ASME

Adaptive Structures & Material Systems

AIAA

ASME & AIAA Adaptive Structures & Material Systems Newsletter Spring 2012

MESSAGE FROM THE CHAIR

Marcelo Dapino, Ohio State University ■ This year's edition of the AIAA and ASME Adaptive Structures and Materials Systems Newsletter highlights the major organizational changes that have taken place in the Aerospace Division of ASME. These changes are a direct response to the growth of the smart materials community, which continues to strive despite the financial difficulties in many parts of the world. The four conferences promoted by the Adaptive Structures and Material Systems Technical Committee - SPIE Smart Structures/NDE, ASME Smart Materials, Adaptive Structures and Intelligent Systems, AIAA Adaptive Structures Conference, and ICAST - saw a combined growth in accepted submissions of 6.5% between 2010 and 2011. More importantly, the conferences grew by 20% since the onset of the economic crisis in 2008 and by a staggering 50% relative to pre-crisis numbers. It must be noted that the SMASIS conference was established in 2008, which undoubtedly contributed along with other factors to the sustainability of the community during this period. Other international meetings relevant to the smart materials field, such as ACTUATOR (Germany) and CIMTEC (Italy), are also robust. These meetings highlight the international dimension that our multifaceted field has achieved since its inception in the 1990s. A calendar of events listing the upcoming meetings is shown on page 9.

At its meeting last October in Scottsdale, Arizona, the Aerospace Division's Executive Committee passed new bylaws that fundamentally change the Division's structure. The new bylaws will strengthen the Division's position within ASME by allowing better visibility to the activities carried out by its various technical groups and leveraging the Division's strong membership–currently well over 5,000. While technical committees are not new in the Aerospace Division, the new bylaws organize technical committees under two new branches, Adaptive Structures and Material Systems and Aerospace Systems. Each branch will have its own technical committees. Each committee will be created considered the relevant issues that the community faces as it continues to advance both fundamental research and commercial applications. As is the case with the existing technical committees, the new technical committees will be encouraged to organize sessions at various conferences and to propose awards to recognize accomplishments related to their focus area. The success of the new organization will greatly depend on your involvement, for the activities carried out by each technical committee will become the engine that continues to propel our research community forward. Considering this, I want to encourage you to participate in the development of new technical committees for both branches; if you have a technical committee you would like to form, please contact Chris Lynch (Chair of the Aerospace Division's Executive Committee, cslynch@seas.ucla.edu), or Diann Brei (Incoming Chair of the Aerospace Division, dibrei@umich.edu).

Finally, as chair of the ASME Adaptive Structures and Materials Systems Technical Committee, I would like to acknowledge all of the people who have contributed to the success of the activities that our Technical Committee has conducted over the years. These activities range from the organization of regular and special sessions at conferences to running various awards that recognize the efforts of smart materials researchers around the world. You can read about these activities in this newsletter. Last, but not least, I want to acknowledge the hard work of Diann Brei and Sergio L. dos Santos e Lucato, whose leadership and commitment to "spreading the word" makes this newsletter possible.

Marcelo J. Dapino
Chair, ASME Adaptive Structures and Material Systems Technical Committee. ■

Diann Brei ■ EDITOR
dibrei@umich.edu

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For more information visit the Technical Committee Websites:

ASME: http://asms-tc.org

and AIAA:

http://info.aiaa.org/tac/adsg/ASTC

Feature Article

Beyond Incandescent Light Bulbs: Advanced Sensors from GE

Eric J. Ruggiero and Charles Seeley, GE Global Research ■

Pushing the Limits of Technology

The fun part of working for the General Electric Company is technology innovation in support of the company's diverse product portfolio that includes aircraft engines, turbines for power generation, MRIs and CT Scanners, advanced batteries, wind turbines, and advanced LEDs. At GE, we love technology and developing cutting-edge solutions to the world's toughest problems.

Smart materials is one area of active research within GE. There is a common need for advanced sensors and actuators to monitor the health and performance of machines under the harshest of conditions across GE's businesses. High temperatures (>1000°C), high pressures (>100 bar), large actuation strokes (>25.4 mm), high electro-magnetic fields, and high speed rotation are some of the common challenges and requirements for GE's product lines. Multi-functional materials offer new technology avenues to meet product life requirements ranging from 3000 hours to over 25,000 hours. The following sections highlight two examples of smart material technology solutions innovated at GE in the past decade.

Advanced Sensor Brush Seals

Brush seals are found in many different applications, including aircraft engines, steam turbines, power generators, and even in the bearing housing location of compressors. In certain applications, like jet engines, the brush seals are buried deep within the heart of the engine and consequently, are difficult to service. Further, because of their location, there is no way to monitor the health of the seal except by visual inspection during a major engine overhaul. Without a means of measuring or quantifying the wear of brush seals on in-service aircraft, there is a possibility that brush seals in excellent condition will be prematurely replaced during the engine's life at a high cost.

