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Adaptive Structures & Material Systems

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ASME & AIAA Adaptive Structures & Material Systems Newsletter — Spring 2009

Diann Brei ■ EDITOR

MESSAGE FROM THE CHAIR

Vit Babuska, AIAA ASTC ■ Regular readers will notice that this column alternates between the AIAA Adaptive Structures Technical Committee and the ASME Adaptive Structures and Material Systems Committee. In May 2008, I became Chairman of the AIAA ASTC, so this is my first contribution to the newsletter. I have been involved with smart structures and with the AIAA ASTC since the 1990's. I have watched the field evolve, expand and grow through the years. Things that started out as research ideas evolved into tangible products that added value and unique capabilities to a wide variety of systems. The smart structures field is very diverse and continues to provide unique solutions across the board. I am confident that this trend will persist if we continue to attract bright, clever students, and educate them in the multidisciplinary aspects of our field.

Technical conferences play an important part in the development of any technical area, for they are forums for exchanging ideas both formally and informally, and for introducing students, educators, and engineers to new ways of doing things and thinking about them. At the 16th AIAA/ASME/AHS Adaptive Structures Conference held in Schaumberg, IL in April 2008, we introduced the 1st Adaptive Structures Shootout. The Shootout was the brain child of Dr. Steven Griffin, who led the planning and execution of the event, over a two-year period. Four student competitors designed compensators for a relatively simple adaptive structure. The compensators had to attenuate the vibration of the structure and adapt to a step change in the structure configuration. Dr. Griffin even secured a donation from the Boeing Company for a monetary prize. The shootout was the first hardware competition session at the conference. It engaged participants and the audience in a hands-on demonstration of adaptive active vibration control. Dr. Gangbing Song organized a similar event for the ASCE Earth and Space Conference, Intelligent Sensors and Actuators Symposium in March 2008. Both were successful events, and it is my hope that their successes will lead to more such non-traditional, compelling conference sessions.

The AIAA Adaptive Structures Shootout and the ASCE Active Vibration Control Competition are innovations to the traditional conference session format. While they are much harder to organize and execute than traditional sessions, they provide a new dimension to our meetings. The AIAA ASTC will continue with such competitive sessions at upcoming conferences.

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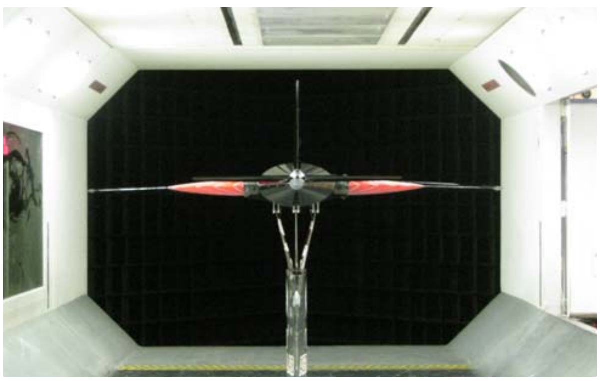
Multifunctional Unmanned Flight Systems
NextGen Aeronautics

Shiv Joshi, NextGen Aeronautics ■ NextGen Aeronautics successfully completed flight testing of an autonomous morphing aircraft in 2007. Since then we have continued to develop technologies that improve the performance and utility of this class of future vehicles. We are also developing other multifunctional vehicles. Traditional aircraft design is limited by its fixed architecture, which is generally optimized for a particular flight condition. The resulting aircraft performs poorly in an off-design flight condition and has a very restricted flight envelope. Under DARPA, Air Force, and NASA leadership, NextGen Aeronautics developed a variable-geometry aircraft wing capable of changing its geometry drastically in order to optimize the wing shape and size for different flight conditions. The present NextGen design provides a 200% change in sweep, 56% change in wing area, 38% change in span, and more than 100% change in aspect ratio. The main innovations of this design stem from an internal mechanism, an unconventional internal structure, a flexible skin, and a distributed actuation system. Preliminary mission analysis suggests dramatically improved performance over that of traditional fixed-wing reconnaissance and attack aircraft. The wind-tunnel test of the morphing aircraft wing model was successfully completed in November 2005 at the NASA TDT, followed by a flight test of a 100-lb UAV, MFX-1, in August 2006. Phase III of the program culminated with a morphing flight demonstration of a 200-lb model, MFX-2, in May 2007.

NextGen incorporated the morphing wing and skin technology into innovative reconfigurable wing designs for future short take-off and landing (STOL) aircraft. This is a promising application of a morphing wing to reduce aircraft takeoff and landing speeds. Wing morphing can provide both an increase in wing area and change in wing camber, resulting in significantly reduced wing stall speed and, hence, landing and take-off distances. With its decreased stall speed, a morphing-wing intra-theater transport aircraft could replace current helicopters. This morphing wing concept can be used to complement direct lift from additional thrust-producing devices.



