Center Offers Updated Composites Design and Analysis Software

Over the past two decades, software has simplified and streamlined the design and analysis of complex advanced composites. The University of Delaware Center for Composite Materials has been at the forefront of software development, and its CDS program, *Composite Design and Simulation*, has recently undergone yet another upgrade to improve functionality and user-friendliness.

CDS3.0 Composite Design and Simulation Software GUI

University of Delaware
Center for Composite Materials

COMPOSITES
UPDATE
January 2011

The newest version of the application, CDS 3.0, builds upon previous versions with integrated parametric design and analysis of composite laminates and cylinders, material ranking, standard spreadsheet import and export as well as data reduction capabilities.

The software enables design engineers, process engineers, and students to quickly determine the effective properties and response of composite laminates, conduct micromechanics calculations, and carry out virtual process simulation and optimization.

“I like to think of CDS as an advanced scientific calculator for composites, with additional capability for processing and loading laminated plates and tube structures,” says John Tierney, CCM scientist and creator of the software. “We started to develop the various components of CDS in 1999, and since then it has been a continuously evolving environment for real-time design and analysis of composite laminates.”

Raw data import has recently been added to allow easy reduction of multiple experiments. Users can quickly check the validity of experimental data, as well as crop and export the data to their preferred spreadsheet application. CDS3 also includes a number of curve fitting options and an area calculator which is useful for energy calculations.

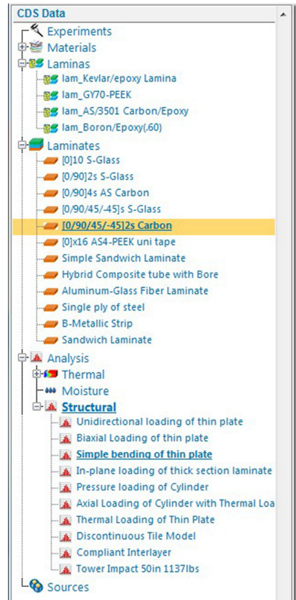
TOP STORY (Continued)

According to Tierney, the CDS website has been also updated to include searchable help and pdf documentation. The program includes many built in examples of materials, laminates and processing, making it easier for the user to learn.

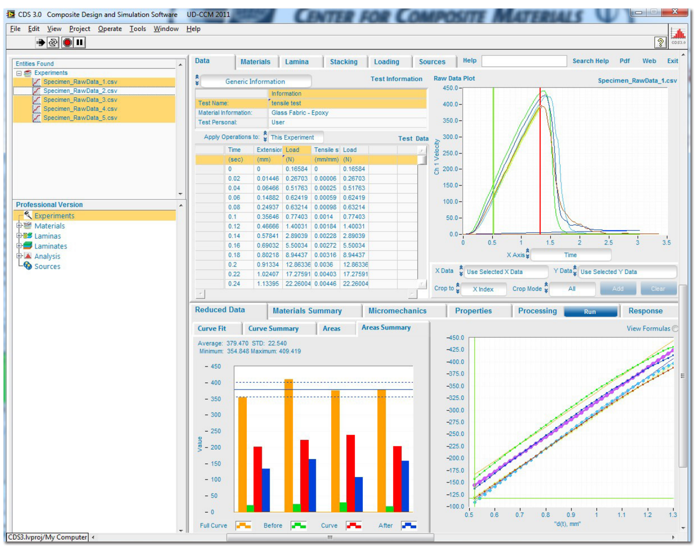
The website also includes the theory behind the models used, and the software is continuously updated to incorporate new models developed at CCM. “Our very active and robust research programs here at the Center mean that our software reflects the latest knowledge being developed on composite design and analysis,” Tierney says.

CDS is available to industrial consortium members, academic institutions, and government sponsors.

For more information about CDS,
visit the software website: **http://www.ccm.udel.edu/CDS/**
or contact John Tierney (**jtierney@udel.edu** or 302-831-0548).



CDS Menu Tree
Click here to view enlarged image



CDS Data Reduction
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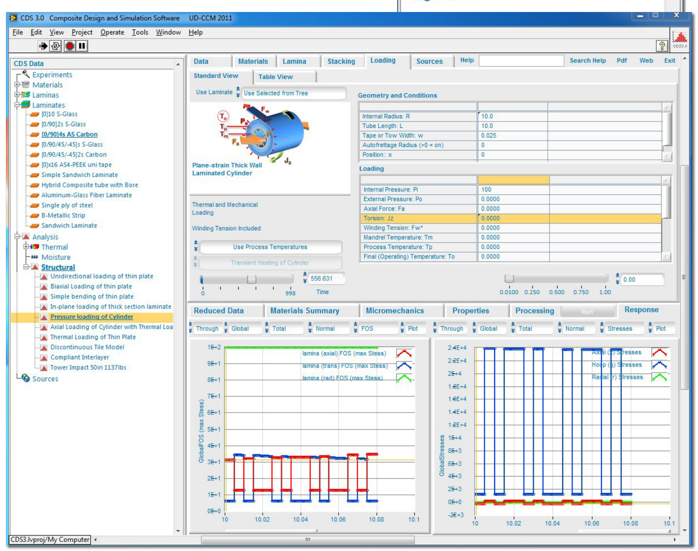