A means of remotely interrogating the health of a brush seal is to incorporate fiber optic sensors within the brush seal bristle pack. Fiber optics are a synergistic fit with brush seals, as the diameter of the fiber optic sensor line (125 micrometers) is typically on the same order of magnitude as the bristles within a brush seal bristle pack. Through the use of Fiber Bragg Grating (FBG) sensors, temperature and strain measurements can be extracted from the bristle pack based on changes in measured wavelength of the back-reflected peaks. Additionally, the use of multiple Bragg gratings within a single mode fiber allows identification of both temperature and strain simultaneously. Figure 1 shows an example prototype sensor brush seal with the incorporated FBG sensor. The sensor brush seal was tested on a desktop rotating rig spinning up to 10,000 rpm and with various pressure levels across the bristle pack. With the test, the sensor brush seal prototype demonstrated the ability of the FBG sensors to 1) detect temperature distribution within the bristle pack; 2) detect the deflection of the bristle pack under pressure (a phenomenon known as blow-down); and 3) detect the onset of bristle wear. Figure 2 shows the experimental test setup with the sensor brush seal installed.

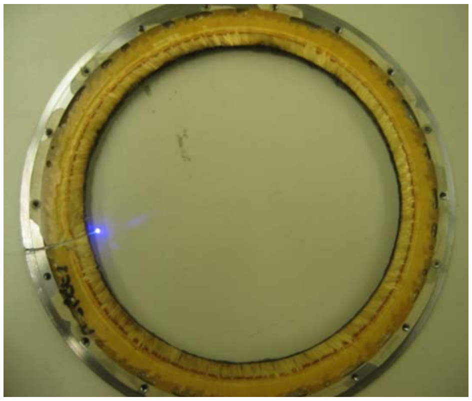

Figure 1: Prototype advanced sensor brush seal with illuminated FBG sensor.

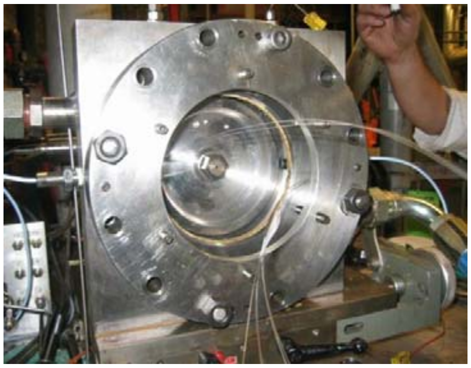

Figure 2: Subscale rotating test rig with advanced sensor brush seal installed.

Advanced Remote Voltage Sensor

GE has markets in the electric power, gas, and oil industrial segments. These industries require sensors that are small, lightweight, with large dynamic range, and immunity to electromagnetic interference (EMI) and radio frequency (RF) interference. FBG sensors can meet these requirements and have additional benefits such as multiplexing along a single fiber, insensitivity to loss variations in the transmission fiber network, and potential cost effectiveness due to the high volume inventory from the telecommunication industry. The use of FBGs, in conjunction with piezoelectric materials, for remote voltage sensing, is a new approach that has been investigated with partial success in low and high voltage applications.

At GE Global Research, a piezo-optic composite material was developed that included an optical wave guide integrated with parallel piezoelectric fibers embedded in a dielectric matrix material. The piezo-optic material was packaged with a lamination of interdigitated electrodes printed on polyimide film that produced an electric field along the length of the fibers in proportion to the voltage to be measured. Because the electric field was aligned with the axis of the fibers, the induced strain exploited the major longitudinal piezoelectric charge coefficient, thus maximizing the strain sensitivity. The integration of the wave guide into the composite material gave improved strain transfer compared to surface bonding used in previous efforts. The mechanical integrity of the piezo-optic material was much higher than fragile piezoelectric (PZT) wafers, and the final package was similar to a thin flex circuit convenient for integration into larger systems. A reference FBG was also included in the design to mitigate temperature and vibration effects. Fabrication of the sensor package was based on an economical process developed for macro fiber composites (MFCs) that utilized diced piezoelectric fibers embedded in a dielectric matrix. This approach was extended to include an optic fiber embedded directly into the dielectric matrix in addition to the piezoelectric fibers. Instrumentation was customized to drive the device under test (DUT) with arbitrary voltage waveforms customized to represent operational features of a possible application. The optical wavelength shift from the FBG was obtained using a high speed, software driven, optical sensing interrogator. Results obtained, thus far, indicate promising performance from this first generation device. ■

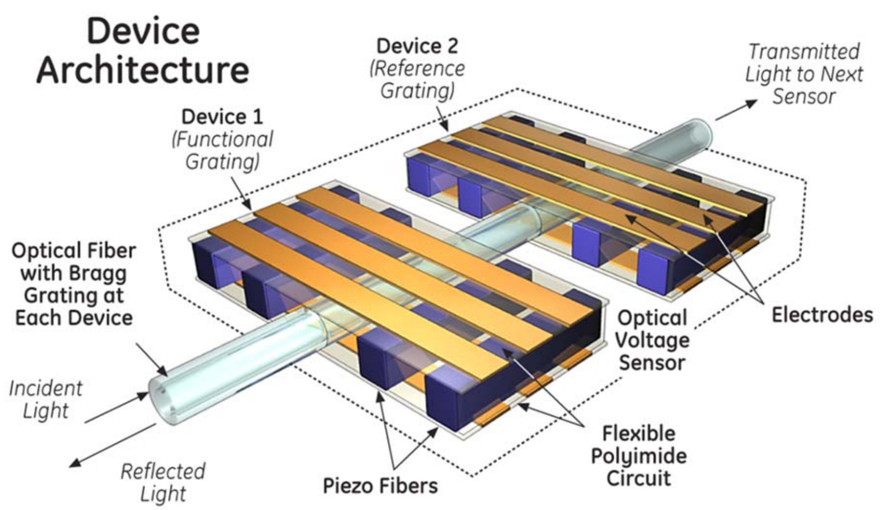

Figure 3. Piezo-optic voltage sensor device architecture.