NextGen Aeronautics, with support from Purdue University, plans to build on its prior and ongoing work to develop and mature morphing wing concepts for application to future ESTOL/VTOL aircraft designs. Our work in 2008 established the feasibility of using a combination of morphing wing and direct lift technology for STOL aircraft. We plan to design, build, and test a morphing wing for the STOL aircraft to validate performance and weight penalty assumptions in Phase II of the STOL program.

Another application of morphing technology is a stowable unmanned air vehicle. We are developing viable, low-stored volume wing designs for high-altitude, long-endurance (HALE) aircraft. The NextGen team has completed an aerodynamic design of a hybrid inflatable-deployable wing which will be tested next year.

Under the DREAM-UAV SBIR-Phase I program (funded by NASA) and the Phase II program (funded by DARPA), NextGen developed a unique approach to morphing wing design technology with substantially enhanced performance due to drastic geometry changes and actuation options and minimal interference with fuselage structure. The main innovations include: a central pivot mechanism controlling individual rotating spars of the wing; skin attachment with understructure; skin folding; and an actuation / deployment mechanisms. For the skin folding mechanism, we developed a unique rigid-flex assembly using shape memory polymer. The model shown in the photo was tested in October 2008 at the University of Washington Aerodynamic Laboratory wind tunnel.

NextGen is presently working with academic partners in multifunctional materials and structures research that, when matured, will be incorporated into UAV systems under development. Research areas of interest to NextGen Aeronautics are flexible skins, self-healing materials, designed electro-mechanical properties, reactive structural materials, and intelligent structures.

New threats and changing technology are driving the push toward increasingly agile and versatile defense systems. The urgent need for intelligence, surveillance, and reconnaissance (ISR) lends particular support for these new operating methods. NextGen is developing several UAVs that utilize multifunctional structures and cognitive control strategies to satisfy near future defense needs. ■

ASME 2008 Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS 2008)

Diann Brei, University of Michigan, Christopher Lynch, UCLA ■

SMASIS 2008 was a rousing success! We are thrilled with the exceptional response we received for this first year. Our sincere appreciation goes to all the presenters for choosing to share their very best work at this conference and to the over 300 participants who created an energetic and beneficial conference through their active engagement. All the feedback noted the high quality of work presented.

SMASIS 2008 was divided into six symposia that included basic research, applied technological design and development, and industrial and governmental integrated system and application demonstrations. The six symposia were

1. Multifunctional Materials
2. Active Materials, Mechanics and Behavior
3. Enabling Technologies and Integrated System Design
4. Structural Health Monitoring/NDE
5. Nonlinear Dynamics and Passive/Adaptive Controls
6. Bio-inspired Smart Materials and Structures

We were honored to have three keynote speakers – Leo Christodoulou (DARPA), Jay Kudva (Next Gen Aeronautics, Inc.), Dan Inman, (Virginia Tech) – and eleven invited speakers who are recognized leaders in their respective fields. We also had two outstanding lunch panels: Future Horizons (governmental) and Emerging Technology Requirements for Industrial Applications, which addressed key challenges and upcoming opportunities for the scientific community.

Our hope was that the selection of a venue that was slightly off the beaten path would lead to many opportunities to meet new colleagues and establish new research directions. We were delighted with the diversity represented at the conference. Attendees of the conference included a broad range of individuals from industrial, academic, and government laboratories; with individuals from a variety of cultures, ethnicities, and age groups. There were several social functions to help lighten the mood and make new contacts including a Harvest Reception with a local flavor and seasonal spirit and the Pioneer banquet that highlighted reminiscences of several of the pivotal pioneers of our field. Several people claimed it was like a reunion with age-old friends – of course, the open-bar Karaoke afterward certainly helped to build new, unforgettable ties!

Students were a major component to the conference, with several special events geared toward them including student best paper awards, an Inner Harbor excursion to the famous Baltimore Aquarium and a networking luncheon with industrial leaders. The student best paper competition was held for the newest members of the community. The outstanding quality of the papers made the judging extremely difficult. One student best paper award was given for each of the symposia, and an overall best student paper award was given for the conference.

The planning for this conference has been a significant team effort involving three technical committees: the ASME Adaptive Structures and Material Systems Technical Committee, the ASME Technical Committee on Sound and Vibration, and the AIAA Adaptive Structures Technical Committee. We received generous support from our sponsors, General Motors, CSA, Teledyne, NextGen, and SMS, all of which is sincerely appreciated. There has been tremendous support and guidance from our executive committee, and we could

not have proceeded without all the contributions of the symposium chairs, co-chairs, and their organizing committees. Our thanks go to them for assembling such outstanding technical programs. We also recognize all the authors, keynote and invited speakers, and panel participants who were major contributors to the success of SMASIS.