CDS Cylinder Design
Click here to view enlarged image

OTHER NEWS

US Army Composite Ambulance Module Developed at UD-CCM

To effectively reach soldiers in the field of battle, properly treat the wounded and return them to safety, it is of the utmost importance to outfit the medics and ambulatory personnel with the best equipped vehicle to handle a situation that that could mean life or death.

With these goals in mind, a group led by TARDEC (the Tank Automotive Research, Development and Engineering Center) including the Center for Composite Materials (CCM) at the University of Delaware, the U.S. Army Medical Command, and the Army Research Lab (ARL) set out to produce a lightweight high performance armored ground ambulance sturdy enough to house up to four wounded soldiers with the best available medical crew and care.

"This project was to span a twelve-month timeline led by CCM's Applications and Technology Transfer Laboratory (ATTL) based out of the off site facility in Newark, Delaware. The project requirements were carefully defined by CCM, AMC, and the TARDEC at the kick off meeting early in 2010 after which, CCM began to execute the project plan utilizing state of the art engineering CAD/CAM/CAE software." said Program Manager Mark Scott.

CCM is fully equipped with 3D parametric modeling and simulation software typically used to design, analyze and validate composite mechanical structures in the automotive and aerospace industries. The CAD (Computer Aided Design) software utilized for this specific project was the CATIA system. CATIA consists of several workbenches which allow the composite designer to develop 3D solid models to define all components and assemblies required to meet the fit, form, and functional requirements of the ambulance application. The models developed provide the foundation from which finite element structural analysis can be performed. MSC/PATRAN and MSC/NASTRAN was used to perform the global and detailed structural analysis to conduct trade-studies. These analyses are conducted to engineer tactical ground vehicles which satisfy the mobility performance requirements yet minimize the vehicle weight. Any weight which can be saved in the primary structure can then be traded to increase payload and/or improve armor solutions to meet the ever increasing threat levels specified by the Army. The end result is a lightweight ambulance module with highly tailored section details that lends itself to low cost manufacturing.

The manufacturing workbenches in CATIA provide the ability for the composite engineers to machine metallic components but also design the laminated composite construction used for the overall shelter. The FiberSim workbench allows the process engineer to create and simulate the draping of flat patterns onto complex 3D geometries. These patterns are developed using good composite design practices to insure that boundaries of all patterns are staggered and placed in such a way that the structural integrity of the structure is not compromised. The patterns are generated and assembled into ply books which can then be used as hard copy documentation during the fabrication process by the composite technicians. FiberSim also generates the appropriate data formats which is sent to the numerically controlled American GFM fabric cutting machine. This technology greatly reduces the time to manufacture the preforms required for composite structures.

OTHER NEWS

“Here at the Applications and Technology Transfer Laboratory, we were tasked with building the ambulatory module, from design and fabrication to outfitting and integration of the necessary equipment and materials,”Scott said. “We took it the whole nine yards, so to speak.”

An M.E. graduate of the University, Scott and the development team of less than a dozen went to work on creating the one-of-a-kind Composite Ambulance Module with the aid of the aforementioned computer programs to develop the module’s geometry in 3D. This allowed the crew to investigate the fit and function and ultimately produce the seamless composite materials, infusing them with resin to create each component.

Inside the module itself, the necessary equipment included a mine-blast absorbing medic seat attached to the floor of the structure, which allows for shock absorption without injury, and two extendable litter platforms, bolted to the sides of interior walls of the module, for the same reason.

Inside the module itself, the necessary equipment included a mine-blast absorbing medic seat attached to the floor of the structure, which allows for shock absorption without injury, and two extendable litter platforms, boltedto the sides of interior walls of the module, for the same reason.

“The two platforms that extend or slide horizontally from the rear of the module allow for simpler litter loading onto each platform, which can be done from the exterior of the ambulance itself,” Scott said. “This also makes it easy for medics and assisting soldiers to load the module from the ground, rather than having to climb inside to load the litter and patient.”

Once inside the Composite Ambulance Module, the medic has at their fingertips all the equipment found in a traditional hospital room, including oxygen concentrators, a vital signs monitor, intravenous packs and suction system, all mounted to the interior walls. A fully equipped first aid kit is also bolted to the exterior of the rear door.