5 YEARS OF SMASIS

Honors and Awards

2010 Gary Anderson Early Achievement Award

Marcelo Dapino, Ohio State University ■ Dr. Lisa Weiland is an Assistant Professor of Mechanical Engineering and Materials Science at the University of Pittsburgh. She is also a Mascaro Center for Sustainable Innovation faculty member and chair/ founder of the Engineering for Humanity Certificate program. Weiland completed her PhD studies in Mechanical Engineering at the Georgia Institute of Technology in 2003. Her research focus is mechanics of active materials with application emphasis on creation of adaptive and sustainable structures. Among her current research application interests are restoration of, and energy harvesting from rivers and coastal areas; her work has been covered internationally in the popular press.

The Gary Anderson Early Achievement Award is conferred to a researcher in his or her ascendancy whose work has already had an impact in his/her field within Adaptive Structures and Material Systems. The winner of the award must be within 7 years of terminal degree at the time of nomination. Nominations may be received at large from any source and should be sent to Dr. Marcelo Dapino at *dapino.1@osu.edu*. ■

2010 ASME Adaptive Structures and Materials Systems Prize

Marcelo Dapino, Ohio State University ■ Prof. Lynch received his undergraduate and graduate education in Mechanical Engineering, completing his doctorate in 1992 at the University of California Santa Barbara (UCSB). Prior to joining the faculty at UCLA he spent 12 years on the faculty at Georgia Tech, eight years in industry, and two years as a post-doctoral researcher at UCSB. Prof. Lynch has focused his research on smart materials and structures:

non-linear and hysteretic field coupled material characterization, constitutive modeling with finite element implementation, experimental and theoretical fracture mechanics of field coupled materials, and solid state actuator development for aerospace applications. His work on the Smart Wing project combined with a NASA - sponsored project led to the development of a piezoelectric-hydraulic pump. Other aerospace related projects include work on the NextGen Aeronautics Morphing Aircraft, UAV applications of compact hybrid actuators, and actuator development for a helicopter rotor TE flap for vibration and flight control.

Prof. Lynch has been the recipient of an NSF CAREER Award and an ONR Young Investigator Award for work in this area and is a Fellow of ASME. He is the former Chair of the Adaptive Structures and Materials Systems Technical Committee (ASMS TC) of the ASME Aerospace division. This TC organizes four international adaptive materials and structures conferences annually (SPIE, ASME, ICAST, AIAA) and administers several adaptive materials and structures awards. He is currently Chair of the ASME Aerospace Division Executive Committee.

The ASME Adaptive Structures and Materials System Prize is presented to a member of the technical community who has made significant contributions to the advancement of the sciences and technologies associated with adaptive structures and/or material systems. The $1,000 cash award and certificate are meant to recognize scientific contributions as measured by leadership, technical publications, and advances made. The award also includes a special evening lecture given by the recipient on Wednesday after the last session of the AIAA Adaptive Structures Conference. Nominations for the 2012 prize can be sent to Dan Inman at *dinman@vt.edu* by November 2012. ■

Honors and Awards, continued

ASMS TC Best Paper Awards

There are two best paper awards established by the ASME Adaptive Structures and Materials Systems Technical Committee (ASMS TC): Materials and Systems Best Paper Award and Structures and Structural Dynamics Best Paper Award. Papers published in journal publications relevant to smart materials and structures and conference proceedings sponsored by the ASMS committee are eligible for the best paper competition. Nominated papers are sent out for review. The winners of this year's awards are listed below.

2011 Best Paper in Structures and Structural Dynamics

"A.S. Purekar and D.J. Pines, "Damage Detection in Thin Composite Laminates Using Piezoelectric Phased Sensor Arrays and Guided Lamb Wave Interrogation," Journal of Intelligent Material Systems and Structures, July 2010; vol. 21, 10: pp. 995-1010.

A. S. Purekar, Program Manager, Techno-Sciences Inc, received his PhD from the Aerospace Engineering Department at the University of Maryland. His thesis focused on the use of guided waves and phased array analysis for damage detection in panel structures. Currently, Ashish is a Program Manager at Techno-Sciences, Inc. in Beltsville, MD where he has continued working on damage detection and health monitoring projects and has also led projects on energy harvesting and advanced sensor concepts.

Darryll J. Pines, Dean, A. James Clark School of Engineering, University of Maryland, became dean of the Clark School on January 5, 2009. He came to the University of Maryland in 1995 as an assistant professor in the Clark School and has served as chair of the Department of Aerospace Engineering since 2006.