We hope you will join us for the next SMASIS, to be held September 20-24, 2009 at the beautiful oceanfront Embassy Suites Mandalay Beach Resort in Oxnard, California. The website is: *http://www.asmeconferences.org/SMASIS09/*. Our goal is to live up to and exceed the standard that we started with SMASIS 2008! ■

Important Dates for 2009

March 23, 2009:	400 word abstract due
April 27, 2009:	Authors informed of abstract acceptance
June 8, 2009:	Copyright form due
June 15, 2009:	Final full-length paper due

2008 Gary Anderson Early Achievement Award

Marcelo Dapino, Ohio State University ■ Dr. Ibrahim Karaman, associate professor in the Department of Mechanical Engineering at Texas A&M University, has been awarded the Gary Anderson Early Achievement Award by the ASME Adaptive Structures and Material Systems Technical Committee.

The award, consisting of an ASME certificate and honorarium of $1,000, was presented at the 2008 Smart Structures and Materials meeting in San Diego, California.

Karaman joined Texas A&M University in 2000 after receiving his Ph.D. from the University of Illinois at Urbana-Champaign. He currently holds The Dietz Career Development Associate Professor I Position in the Department of Mechanical Engineering

He received The Minerals, Metals and Materials Society Robert Lansing Hardy Award in 2005 and Honorable Mention for the 2007 Early Career Faculty Fellow Award. He was named TEES Fellow at Texas A&M in 2006. He also received the National Science Foundation CAREER Award in 2002 and Office of Naval Research Young Investigator Award in 2005.

Karaman's research interests include: processing-microstructure-mechanical property relationships in metallic materials, conventional and magnetic shape memory alloys; bulk metallic glasses and composites; micro-mechanical constitutive modeling of crystal plasticity; twinning and martensitic phase transformation in metallic materials; and magnetic, thermal and mechanical activation of martensitic phase transformation.

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. Don Leo at *donleo@vt.edu*. ■

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2008 ASME Adaptive Structures and Materials Systems Prize

Marcelo Dapino, Ohio State University ■ Dr. Kon-Well Wang, formerly the William E. Diefenderfer Chaired Professor in Mechanical Engineering at the Pennsylvania State University, University Park, PA, received the 2008 ASME Adaptive Structures and Materials Systems Prize. The prize was awarded at the AIAA ASC conference in 2008. At Penn State, Professor Wang served as Director of the Structural Dynamics and Controls Lab, Associate Director of the Vertical Lift Research Center of Excellence, and Group Leader of the Center for Acoustics and Vibration. He is currently the Department Chair and Stephen P. Timoshenko Professor of Mechanical Engineering at the University of Michigan, Ann Arbor, MI.

Professor Wang was honored for his seminal and often referenced work in multi-field tailoring of adaptive structural systems for control and identification enhancement. He has authored or co-authored over 200 scientific publications. His work has received several awards and recognitions, including among others the ASME N. O. Myklestad Award, the NASA Tech Brief Award, and the Penn State Engineering Society Premier Research Award. Professor Wang is a Fellow of ASME and the Chief Editor of the ASME Journal of Vibration and Acoustics.

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. Professor Wang delivered the Adaptive Structures Award Keynote Lecture titled "Adaptive Structural Systems - Multi-Field Tailoring."

Nominations for the 2009 prize can be sent to Dan Inman at *dinman@vt.edu* by November 2009. ■

For more information visit the Technical Committee Websites:

ASME: http://divisions.asme.org/Aerospace/Adaptive_Structures_Material.cfm

and

AIAA: http://www.aiaa.org/tc/as

Honors and Awards, continued

2008 Smart Structures Product Implementation Award

Janet Sater, IDA ■ The 2008 Smart Structures Product Implementation Award was presented to Face International Corporation and PulseSwitch Systems, LC, for their Lightning Switch product.

The Lightning Switch system is a wireless, batteryless radio remote control light switching system. The basic system consists of one or more transmitters and one or more receivers. How does it work? The receivers wire in to junction boxes or into the finished product, such as a light fixture, plug into outlets, or come arrayed in Lightning Control Panels that permit switching of circuits or of the building at up to 347 V and 60 A for each circuit. Each receiver is taught to communicate with a batteryless remote control transmitter-one receiver can be commanded by up to 30 transmitters and one transmitter can command any number of receivers. When the switch is "flipped", the mechanical energy is converted to the right amount of electrical energy to send a unique radio signal to its companion receiver, and the radio signal turns the electrical device on or off. Note that the fixture has to have electrical energy flowing to it but the switch does not have to be wired to the fixture. The mechanical energy in the transmitter comes from its vibrating piezoelectric generator. This generator, based on the NASA composite THUNDER (THin layer UNimorph ferroelectric DrivER and sensor) piezo element, is a thin piezoelectric wafer bonded to a metal substrate. Transmitters work over a range of 45 to 100 feet, but that can be extended with the addition of some other hardware. In normal use, these remote transmitters can work for decades.

