas turbine heat transfer.

[1] Curtis Chan, "Penn State, Pratt & Whitney inaugurate most advanced turbine testing lab in U.S.," *Penn State News*, March 20, 2013.

Noteworthy Achievements



Gabriela Hug

Carnegie Mellon University (CMU) assistant professor in electrical and computer engineering and NETL Regional University Alliance (NETL-RUA) principal investigator (PI) **Gabriela Hug** has received the National Science Foundation (NSF) Early Career Development Award, its most prestigious award for junior faculty. Hug was awarded a five year, $400,000 grant to make the electric power grid more secure and flexible. Her plan for the grant is to develop tools to enable a self-managing grid by the means of ubiquitous power flow control. Hug's NETL-RUA work supports the Grid Technologies Collaborative (GTC) strategic growth area (SGA), concentrating on the optimal usage and integration of storage devices.

Long-Qing Chen

Long-Qing Chen, a NETL-RUA PI, was recently granted the title of Distinguished Professor of Materials Science and Engineering at Penn State. Chen is recognized world-wide for his leadership in computational materials science and is attributed with pioneering the development of phase-field models to understand grain growth, domain evolution, interactions between defect and phase microstructures, and strain-dominated microstructure evolution in cutting-edge elastically inhomogeneous systems. In 2011 Chen also received The Minerals, Metals and Materials Society (TMS) Electronic, Magnetic, and Photonic Materials Division (EMPMD) Distinguished Scientist/Engineer Award and was honored with two symposium sessions at the 2012 TMS Annual Meeting. Chen was also elected to a Fellow of American Society for Metals (ASM) International in 2012 and a Fellow of Materials Research Society in 2013. Chen's NETL-RUA work supports the Fuel Cells and Innovative Process Technologies (IPT) teams.

CMU graduate student and NETL-RUA participant **Tao-Lun Chin** successfully defended his thesis entitled "High Temperature Wireless Surface Acoustic Wave Gas Sensors Using zinc oxide (ZnO) and tin oxide (SnO_2) Thin Films. Chin's NETL research was focused on the development of wireless oxygen sensors for placement in hostile environments in support of the IPT team. The research provided a new understanding of the design constraints for stable and accurate surface acoustic wave (SAW) sensors in relevant high temperature and harsh environmental conditions. CMU Professor, and NETL-RUA PI, David W. Greve served as Chin's advisor. NETL researcher Dr. Paul Ohodnicki served on his thesis examination committee with project oversight and guidance provided by NETL researcher Dr. Benjamin Chorpening.

NETL-RUA Outstanding Colleague

Virginia Tech Professor Srinath Ekkad

Srinath Ekkad

Srinath Ekkad, professor of mechanical engineering in the College of Engineering at Virginia Polytechnic Institute and State University (Virginia Tech), has been instrumental in ongoing NETL-RUA research as the PI on tasks related to the quantification of uncertainty involved in simulating multiphase flows and in film cooling in gas turbine engines. His research has significantly added to the success of NETL-RUA's Turbine Thermal Management team.

Dr. Ekkad was recently named Commonwealth Professor for Aerospace Propulsion Systems at Virginia Tech. This distinguished professorship recognizes research excellence, and recipients hold the position for a five-year term.

A member of the Virginia Tech community since 2007, Ekkad's research focuses on the development of highly accurate two-dimensional, high-resolution surface heat transfer measurements for complex geometries. His work in applying these techniques in gas turbine engine systems is widely recognized. An Ekkad paper published in the ***International Journal of Heat and Mass Transfer*** in 1997 on heat transfer in rib turbulated channels provided the first detailed measurements of complex turbulated flow inside channels with periodic trip strips and is frequently cited.

Ekkad co-authored a book entitled ***Gas Turbine Heat Transfer and Cooling Technology***, which is considered to be among the most influential contributions to this field of research. Ekkad was named the American Society of Engineers' Bergles/Rohsenow Young Investigator in Heat Transfer in 2004 for making significant contributions to the field of heat transfer for a researcher under the age of 36. Ekkad was also named a Fellow of the American Society of Mechanical Engineers in 2010 for his overall research contributions to the field of heat transfer. He received the College of Engineering Dean's Award for Excellence in Research in 2012 at Virginia Tech.

Ekkad received his bachelor's degree from Jawaharlal Nehru Technological University (India), a master's degree from Arizona State University, and a Ph.D. from Texas A&M University.

Congratulations, Dr. Ekkad !

Upcoming Events

- **12th Annual Conference on Carbon Capture & Sequestration**
  May 14-16, 2013
  David L. Lawrence Convention Center, Pittsburgh, PA
- **American Association of Petroleum Geologists (AAPG) Annual Convention & Exhibition**
  May 19–22, 2013
  David L. Lawrence Convention Center, Pittsburgh, PA

Your favorite issues of the NETL-RUA E NEWS are now available on the MOSS and the NETL-RUA website (www.netl.doe.gov/rua)

New Funding Opportunity

RFPs Due by May 1

The Request for Proposals (RFPs) for each of three awards being offered by URS in support of the NETL-RUA strategic plan, for a total of $110,000 in funding, have been released. One of the three awards is open to all university researchers and faculty from the five member universities (so spread the word!), while the other two are reserved for existing NETL-RUA projects. Visit (**https://portal.netl.doe.gov/sites/RUA/URS%20Funding%20Opportunities/Forms/AllItems.aspx**) if you have access to the Members Only Sharepoint Site, or ask your Consortium Area Lead* (CAL) for details on submitting proposals. Inquiries on the RFP should be directed to **Janet.Nelson@contr.netl.doe.gov**.

* A. Gellman, CMU; D. Haworth, Penn State; R. Yoon, Virginia Tech; B. Gleeson, Pitt; R. Bajura, WVU

Technology Spotlight

A Visualization Center Coming to a Campus Near You!

NETL-RUA researchers have new and powerful help in discovering new materials, optimizing designs, and better predicting operational characteristics of power plants and components. One of the world's fastest, most energy-efficient supercomputers is up and running at NETL in Morgantown, West Virginia. The Simulation-Based Engineering User Center (SBEUC) combines this high-performance computing cluster with advanced visualization centers, serving the organization's research and development needs. The SBEUC will help to overcome technical development barriers quickly, reliably, and cost-efficiently.

To support collaboration among researchers and improve interaction between NETL and NETL-RUA sites, visualization centers have been established at each of the three NETL research sites (Morgantown, Pittsburgh, and Albany), and others will be installed at all five NETL-RUA universities later this spring. These workspaces include large high definition displays allowing collaborative interaction and a more detailed exploration of simulation results. Users will also be able to connect from off-site locations to monitor simulation progress from outside the laboratory and can share their simulation results with other SBEUC users.

The computing facilities of the SBEUC are world class, featuring a 503 teraFLOPS (trillion floating-point operations per second) high-performance computer that enables the simulation of phenomena that are difficult or impossible to measure, such as coal jet penetration into a gasifier. This computer, the High Performance Computer for Energy and the Environment (HPCEE), is recognized as one of the top 100 supercomputers in the world (currently ranked at number 55). It is extremely energy efficient, using only 5.7 percent of its power for cooling versus 50 percent for traditional data centers. This is due in part to a free air cooling method which circulates outside air while also using traditional evaporative cooling methods as needed, allowing the HPCEE to be one of the most efficient in the world.

The SBEUC will be officially dedicated on Saturday, June 8, at an NETL Open House at the Morgantown site. Look for event details in upcoming issues of the newsletter.

The NETL Morgantown Visualization Center provides ample work space for NETL-RUA collaboration.

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