2011 Best Paper in Materials and Material Systems

Haixiong Tang, Yirong Lin, Clark Andrews and Henry A Sodano, "Nanocomposites with increased energy density through high aspect ratio PZT nanowires," Nanotechnology, Vol. 22, No. 1, 015702, 2010

Henry A. Sodano, Associate Professor, University of Florida, is currently an Associate Professor jointly appointed in the Mechanical and Aerospace Engineering and Materials Science and Engineering departments the University of Florida. He received his Ph.D. in Mechanical Engineering from Virginia Tech in 2005, his M.S. in 2003, and his B.S in 2002, also from Virginia Tech. Haixiong Tang is a PhD student in the Materials Science and Engineering Department at the University of Florida. Yirong Lin is an Assistant Professor of Mechanical Engineering at the University of Texas at El Paso. Clark Andrews currently works in the C4 systems division of General Dynamics in Scottsdale, Arizona. ■

Thank You!

To all those that contributed and helped in the preparation

Diann Brei *University of Michigan*

Marcelo Dapino *Ohio State*

Sergio L. dos Santos e Lucato *Teledyne Scientific*

Greg Reich *Air Force Research Laboratory*

Eric J. Ruggiero *GE Global Research*

Janet Sater *IDA*

Charles Seeley *GE Global Research*

Aimy Wissa *University of Maryland*

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Secretary: Mohammad Elahinia, *mohammad.elahinia@utoledo.edu*

Treasurer: Lisa Mauck Weiland, *lmw36@pitt.edu*

Historical Note

Greg Reich, Air Force Research Laboratory ■ Welcome back to the history corner! In this edition, we'll discuss the origins of both the ASME Adaptive Structures and Material Systems TC and the AIAA Adaptive Structures TC. To get the inside story, we turn to one of the key protagonists, Mr. Ben Wada, then of JPL:

"At the 1989 SDM meeting I gave an SDM lecture on Adaptive Structures. I thought of establishing this NEW field where funders of technology would recognize its potential and provide funding. My first thought was to publish a pamphlet on Adaptive Structures by a reputable technical organization and to establish a conference that would give it legitimate recognition. I volunteered to organize and chair a session that lead to an ASME publication titled 'Adaptive Structures' at the 1989 ASME Winter Annual Meeting.

The next step was to organize a stand-alone meeting. I felt the best approach was to partner with my contacts Drs. Miura and Natori in Japan, and hold the meeting in Hawaii, halfway between US and Japan. The Japanese agreed and would provide support since both Drs. Miura and Natori were respected in their country. Within a nine-month period I was able to organize the First Joint US/Japan Conference on Adaptive Structures in Maui, Hawaii in Oct. 1990. A small hotel in Maui, Hawaii was selected that did not require a guarantee of the number of participants. Approximately 100 engineers attended the meeting. The US committee members consisted of leaders in the field and included Craig Rogers, Jim Fanson, Eric Cross, Ed Crawley, and others. The objective was to rotate the annual meeting between the US and Japan. Each host would be responsible for financing the meeting in their country. After the second meeting, the Europeans wanted to participate; the meeting in November 1992 was titled the 3rd International Conference on Adaptive Structures [now ICAST, the International Conference on Adaptive Structures and Technologies, in its 22nd year].

The next step was to have ASME and/or AIAA establish a technical committee on Adaptive Structure. At the 1991 ASME Winter Annual Meeting an announcement was made regarding the organization of the Adaptive Structures Committee; surprisingly about 20 people attended. Craig Rogers was nominated to be the committee chair. The membership and leadership of the committee was unique, as many were very young engineers. Many were young people trying to find a career research field. My guess is the average age was about 30, whereas the other ASME and AIAA committees' average age was greater than 50.

As one of the Directors of AIAA responsible for the AIAA SDM Conference, I was then approached by AIAA to somehow introduce Adaptive Structures as part of the AIAA meetings. My approach was NOT to introduce a new meeting, but to integrate it into the well established SDM meeting. My approach was to introduce the concept of a FORUM where new technology papers and topics would be introduced. Thus, the call for papers for the 1994 SDM meeting included papers for the Adaptive Structures Forum with myself as the chairman and Andy Bicos as the technical chair. Eventually, with the continued interest exhibited by an increasing number of papers and sessions, the Forum became an Adaptive Structures Conference within the SDM. In 1996, I was approach by David Jensen to form an Adaptive Structures TC within AIAA. I guided him through the process, and we organized a new AIAA TC with Jensen as the chairman."

So there you have it. A clear developmental path for a whole new area of engineering technology and research, from a conference session and associated manuscript, to an independent international conference, to acceptance by ASME, and finally integration into AIAA. It's truly remarkable to be a part of a research community that remains overwhelmingly young and vibrant, one that can still trace its origin story and hear it directly from one of the principals involved. ■

Education Corner

SMASIS 2011 Outreach Event

Aimy Wissa, University of Maryland ■ During the ASME 2011 Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS) conference in Scottsdale AZ, the graduate student committee hosted an outreach event for undergraduate students from a local college. During the event, students learned about various smart materials such as shape memory alloys, piezoe-