These switches can be installed quickly at a fraction of the cost of regular wired switches. Cost savings on the order of 70 to 80% over that for standard wiring are possible, particularly for brick and concrete structures, buildings with cement-stucco walls, and log homes as well as closets, stairways, basements, attics and garages.

A few examples of applications to date include lighting control for industrial and commercial buildings as well as private homes; vote registration for gaming systems; lift control for handicapped people; and hotel taxi-calling systems; among others. These Lightning Switch products are featured in the Dept. of Housing and Urban Development's PATH Concept Home. The Natl. Association of Home Builders recommends them for solid wall construction. The Lightning Switch has been identified by NASA as one the top 20 spin-off technologies since 2002 and won the 2006 NOVA award, the highest international honor for innovation in the construction industry. ■

Message from the Chair, continued

We are working on a new event, refining our approach using the lessons learned from the first ASC shootout.

In closing, I believe that we must do more to directly engage students at both the graduate and undergraduate levels through conferences sponsored by our Technical Committees. Such engagement will be good for students and for the vitality of our meetings. I encourage the entire community to think of out-of-the-box ways for our conferences to connect with and motivate the next generations of researchers and engineers.

Vit Babuska
AIAA ASTC Chair 2008 - 2010
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Smart Vehicle Concepts Center – Research for Industry

Sergio Lucato, Teledyne Scientific ■ Engineering researchers at the Smart Vehicle Concepts Center (SVC) are bringing lighter, more intelligent materials to vehicle design – thanks to a multi-year grant from the National Science Foundation Industry/University Cooperative Research Centers (NSF I/UCRC) program. The mission of SVC is the development of active material based devices that will achieve superior force, motion, noise and vibration control performance goals, with applications to ground and aerospace vehicles.

The Center is a joint effort between Ohio State University professors Rajendra Singh, Marcelo Dapino, and Gregory Washington, and Texas A&M University professors Dimitris Lagoudas, Jim Boyd, and Ibrahim Karaman. With support from NSF and 15 sponsors from industry and government laboratories, SVC could influence almost every aspect of the operation of a vehicle with the smart materials based devices being conceived.

Smart material actuators and sensors have significant advantages over conventional devices. Because these devices have fewer moving parts and are multi-functional, they could lead to a reduction in cost, weight and size. “Right now we have smart materials typically being made in smaller quantities, at a higher cost,” says Dapino. “Eventually, we want to change this to higher quantities, at low cost.” Putting lighter materials in cars makes them less heavy and more energy-efficient.

The smart material applications investigated at SVC could improve the efficiency, safety, reliability, and functionality of vehicles by improving the static and dynamic performance and acoustics and vibration features in cars and airplanes. Smart materials could also be used in sensors that can configure the safety systems after detecting certain characteristics in a component or system. “Companies are looking for ways to create products with enhanced features that also have reduced mass and complexity, higher energy efficiency and yet are cheaper to make,” says Dapino. “Smart materials can overcome these contradicting requirements in a way that is perhaps impossible with conventional technologies.”

www.SmartVehicleCenter.org

The work being done at the Smart Vehicle Concepts Center is supported and monitored by a consortium of companies, small businesses, R&D organizations and government laboratories with international influence. Center sponsors like The Boeing Company, Honda R&D Americas Inc., NASA, Army Research Laboratory, and Edison Welding Institute all share responsibilities in evaluating current research, suggesting new opportunities, and matching Center capabilities with unfilled research needs. Members of the consortium – which has surpassed NSF's fundraising goals for the first year – pay an annual membership fee, allowing them to have representatives on the Industrial Advisory Board.

“The key to innovation is the partnership between industry, government, and academia, and, in fact, the SVC implements this paradigm very well,” says Singh. “We are focusing on pre-competitive technology and on R&D problems of common interest. This is a win-win for all concerned as cutting edge research problems are being addressed in a collaborative manner.”

Research at the Center covers a range of thrust areas including interfacial mechanisms, adaptive noise vibration and harshness, safety, energy, and shape memory alloys. The center works collaboratively with researchers at Texas A&M University and other engineering disciplines at Ohio State to focus on active material-based composites, piezoelectric and magnetostrictive materials, shape memory alloys, and magnetorheological fluid-based devices.