Exterior dimensions are measured at 55 inches in height, 88 inches in width and 98 inches in length, which yields just enough space for medics to work comfortably inside the module, while attempting to minimize the external area and resultant weight of the armor used.

“We had to design a module that would allow the medic to work overtop a wounded soldier lying on the litter platform without being encumbered by the ceiling or surrounding walls,” Scott said. “The lighting and overhead room will also allow for the medic to wear a helmet camera in the case of receiving instruction from a surgeon remotely.”

As for the structure itself, the composites used in assembly include fiberglass and foam core sandwiched together, allowing for insulation that can withstand temperatures of over 200 degrees F, thus protecting soldiers from extreme temperatures and providing extra comfort to the wounded.

The Composite Ambulance Module will support the weight of all the materials, personnel weight, gear and protective armor. It is designed to handle further weight increases that may be needed to meet future requirements. The module is now destined for the Army Medical Department at Ft. Detrick, where medical personnel will test and asses the prototype.

OTHER NEWS

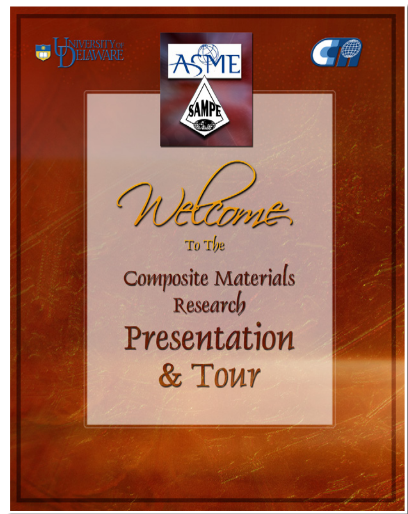
Students Organize Successful Composites Meeting at CCM

Some eighty students, faculty, and representatives of the composites industry attended a meeting on composite materials hosted by CCM and sponsored by ASME and SAMPE on Wednesday, November 17, 2010.

The free event included a student poster session along with dinner and a SAMPE showcase, followed by a research presentation and tours of the Composites Manufacturing Science Lab on the University of Delaware campus. There was also plenty of time for networking among students, representatives from industry and faculty throughout the evening.

Delivered by Erik Thostenson, assistant professor of mechanical engineering at UD, the talk addressed "Carbon Nanotube-Based Composite Materials: Bridging the Micro and Nano Scales." Thostenson is conducting innovative research on the use of carbon nanotubes for sensing and other multifunctional material applications.

The meeting was co-organized by ASME-UD president Allan Burleigh and members of the SAMPE student chapter at UD: president John Gangloff, vice president Cedric Jacob, secretary and outreach coordinator Sarah Friedrich, treasurer Andrew Baker, and project manager Anthony Coppola.



"The meeting provided a great opportunity for the two professional societies to network and for the undergraduates to showcase their research," said Jacob. "It was cool to see our undergraduate interns and graduate students come together with research staff at CCM and other professionals in the field."

Gangloff said that many of the ASME members were not familiar with CCM's facilities and capabilities. "There's also a lot of interest among ASME members in learning more about composites technology," he said. "Many of the attendees were blown away by the work Professor Thostenson is doing in the nano area."

In addition to research posters, displays showcased the bridge and wing prototypes developed by UD students for SAMPE competitions. "This is a great example of students applying their education to cutting-edge problems," said Thostenson, "and people were impressed by the caliber of the students' work."

"As far as the ASME Delaware Section is concerned, the meeting was a huge success," said Michael Keefe, a member of the organization's executive board and an associate professor of mechanical engineering at UD.

"It was the biggest crowd I've seen in a long time at an event co-sponsored by our section, and it helped reinforce composite materials among our undergraduates—all in all, it was a great evening."

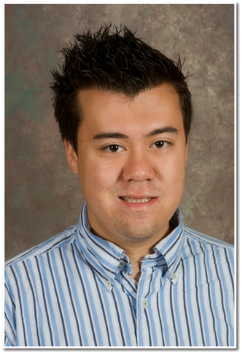
Article by Diane Kukich

OTHER NEWS

UDaily Article

CCM Students Hopeful Finalists in Owens Corning Composite Challenge

Photos courtesy of UDaily



John Gangloff, Jr.

Cedric Jacob

1:26 p.m., Jan. 10, 2011----John Gangloff, Jr., and Cedric Jacob are true Blue Hens.

Both are Newark natives. Both completed undergraduate degrees in mechanical engineering at the University of Delaware in 2009. Both, despite other offers, are continuing their graduate studies at UD and dream of launching a start-up company here.