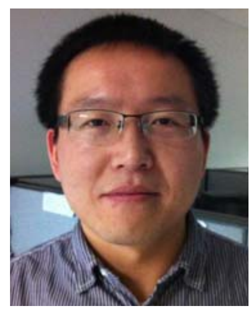
lectric materials and optically adaptive materials. They also learned about the application of these materials in various industries like the automotive and aerospace industries. The students were divided into groups where each group had a hands-on experience with smart materials that were included in our AIAA Adaptive Materials Demonstration Kits. These kits allowed the students to conduct experiments in: heating SMA wires, introducing electric voltage to an electroluminescent wire, applying a mechanical strain to a piezoelectric ceramic to monitor the voltage change, applying magnetic field to a magnetorheological material, and heating and cooling a thermochromic plastic. As a result, the students gained true insight into how smart materials work and where they are used in their daily lives. At the end of the outreach event, a panel including subject matter experts from both academia and industry was convened. Students had the opportunity to ask the panel members general questions about exploring a career as an engineer or pursuing an advanced de-

gree via graduate school. The outreach event proved very successful in introducing the field of smart materials to students and will be continued in future SMASIS conferences. ■

STUDENT SPOTLIGHT

Chin-Jui "Ray" Hsu is a PhD candidate expected to graduate this year in the Department of Mechanical and Aerospace Engineering at UCLA. Prior to joining the Active Materials Lab led by Prof. Gregory Carman, he was an assistant researcher at Chung Shan Institute of Science and Technology (CSIST) in Taiwan. His work on virtual instruments control at CSIST won first place in a national paper contest held by National Instruments Company. In 2008 he received a scholarship from UCLA and began to focus on understanding magnetic domain engineering in multiferroic systems for applications such as thermal energy harvesting and memory spintronics. During Ray's PhD career, he analyzed the thermomagnetic energy conversion efficiency for the ferromagnetic 3d and 4f elements. Based on this study, he proposed using nanoscale single domain elements that exhibit high spontaneous magnetization to increase the efficiency of thermomagnetic energy harvesting elements by threefold which is superior to conventional Seebeck thermoelectric devices. Ray used several different micro/nanofabrication processes including electron beam lithography and focused ion beam milling to construct the single domain nanoscale elements. During characterization of these elements, he discovered a spin-reorientation and crystal structure transition phenomena present in nanostructured Gadolinium (Gd). Based on these findings, an energy harvesting project focused on spin-reorientation was initiated in 2011. In addition to energy harvesting, Ray was one of the first researchers to demonstrate an electrically controlled, out-of-plane magnetization change in a nickel/ferroelectric heterostructure using magnetic force microscope experiments. Ray's work appears in five published and three soon-to-be published journal papers, and more than ten conference papers and posters, including an invited talk at the Materials Research Society spring meeting at San Francisco in 2011. He also holds a patent based on his graduate school work in Taiwan. Recently, one of Ray's scanning electron microscope images on Gd nanostructures won the "Best SEM Image Award" from FEI and has been highlighted in the UCLA Engineering E-bulletin. The related research results have also been selected as a student platform talk in the Southern California Society for Microscopy and Microanalysis symposium in 2012. ■

Hongbo Wang is a PhD student in the Mechanical Engineering Department at Florida State University (FSU) who specializes in nonlinear mechanics of active materials. He has two MS degrees in Physics, one from Lanzhou University in China and one from Florida State University. He joined the Mechanical Engineering Department at FSU in 2009 where he has worked in the Active Structures and Microsystems Laboratory with Dr. William S. Oates for the past three years. His research includes theoretical, computational, and experimental solid mechanics of photo-responsive active materials and structures.



He has been instrumental in understanding complex photoisomerization processes of azobenzene liquid crystal polymer networks that have the potential for developing novel actuators and sensors that are controlled with blue-green polarized light. Through support from DARPA, he quantified a complex microstructure evolution process speculated to occur in these materials as they change their molecular structure from polarized light interactions. His model predictions of polymer photomechanics were later confirmed by collaborators at the Air Force Research Laboratory's Manufacturing and Materials Directorate. His model uses finite deformation mechanics coupled to time-dependent electromagnetics and photochemistry within a phase field FEM. Different aspects of this work, in combination with *in situ* photomechanical experiments, were awarded two best paper awards; one at the ASME SMASIS (Smart Materials, Adaptive Structures and Intelligent Systems) conference and one at the SPIE Smart Materials and Structures Conference.

He is now conducting research at the National High Magnetic Field Laboratory to quantify the detailed molecular evolution of these materials *in situ* using light and temperature control within a solid state NMR probe. In addition, he has broadened his research expertise to other active materials including chemically responsive polymers and ferroelectric materials. Hongbo successfully defended his PhD thesis recently and has published the key results of a two year DARPA program in the journal of Macromolecular Theory and Simulation, *DOI:10.1002/mats.201100089*. ■

Mehran Tehrani is a PhD student in the Department of Engineering Science and Mechanics (ESM) at Virginia Tech. Throughout his graduate studies he has always excelled in academic pursuits and has won several competitive awards at departmental, college, and national levels. Amongst others are:

- PerkinElmer presentation award from Society of Plastic Engineers (2012)
- PerkinElmer best abstract award from Society of Plastic Engineers (2011)
- Virginia Tech College of Engineering Outstanding Doctoral Student (2012)
- University of New Mexico Regent's fellowship (2009)
- UNM Mechanical Engineering outstanding graduate student (2009)
- Liviu Librescu fellowship from the ESM department, VirginiaTech (2011)
- Pratt Presidential Graduate Fellowship, fall 2010 and spring 2011; ESM

Mehran's research spans over diverse fields such nanomaterials, nanomechanics, composites and solid mechanics. His forte is his adeptness at both experiment and computation. Among his recent experimental research highlights are fabrication of composites for blast resistance and high-energy particle radiation shielding, synthesis of alumina nanoparticles for dental applications, and magnetic annealing of nanocomposites and polymers to enhance their mechanical properties.