Some projects currently under way include work on development of interfacial force sensing systems using experimental and computational methods, multifunctional composites with embedded actuators, sensors and stiffness control, and critical assessment of active noise and vibration technology for rotorcraft gearboxes and airframes.

The Center held its first conference in August 2008 at the Ohio State University; the second semi-annual conference was held at Texas A&M in February, 2009.

In addition to conducting relevant research, the Center provides advanced industrial education (short courses, web based tutorials and conceptual demonstrations) to improve the knowledge and skill base of practicing engineers.

Current and future projects at the Smart Vehicle Concepts Center will focus on the following areas

Interfacial Mechanisms Advanced electro-hydrostatic actuators, adaptive powertrain mounts, interfacial force sensors, torque sensing and actuation, etc.

Adaptive Noise Vibration and Harshness (NVH) Active micro and nano-composites, gear noise control, vibration control of vehicle systems, acoustic micro-sensors, panels with tunable stiffness, etc.

Safety Distributed force sensors, air bag sensors, adaptive seat belt systems, advanced energy absorbing foams, etc.

Energy Energy harvesting devices, adaptive fuel management concepts, powertrain breathing systems, friction control, efficiency enhancement, etc.

Shape Memory Alloys Alloy design and processing; active material characterization and model development; engineering application design and performance

"The SVC will be the only major center in the U.S. that can provide to industry and other educational institutions world-class information on smart materials applied to transportation applications, thereby enabling the forces and motions necessary for 21st century automotive and aerospace systems," adds Singh. "By providing not only technical results and solutions, but also being a major educational and training source, the SVC will help the U.S. automotive and aerospace industries to remain competitive in an increasingly difficult global economy."

To learn more about the Center visit *www.smartvehiclecenter.org*. ■

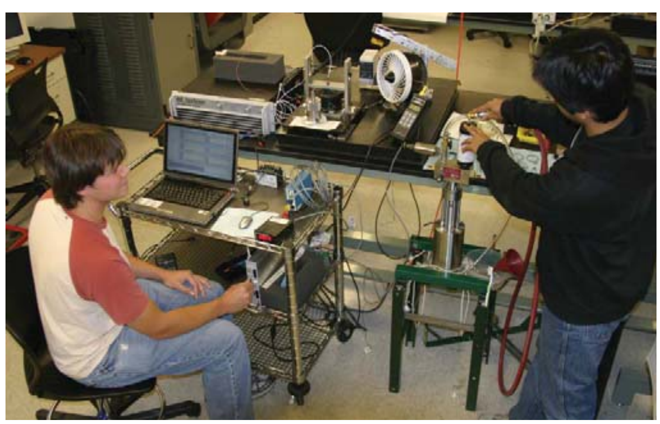
Example Project

Passenger comfort and safety are behind professor Marcelo Dapino's efforts at the *Ohio State University Smart Vehicle Concepts Center*. Supported by a Honda Initiation Grant award and a Honda R&D Americas grant, Dapino is seeking to improve occupant safety by incorporating piezoelectric devices into seatbelts. Piezoelectric materials change shape in response to electrical signals and generate charge when strained. Their extreme precision has been used for years in sensors, positioning applications, and actuation where rapid, precise, small magnitude motion is required.

Without mechanical amplification, piezos have an upper limit of about 0.1% strain at operating voltages ranging anywhere from 100 V to 1000 V and currents on the order of milli-Amperes. More recent work, including Dapino's, has focused on incorporating the precision and rapid reaction time of piezos into systems that can more efficiently accomplish new functions.

Current seatbelts are effective at protecting the occupant during a crash, but have tradeoffs. When the car's sensors detect a rapid deceleration, as from a frontal impact, they trigger pretensioners in the buckle or seatbelt retractor mechanism. The pretensioners are electric servos or pyrotechnic-charge-triggered racks that rapidly remove slack from the belt and place the occupant in a safe position. Mechanical load limiters, like torsion bars in the retractor, are designed to maintain constant force on the occupant during a crash. The existing load limiters are too massive and complex and cannot maintain a constant force when the occupant's size and weight fall outside of a narrow design window.

Dapino's group aims at developing active seatbelts that can optimally restrain any occupant, regardless of the occupant's size and weight, while simultaneously reducing the complexity and mass of the entire seatbelt system. They plan to accomplish these contradicting requirements by creating a closed-loop system to accurately control the force that the seat belt applies on the occupant's chest during a crash event. Piezoelectric actuators placed in the seatbelt's D-ring control the friction force between the D-ring and webbing. Active nanofiber sensors being developed by Texas A&M University professor Zoubeida Ounaies measure dynamic forces within the belt webbing. Working together in real time as a crash unfolds, the sensors and actuators adapt the belt's response to manage the occupant's crash energy. The sensor detects the force on the occupant and 'instructs' the actuator to increase or decrease the force to achieve optimal occupant restraint. "This adaptive approach to seatbelt design will ultimately eliminate the tradeoffs of existing passive or semi-active systems, and will lead to an unprecedented degree of occupant safety while simultaneously offering high design simplicity and flexibility, compact operation, and reduced mass," Dapino said. ■



Ryan Hahnlen (left) and Suryarghya Chakrabarti (right) setup a test pump in one of the SVC labs.