Now, these two promising leaders hope to elevate the reputation of UD research worldwide as finalists in the international Owens Corning Composite App Challenge

One of 16 finalists worldwide

The challenge is a design and business plan competition hosted by Owens Corning Company, a leading global producer of glass fiber reinforcements for composite systems and building materials. Its purpose is to stimulate new composite applications in four categories -- infra-structure durability, fuel efficiency, renewable energy and protection from harm.

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Tsu-Wei Chou with awards received after presenting lectures.

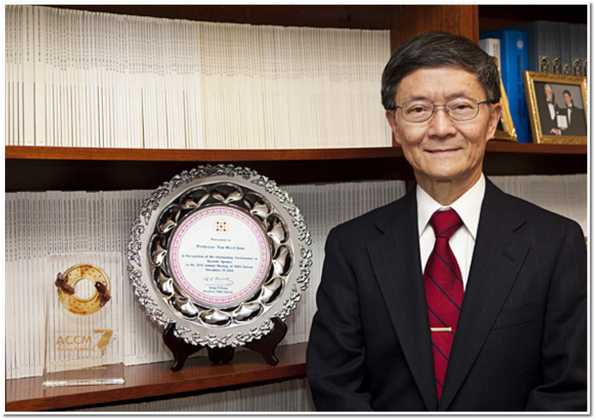

Photo courtesy of UDaily

UDaily Article

Chou Sought After as International Lecturer on Nanocomposites

8:13 a.m., Dec. 17, 2010----Tsu-Wei Chou, Pierre S. du Pont Chair of Engineering at the University of Delaware, is in high demand as an expert on nanocomposite materials, delivering six invited lectures in Asia, South America, Europe and the United States in 2010.

Nanotechnology is an active research area, says Chou, with implications in aeronautics and biotechnology, among other things. He views lecturing as an important way to elevate the work done by UD researchers.

"I am very pleased to have the opportunity to enhance the University of Delaware's visibility at scientific, technical gatherings. It is the best forum to share research findings with our colleagues in nanoscience and nanotechnology worldwide," says Chou.

Click here to read full article in UDaily.

UDaily Article

Newark High Applauds UD Researchers for Outreach to Students

8:33 a.m., Dec. 16, 2010----When members of the Newark High School Parent-Teacher-Student-Association (NHS-PTSA) wanted to enhance the science education curriculum at NHS to better prepare students for college, they turned to researchers at the University of Delaware for help

Click here to read full article in UDaily

Pictured are, from left, Dirk Heider, assistant director of CCM at UD; Anastasios Melsaris, president of NHS-PTSA; NHS students James Idsari and Isaac Watkins; NHS science teacher Stewart Dotts; and Shridhar Yarlagadda, assistant director of CCM.

NEW PUBLICATIONS

Journals

Lim, A. S., S. L. Lopatnikov, N. J. Wagner, and J. W. Gillespie, Jr., "An Experimental Investigation into the Kinematics of a Concentrated Hard-Sphere Colloidal Suspension during Hopkinson Bar Evaluation at High Stresses," Journal of Non-Newtonian Fluid Mechanics, http://dx.doi.org/10.1016/j.jnnfm.2010.06.015, 165, pp. 1342-1350, 2010.

Yoon, M. K., D. Heider, and J. W. Gillespie, Jr., "Local Damage Detection with the Global Fitting Method using Operating Deflection Shape Data," Journal of Nondestructive Evaluation," 29 (1), pp. 23-37, March 2010.

Conferences

Jang, J-S., J. Varischetti (University of Nevada), R. G. W. Lee (Chonbuk National University), J. Suhr, "Investigation of Mechanical and Thermal Stability of Hybrid Polymer Nano-Composites," ASME 2010 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, Philadelphia, PA, September 28 - October 1, 2010.

Kim, H-I, E-C. Kang (Sauer-Danfoss-Daikin Ltd.), J-S. Jang, J. Suhr, "Energy Absorption in Particle Reinforced Polymer Composites," ASME 2010 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, Philadelphia, PA, September 28 - October 1, 2010.

Varischetti, J. (University of Nevada, Reno), J-S. Jang, J. Suhr, "Development of Modeling Techniques for Damping Applications of Nano Structured Composites with High Aspect Ratio Fillers," ASME 2010 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, Philadelphia, PA, September 28 - October 1, 2010.

CONSORTIUM MEMBERS

We would like to thank **Leading Edge Composites,** Nottingham, PA, for the recent renewal of their consortium membership, and for continuing to participate in CCM's research and development activities.

To learn more about the benefits of becoming a member, please visit us on the web at **www.ccm.udel.edu/Consortium/benefits.html**

Celebrating 35 years of significant contributions to composites science and technology, the education of students, and the creation and transfer of technology to industry.

1974-2009

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Please visit us on the web at **http://www.ccm.udel.edu**

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