Mehran has authored and co-authored

10 published articles in journals such as ASME-Journal of Engineering Materials and Technology, Power Sources, Carbon, Int. J. Plasticity and is currently participating in 4 more papers under review. He is also the author and coauthor of 10 proceedings articles and has presented 8 talks in national and international conferences such as SMASIS, ASME IMECE, and SEM annual conference.

Despite his regular course load and numerous research assignments, he found the time for departmental, university, and societal activities. He currently serves as the ESM department delegate at Virginia Tech graduate school, student member of the graduate committee of ESM. He was vice president of the Iranian Society at Virginia Tech. Mehran also served as a reviewer for several journals such as Composites Part A, Mechanics of Materials, eXPRESS Polymer Letters and ASME- J. Engineering Materials and Technology. He is an active student member in several engineering's societies including ASME, ASC (composites), SPE (Plastics), SEM, and MRS. ■

Yashwanth Tummala is a PhD candidate in Mechanical Engineering at The Pennsylvania State University. He has presented his work on design optimization of a novel compliant spine for passive morphing of ornithopters at two conferences (2010 SMASIS and 2011 SMASIS). His 2010 SMASIS paper received the best student paper award in the Bio-inspired smart materials and structures symposium. Prior to attending Penn State, Yash obtained his B.Tech in Mechanical Engineering with a minor in Bio-medical engineering from Indian Institute of Technology Madras. For his PhD dissertation, Yash is currently working on designing contact-aided compliant mechanisms for passive morphing of ornithopters in collaboration with University of Maryland. This research is funded by Air Force Office of Scientific Research. His team includes his adviser, Dr. Mary Frecker, and his collaborators, Dr. James E. Hubbard Jr., and Aimy Wissa.

Passive morphing of ornithopters is important because they require no addi-

tional power, add very little extra weight, and do not need any closed loop control or feedback. The contact - aided compliant mechanisms that he and his team have designed have tailorable non-linear stiffness properties. Such passive compliant mechanisms can induce bending, sweep and twist of ornithopter wings when inserted in the leading edge wing spar. To achieve bending alone in ornithopters' wings, he and his team have designed a contact-aided compliant mechanism called a compliant spine with non-linear bending stiffness properties to imitate Continuous Vortex Gait. An avian wrist is the primary joint responsible for this gait in birds. A compliant spine does the same job in ornithopters. This compliant spine was inserted in the leading edge spar of the ornithopter wings at the wrist location and was tested by Aimy. Yash has formulated a multi-objective optimization problem and a design optimization methodology to design these contact-aided compliant mechanisms with optimal characteristics. This design optimization methodology can be used to

Calendar of Events

SPIE Smart Structures & Materials Symposium
San Diego, CA
Dates: March 11–15, 2012
http://spie.org/smart-structures-nde.xml

IWPMA 2012
Location: Hirosaki, Japan
Dates: April 22-25, 2012
http://www.ems.k.u-tokyo.ac.jp/IWPMA2012/index.html

AIAA/ASME/AHS Adaptive Structures Conference
Location: Honolulu, Hawaii
Dates: April 23-26, 2012
http://www.aiaa.org/SDM2012/

2012 International Workshop on Acoustics Transduction Materials and Devices
Location: State College, PA
Dates: May 8-10, 2012
https://www.mri.psu.edu/conferences/usnavy/index.asp

4th International Conference "Smart Materials, Structures and Systems
Location: Montecatini Terme, Tuscany, Italy
Dates: June 10-14, 2012
http://www.cimtec-congress.org/2012/

13th International Conference on New Actuators
Location: Bremen Germany
Dates: June 18-20, 2012
http://www.actuator.de/

ASME Conference on Smart Materials, Adaptive Structures and Intelligent Systems
Location: Stone Mountain, GA
Dates: September 19 - 21, 2012
Abstracts Due: March 23, 2012
http://www.asmeconferences.org/SMASIS2012/index.cfm

23rd International Conference on Adaptive Structures and Technologies
Location: Nanjing, China
Dates: October 11-13, 2012
Abstracts Due: May 4, 2012
http://aero.nuaa.edu.cn/ICAST2012/Default.asp

AIAA/ASME/AHS Adaptive Structures Conference
Location: Boston, MA
Dates: April 8-11, 2013
Abstract Due: August 3, 2012
http://www.aiaa.org/SDM2013

Education Corner, continued

design these contact aided compliant mechanisms for other applications as well. He presented his methodology and design optimization of the compliant spine at SMASIS 2011. His PhD dissertation involves designing, optimizing and inserting contact-aided compliant mechanisms for bending, sweeping and twisting, in the leading edge spars of the ornithopters to achieve passive wing morphing for increased lift, agility and endurance. ■

Ryan Hahnlen is a PhD candidate in mechanical engineering at The Ohio State University working under the guidance of his advisor, Professor Marcelo Dapino. Ryan graduated cum laude, obtaining his bachelor's degree in mechanical engineering with a minor in aviation (2007), and received his master's degree in mechanical engineering (2009), both from The Ohio State University. His master's research focused on creating and characterizing Shape Memory Alloy (SMA) composite systems, including methods of joining NiTi to steel and aluminum alloys through laser welding and soldering.