Historical Note

Greg Reich, Air Force Research Laboratory ■ Ben Wada was one of the founding fathers of the field of Adaptive Structures. Ben Wada's career progression put him in a unique position as an advocate for the area of adaptive structures and structural control. By the mid-1980's, he was a manager at JPL, responsible for a large group of researchers all working on adaptive structures. His position within JPL, as well as at ASME and AIAA at the time, gave him the opportunity to influence organizational leaders in those groups and educate them on the need for meetings addressing this subject. He, along with others such as Craig Rogers, was instrumental in influencing the ASME Aerospace Division to create a technical committee on adaptive structures. Since many of the original founders were also AIAA members, this eventually led to AIAA's creation of a committee of their own. Additionally, Ben Wada organized the first several U.S./Japan meetings on adaptive structures (which developed into the International Conference on Adaptive Structures and Technologies).

In addition to his leadership within the engineering community, Ben Wada wrote many papers and had a number of insightful technical ideas that led to new approaches to structural control for spacecraft. These papers described in simple terms the need for adaptive structures, provided a definition, and gave specific examples from early research that demonstrated the distinctions between adaptive, active, and intelligent structures. These survey papers appeared at the AIAA SDM conference in 1989 as "Adaptive Structures", then subsequently in the Journal of Spacecraft and Rockets in 1990 as "Adaptive Structures: An Overview". Also in 1990 he wrote an article with Jim Fanson and Ed Crawley for volume one of the Journal of Intelligent Material Systems and Structures entitled "Adaptive Structures".

Ben Wada always seemed to be ahead of the curve, willing to try new things and think about the problem or approach it in a different way. He truly was at the forefront of research in adaptive structures, and whether his name appeared on the paper, or one of the people that he managed got the credit, you can be sure that Ben Wada had a tremendous influence on all of us in the adaptive structures technical community. He is currently retired and residing in California. ■

Education Corner

Student Spotlight

Youngjae Chun is PhD graduate student in Mechanical and Aerospace Engineering under the supervision of Professor Gregory P. Carman in Mechanical and Aerospace Engineering and Dr. Daniel S. Levi (MD) in Pediatric Cardiology at Mattel Children's Hospital, UCLA. Mr. Chun's research focuses on the development of novel therapeutic devices fabricated with thin film Nitinol. For his PhD thesis, he has designed, micro-manufactured, and tested (*in vivo* and *in vitro*) a novel transcatheter device for treating both aneurysms and small vessel vascular obstructions. Mr. Chun has successfully fabricated and tested a MEMS device that is both sufficiently flexible and sufficiently low-profile to be delivered into any blood vessel via a 3 Fr microcatheter. Through the use of *in vitro* and *in vivo* studies, he has developed surface modification techniques for thin film Nitinol to enhance hemocompatibility, thereby minimizing / eliminating thrombus formation. His devices are currently in animal testing for use in the treatment of both large and small vessel aneurysms and obstructions. His work appears in eight conference papers, four soon-to-be-published journal papers, and two submitted patents. His novel research work was recently recognized by a "Best Paper Award" in the ASME SMASIS'08 Conference entitled "Thin Film Nitinol Microstent for Aneurysm Occlusion." Prior to attending UCLA, Youngjae received a Research Scholarship from the Korea Science and Engineering Foundation and a two-year fellowship for his masters at Inha University in Republic of Korea. Support for this research is partially provided by CASIT funded by Telemedicine and Advanced Technological Research Center (TATRC) ■

Darren J. Hartl is a student of Dimitris C. Lagoudas and is currently pursuing a PhD in Aerospace Engineering at Texas A&M University. He was accepted into the doctoral program immediately after completing his BS degree in Aerospace Engineering, having worked for two years as an undergraduate research assistant designing experimental apparatus for shape memory alloy testing. He graduated Summa Cum Laude in 2004. In his last year as an undergraduate he received the "Outstanding Senior Award" from Sigma Gamma Tau, the Aerospace Engineering honor society, designating him as one of the "six outstanding students in the United States." Upon entering graduate school, Darren received a 3-year NDSEG (National Defense Science and Engineering Grant) Fellow-

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Education Corner, continued

Adaptive Materials Demonstration Kit Update

Ron Barrett, University of Kansas ■ The ASTC Education Subcommittee has concentrated much of its efforts on the assembly of an Adaptive Materials Demonstration Kit. The kit is ultimately intended to be issued free of charge to every undergraduate Materials Science instructor in the US in Mechanical and Aerospace Engineering Programs at 4-year Universities. The goal is to give instructors at least one complete lecture with interesting demonstrations to spark students interest and teach them about adaptive materials. The kit is intended to help fill a curricular gap in the area of adaptive materials, which is present nationwide. The kit contains five demonstrations, including

- Shape-Memory Alloy Wire
- Piezoelectric Unimorph Element
- Piezoelectric Sparker
- Electroluminiscent Wire
- Magnetorheological Fluid Demonstrator

When shipped to instructors, the kit will be accompanied by a Companion Booklet. Nearly a dozen members of the ASTC have volunteered to author various sections. Instructors will receive at least one hard copy, but it will also be available for download and distribution without cost. The booklet will deliver a top-level overview of several different kinds of adaptive materials classes, describe both the aerospace and industrial applications and give instructors an explanation of the five demonstrations.

1. Overview
2. Shape Memory Alloys
3. Piezoelectric Materials
4. Optically Adaptive Materials
5. Variable Gemology Materials

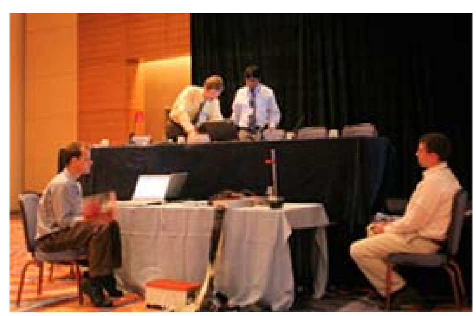
The ASTC is planning on completing the first run of kits this summer. More information on the kits, booklets and ways to obtain kits will be available at *http://www.aiaa.org/tc/as/* ■

Adaptive Structures Shootout

Steven Griffin, Boeing ■ The first ever Adaptive Structures Shootout, held in conjunction with the AIAA 49th Structural Dynamics and Materials Conference, proved a great success. The concept included a relatively simple, adaptive structure, for when researchers pit controls approaches against a performance metric. The hardware is shown on page 1.

The baseline structure was fully characterized and details were made available via the Adaptive Structures website. The baseline structure was changed by the addition of a mystery impedance, a spring-loaded clamp, which dramatically changed its transfer functions during the competition. The compensators not only had to work with the baseline hardware, but also had to adapt to the addition of the clamp. The event was quite instructive with the contestants first explaining their approach and then being allowed to test. Photos of the contest are shown here.

There was a tie between two of the contestants, Mithun Singla and Kevin Farinholt, who equally split the $1500 prize. ■



Photos before and during the shootout. Left: Practice before the contest. Top: Papers presented. Right: The loop is closed and the controller adapts during the competition.

Continued from page 8

ship and has since been involved in the constitutive modeling and numerical analysis of shape memory alloys. Over the past five years, Darren has served on the Texas A&M Graduate Student Council as an Aerospace Engineering representative and appointee to the university-wide Honor Council, which investigates and decides on matters of student academic misconduct. He has served as a judge of undergraduate research presentations for Student Research Week at Texas A&M.

Currently, Darren is an NSF-IGERT (Integrative Graduate Education and Research Traineeship) Fellow. In his time as a PhD student, he has traveled to many conferences, presenting more than 10 times at meetings including the inaugural ASME SMASIS conference where his work earned him the "Best Paper Award" for a student paper and presentation. He is the author of multiple chapters in the textbook edited by his advisor entitled, "Shape Memory Alloys: Modeling and Engineering Applications" and coordinated the compilation of the manuscript overall. His journal paper reviewing the aerospace applications of shape memory alloys was awarded the 2008 William Sweet Smith Prize by the British-based Institute of Mechanical Engineers for best aerospace engineering paper. Three additional journal papers addressing various SMA-related research topics are currently in review. To increase the impact of shape memory alloy research on the industrial community, Darren helped design and present a reoccurring short course on SMA fundamentals. His research on improving the numerical analysis of SMA structures has led to a close collaboration with The Boeing Company, in particular. This past fall, Darren completed the coursework required for his PhD degree and will defend his dissertation this summer, graduating with a GPA of 4.0. ■

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Alper Erturk is a PhD candidate in the Department of Engineering Science and Mechanics at Virginia Tech working in the Center for Intelligent Material Systems and Structures (CIMSS) on problems related to harvesting ambient vibration energy using piezoelectric materials and the electromagnetic effect. In particular, he is focused on modeling. Since he started at CIMSS in January 2007, Alper's research has resulted in the publication of 10 journal articles (plus one currently in review), 13 conference papers, a book chapter, and the filing of one patent application. His latest paper, "Issues in mathematical modeling of piezoelectric energy harvesters", is among the top 10% of downloaded articles for all IOP publications. In addition his article, "A Distributed Parameter Electromechanical Model for Cantilevered Piezoelectric Energy Harvesters", was the topmost downloaded article for the Journal of Vibration and Acoustics in June 2008.