Through his doctoral research, Ryan has continued to focus on the development of active metal-matrix composites with embedded smart materials constructed through Ultrasonic Additive Manufacturing (UAM), an emerging rapid prototyping process. Ryan's current research focuses on the design, characterization, and modeling of UAM SMA composites with aluminum matrices with an emphasis on utilizing the blocking stress in the shape memory alloys to create thermally invariant structures with a near zero coefficient of thermal expansion. In addition to thermal invariance, the composites also enable the creation of tunable dynamic structures through generation of internal stresses and modulus changes and exhibit increases in stiffness with increasing temperature. Ryan is also studying the interface between the SMA and aluminum, a critical aspect enabling the unique behaviors of these composites, through multi-scale characterization.

In addition to SMA composites, Ryan has constructed and characterized composites with Galfenol, a magnetostrictive alloy, and electroactive PVDF, a piezoelectric polymer, embedded within aluminum matrices. Ryan's combined research has resulted in four journal papers, two currently in review, and seven conference papers, including first place and second place papers in the SPIE/ASME Best Student Paper Competition in the 2011 and 2009 conferences on Smart Structures/NDE, respectively. He also co-authored a final paper in the 2011 ASME SMASIS Student Hardware Competition. Ryan's research has earned a Graduate Fellowship for the past four years through the Smart Vehicle Concepts Center, a National Science Foundation Industry/ University Cooperative Research Center. Ryan has also served as a mentor for undergraduate researchers in the lab, leading to successful completion of their honors degrees and continuation into the graduate program. Ryan anticipates completion of his degree at the end of 2012 and upon graduation aims to obtain a research position in industry or the government sector. ■

Aimy Wissa attended the Pennsylvania State University and earned her Bachelor of Sciences degree in Aerospace Engineering in 2008. During her undergraduate studies, Aimy was introduced to research through the McNair Scholars Program. As a participant in the program she conducted summer research under the supervision of Dr. George Lesieutre. Her research focused on Structural Health Monitoring Systems and their applications to Aircraft. This undergraduate research and subsequent thesis work won her the Wolk Award for Best Senior Thesis in Aerospace Engineering. Aimy earned her Masters of Science in Aerospace Engineering from the University of Maryland in 2010. She is currently pursuing her Ph.D. at the same university. Aimy's graduate research focuses on the novel idea of passively improving the performance of flapping wing UAVs or Ornithopters via wing gait modification. There are significant efforts underway focused on understanding the physics of avian-based flapping wing vehicles since there is an increasing need for small aerial robots to conduct a variety of civilian and military mission scenarios. No other form of flight has the potential to combine the desired capabilities of hovering, maneuverability, agility, safety, and stealth as do flapping wing technologies. The research is funded by the Air Force Office of Scientific Research and is a collaboration with Penn State.

In her research, Aimy employs compliant mechanisms, designed and optimized in conjunction with the Penn State team, to achieve passive wing morphing, during steady level flight by introducing an asymmetry between the up and down strokes of the flapping cycle. Introducing the compliant insert into the wing leading edge spar has shown significant performance improvements, which can lead to significantly improved free flight range and endurance and higher payload capability. Thus her previous work was successful at improving steady level performance for the ornithopters. Future work includes using multiple spatially distributed compliant elements to improve the in flight agility by allowing for the achievement of more complex wing kinematics and the application of passive wing morphing to both insect and avian scale ornithopters. Aimy has distinguished herself and her research by publishing and presenting several conference papers and a peer refereed journal paper. She was a finalist for the best student paper award at SMAIS 2010. Aimy is advised by Dr. James E. Hubbard Jr., and she will graduate with her Ph.D. in Aerospace Engineering in December 2013. ■

Ahmadreza Eshghinejad is currently perusing his Master's degree in Mechanical Engineering at the University of Toledo in Toledo, Ohio. Ahmad joined the Dynamic and Smart Systems laboratory in Mechanical, Industrial, and Manufacturing Engineering Department in May of 2010 after completing his bachelor's degree from Isfahan University of Technology in Isfahan, Iran.

Ahmad's research focuses on the finite element modeling and experimentation of medical devices made out of shape memory alloys, especially Nitinol. His research is aimed at utilizing the unique properties of this type of smart material in negotiating the functionality barriers of conventional materials. As part of this research, devices such as smart pedicle screw, esophagus displacer and expandable cage have been modeled and validated with experiments. The smart pedicle screw, as the main project, was designed to enhance the effectiveness of spinal surgical treatments against osteoporosis risks. The screw is implanted in the spinal vertebrae in a collapsed form and expands when body temperature is reached. Thus, as the bone goes through osteoporosis and degradation, the screw maintains its purchase and prevents loosening. Ahmad developed and presented a business plan on his research for The University of Toledo IE Challenge Business Plan Competition and won the honorable mention award with the prize of $500.