In addition to his work on energy harvesting, Alper has collaborated with a number of other researchers on vibrations, modeling smart materials, morphing, and structural control. He also continues to collaborate with his master's degree advisor in the area of machine tool vibrations, vibration suppression, and modeling.

Alper has been an active reviewer for the journals and regularly attends conferences. He has been active in working with our visiting students and faculty and has supervised the research projects of two undergraduate researchers. Before joining CIMSS he served as a teaching assistant for the Mechanical Behavior of Materials Lab.

Alper attended the Middle East Technical University in Ankara, Turkey, receiving his BS in Mechanical Engineering in 2004 and his MS in 2006. He joined Virginia Tech in August of 2006 as a PhD student / Teaching Assistant in Engineering Science and Mechanics. In January 2007 he joined CIMSS as a graduate research assistant supported under the AFOSR MURI program "Energy Harvesting and Storage Systems for Future Air Force Vehicles" under the direction of Prof. D.J. Inman. In the fall of 2008, Alper became the first student to receive the "*Liviu Librescu Memorial Scholarship*". Alper hopes to become a faculty member once he finishes his PhD. ■

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Poorna Mane is a doctoral student in the mechanical engineering department at Virginia Commonwealth University. She holds a masters degree in engineering from VCU and a baccalaureate in computer science and engineering from Goa University, India. Poorna joined the School of Engineering for her graduate degree in Computer Science. Her transfer to ME in the 2nd semester was contingent upon excelling all courses in the new stream. However within one year, she surpassed other students in the department with her perseverance and endless self motivation to understand and learn the various subjects in-depth. Not only did Poorna publish 2 journal papers within the 1st year in graduate school, but currently has 6 journal papers, with 2 in preparation and 7 conference papers. In addition to her strong academic background and dedication to scientific research as demonstrated by her academic record and publications, Poorna has been involved in numerous extracurricular activities including campus associations and academic organizations assuming leadership roles in numerous campus activities. Poorna is a highly motivated individual and was instru-

Calendar of Events

SPIE Smart Structures & Materials Symposium, *San Diego, CA*
Dates: March 8–12, 2009
Abstract due: August 24, 2008
http://spie.org/smart-structures-nde.xml

NATO NATO RTO AVT Morphing Vehicles Specialist Meeting, *Lisbon, Portugal*
Dates: April 8-12, 2009
http://www.rta.nato.int

AIAA/ASME/AHS Adaptive Structures Conference, *Palm Springs, CA*
Dates: May 4-7, 2009
Abstract due: August 11, 2008
http://www.aiaa.org/events/sdm

SPIE Smart Materials and Nanotechnology in Engineering, *Weihai, China*
Dates: July 8-11, 2009
Abstract due: January 15, 2009
http://www.smart-nano.org/smn2009/en/frame.htm

ASME Conference on Smart Materials Adaptive Structures & Intelligent Systems (SMASIS), *Oxnard, CA*
Dates: September 20-24, 2009
Abstract due: March 23, 2009
http://www.asmeconferences.org/smasis09/

International Conference on Adaptive Structures and Technologies (ICAST), *Hong Kong*
Dates: October 20-22, 2009
Abstract due: May 1, 2009
http://www.icast2009.org

CANSMART International Workshop on Smart Materials and Structures
Dates: October 23-24, 2009
http://www.cansmart.com

Education Corner, continued

mental in reviving the dormant student chapter of Society of Women Engineers (SWE) at VCU. She has assumed numerous responsibilities including co-chairing 2008 Mid-Atlantic Region Society of Women Engineers Annual Conference, actively participating in engineering open house, organizing events for alumni and current students and encouraging high school students to pursue a career in science and technology are some of the activities in which she has been in the forefront. Her commitment and love for science makes her an unparalleled asset to the Mechanical Engineering department at VCU; guiding new students, mentoring senior design projects, and assisting her lab-mates with their experiments. Her ingenuity, outstanding academic record and dedication have made her the recipient of numerous awards including the Phi Kappa Phi Graduate School scholarship, VCU Graduate Student Research Grant, Outstanding Graduate Teaching Assistant Award for the School of Engineering, SPIE Student Travel Grant, Preparing Future Faculty Program certification, and mentor in the VCU Graduate School Mentorship Program. Poorna plans to pursue a career in academia conducting research in adaptive materials and structures. ■

Thank You!

To all those that contributed and helped in the preparation of this newsletter!

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