With one published journal paper, seven conference publications, and three journal papers under review, Ahmad has an excellent publication record . Ahmad has also been involved in numerous extracurricular activities. These include volunteering in conferences, serving as reviewer for the Journal of Intelligent Material Systems and Structures, assuming leadership roles in several campus activities, and participating in multicultural programs. Ahmad will defend his thesis this spring semester graduating with a 4.0 GPA and will be seeking a PhD post graduate research position for fall 2012. ■

SMASIS Conference Synopsis

Adaptive Structures and Materials Systems by definition are intelligent, flexible systems that have sentience and responsiveness to ever changing environments. The field has rapidly matured due to synergistic interdisciplinary efforts across sectors of universities, government and industry. To continue the high impact growth of this field and lead it into the future, the purpose of this conference is to assemble world experts across engineering and scientific disciplines (mechanical, aerospace, electrical, materials, and civil engineering, biology, physics chemistry, etc) to actively discuss the latest breakthroughs in smart materials, the cutting edge in adaptive structure applications and the recent advances in both new device technologies and basic engineering research exploration. The conference is divided into symposia broadly ranging from basic research to applied technological design and development to industrial and governmental integrated system and application demonstrations.

Schedule

March 23, 2012:	400 word abstract due
April 23, 2012:	Authors informed of abstract acceptance
May 28, 2012:	Final full-length paper due
June 11, 2012:	Copyright form due

Full paper will appear in an archival ASME Conference Proceedings. Selected papers will be published in archival Journals.

Participation

Authors should submit a 400 word abstract to the conference web site **www.asmeconferences.org/SMASIS2012.** Questions can be directed to:

Stefan Seelecke, General Chair
seelecke@mx.uni-saarland.de

Nancy Johnson, Technical Chair
nancy.l.johnson@gm.com

Andrei Zagrai, Technical Chair
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Image courtesy of Mike Flint

Call for Papers

ASME Conference on

SMART MATERIALS, ADAPTIVE STRUCTURES AND INTELLIGENT SYSTEMS

September 19-21, 2012
Stone Mountain (Atlanta), GA, USA

Sponsored by the Adaptive Structures & Materials Systems Technical Committee, Aerospace Division
Participating society: AIAA Technical Committee on Adaptive Structures

The conference is divided into symposia broadly ranging from basic research to applied technological design and development to industrial and governmental integrated system and application demonstrations. The symposia specifically are:

Development and Characterization of Multifunctional Materials

Chair: Zoubeida Ounaies, *Penn State*
Co-Chairs: Hani E. Naguib, *Univ. of Toronto*
Henry Sodano, *Univ. of Florida*

Topical areas: Material formulations, evaluation, synthesis, and processing; multifunctional composites and hybrid materials; bio-inspired and nano-composites; self-healing materials; novel triggering approaches, including optical, chemical, electrical, and mechanical; material property enhancement; interface and interaction science.

Mechanics and Behavior of Active Materials

Chair: John Huber, *Univ. of Oxford*
Co-Chairs: Travis Turner, *NASA Langley*
Iain Anderson, *Univ. of Auckland*

Topical areas: Advanced constitutive measurements, micro- and nano-mechanics of actuator & sensor materials, phase field modeling, multi-scale and multi-physics material models, finite element implementations, reliability issues: aging, fatigue, and fracture, materials for energy storage.

Modeling, Simulation and Control of Adaptive Systems

Chair: Ralph Smith, *North Carolina State Univ.*
Co-Chairs: Alper Erturk, *Georgia Tech*
Eugenio Dragoni, *Univ. of Modena*

Topical areas: Micro and macro level modeling, vibration and acoustic control, passive/semi-active/active damping and stiffness variation, actuation and motion control, intelligent and adaptive control, nonlinear control, hysteresis control, modeling simulation and control of micro/nano systems, nonlinear dynamics, and nonlinear vibration.

Integrated System Design and Implementation

Chair: Norman Wereley, *Univ. of Maryland*
Co-Chair: Eric Ruggiero, *GE*

Topical areas: Sensors and actuators, power and control electronics, smart devices and technologies, compliant mechanism design, adaptive / intelligent / integrated systems design, smart structures design processes and tools, Industrial and Government smart products and system applications, smart electronics and devices, MEMS.

Structural Health Monitoring

Chair: Oliver Myers, *Mississippi State*
Co-Chairs: Kenneth Loh, *UC Davis*
Andrew Swartz, *Michigan Tech*

Topical areas: Damage identification & mitigation, sensor networks, data fusion, data mining and management, damage diagnostic and prognostic modeling software, system integration, and applications.

Bio-Inspired Smart Materials and Systems

Chair: Mike Philen, *Virginia Tech*
Co-Chairs: Vishnu Baba Sundaresan, *VCU*
Richard Trask, *Univ. of Bristol*

Topical areas: Modeling of biological systems, understanding physical phenomena in biological systems, biomimetic and bio-inspired devices, machines and robotics, utilizing biological systems, smart prosthetic systems and intelligent implant materials and structures.

ASME SETTING THE STANDARD

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