

# NCMS, BMW, UD-CCM JOIN FORCES ON COMPUTING, PERFORMANCE, COMPOSITE MATERIAL STUDY

Drivers could be the big winners in this new study released by NCMS, BMW, and the University of Delaware-Center for Composite Materials (UD-CCM). The team has completed research proving the accuracy of high-speed computing for modeling and simulation to predict the quality and effectiveness of a material that is both lightweight and safety-tested. This effort has demonstrated design, materials, manufacturing, and joining methods for continuous carbon fiber thermoplastics to meet automotive, industry, and government safety specifications.

This two-year program is a successful government-industry-university partnership that involved regulatory agencies, original equipment manufacturers (OEMs), and material suppliers from the composite industry. The objective of this study was to investigate the computational tools for the design, optimization, and manufacture of carbon fiber materials for vehicle side-frame structures (in this case, B-pillar) subjected to high-velocity side-impact crash loading and to investigate and demonstrate the appropriateness of simulation methods and tools to adequately predict behavior relevant for the assessment of vehicle safety.

A specific continuous fiber thermoplastic material, Carbon Fiber Reinforced Plastic (CFRP), is a preferred solution for reducing weight while maintaining safety requirements for vehicles. The team used this material to successfully design and impact test a lightweight, all-thermoplastic, continuous carbon fiber composite B-Pillar for automotive applications.

The B-pillar design was spatially optimized for energy absorption, stiffness, and strength while maintaining part producibility and vehicle integration. The resulting B-pillar is 60% lighter than the existing metallic design while meeting BMW safety requirements for the NHTSA FMVSS214 side impact crash test.

## High Performance Computing Studies

Final Report — Task 0001

Prepared under:  
NCMS Project No. 124015 and the  
U.S. Department of Transportation (DoT)  
National Highway Traffic Safety Adminis-  
tration (NHTSA)  
DTNH22-14-D-00321  
for Task Order 0001

[www.ncms.org](http://www.ncms.org)

[Click here to view the full article & report](#)

COMPOSITES UPDATE

UNIVERSITY OF DELAWARE  
CENTER FOR COMPOSITE MATERIALS



## NEWS

## UD-CCM Collaborates with Hennecke GmbH to Install HP-RTM Processing System

UD-CCM is collaborating with Hennecke GmbH to install a High-Pressure Resin Transfer Molding (HP-RTM) processing system to manufacture ultra-lightweight and high-performance composite structures using fast reacting epoxy, polyurethane or thermoplastic resins. The system will be capable of traditional HP-RTM, Compression RTM and Wet Compression Moulding. The system will be installed at the Center's Application & Technology Transfer Laboratory (ATTL). The 24,000 sq. ft. off-campus facility is fully ITAR compliant and provides for sub-component and full-scale part manufacturing and prototyping to demonstrate production processes at rate and quality.

Hennecke's HP-RTM system will reduce long processing times associated with classical RTM methods to less than 60 seconds, enabling UD-CCM to demonstrate significant advantages in terms of economic efficiency and product quality. Additional equipment for preforming, automation and associated process variations will be integrated. The system will be placed next to a 1000 ton press and pultrusion equipment for joint development programs.

This collaboration will result in the first open-access HP-RTM workcell in the United States allowing for:

- Industry sponsored programs
  - Materials Development (resins, core, preforms, etc.)
  - Prototyping
  - Small to medium production runs
- Academic partnering
- Government programs

UD-CCM has a long history in liquid molding simulation and fabrication. As an Office of Naval Research Center of Excellence established in 1997 under the leadership of Professors Suresh Advani and Jack Gillespie, UD-CCM has received more than \$13.5M government investment in automation, sensing and control, modeling and characterization of LCM processes. "This foundation and expertise will be leveraged to create unique HP-RTM



### About Hennecke GmbH

*For 70 years, Hennecke has been developing and designing high-class machine and systems technology as well as process technology for polyurethane processing. Thanks to intensive research and development work, Hennecke is able to offer innovative systems and technologies with highly economic and ecological benefits tailored to meet their customers' requirements in a wide range of applications. Today, there is hardly any polyurethane-based product idea that cannot be realized by Hennecke.*

**Hennecke**   
Polyurethane Technology

## NEWS

## UD-CCM Collaborates with Hennecke GmbH to Install HP-RTM Processing System

(Continued)

solutions for automotive, aerospace, and sporting good applications," says UD-CCM Director Jack Gillespie.

Dirk Heider, UD-CCM, Assistant Director for Technology says, "This system creates new unique capability to produce high-performance, complex geometry parts at automotive rates and will support UD-CCM's on-going large programs such as our DOE door and DARPA feedstock programs." For more information, please contact Dirk Heider at 302-831-8898 or at heider@udel.edu.

Dan Rozelman, Hennecke Inc., Composites and Advanced Applications Sales Manager says, "Hennecke GmbH and Hennecke Inc. (Pittsburgh, PA) are excited to be collaborating with UD-CCM and its partners. HP-RTM is well established in Europe and Asia. Now the North American market will have access to this light-weighting technology through the UD-CCM." For more information, please contact Dan Rozelman at 724-271-3649 or at dan.rozelman@us.hennecke.com.

## Reducing Radiation

### Paper reports successful use of nanocomposites to absorb electromagnetic radiation

Article by Diane Kukich

The rapid development of modern electronic equipment and wireless devices has resulted in severe electromagnetic (EM) radiation pollution, which has implications in the health of creatures from fruit flies and frogs to horses and humans.

In addition, EM radiation can affect the normal functioning of electronics. These issues have prompted researchers to explore ways to create materials that can effectively absorb EM waves.

According to CCM's Tsu-Wei Chou, carbon nanotubes (CNTs) offer the unique potential to be excellent EM wave absorbents, with most of the research effort to date focused on CNTs decorated with magnetic metal or metal oxide particles for enhancing magnetic attenuation.

However, the anticipated improvement in EM wave absorption performance has often been hindered by the poor dispersion of CNTs.

Now, he and colleagues, including John Xiao, UD professor of physics, and visiting scholar Jinsong Li, have demonstrated that CNT films can facilitate the dispersion of CNTs in the composite matrix.

Their work is documented in a paper, "Superb Electromagnetic Wave-Absorbing Composites Based on Large-Scale Graphene and Carbon Nanotube Films," published online in *Scientific Reports* on May 24.

"We found that the dispersion of Fe<sub>3</sub>O<sub>4</sub> [iron oxide] nanoparticles on the surface of CNTs can actually improve



Tsu-Wei Chou, Pierre S. du Pont Chair of Engineering (top) & visiting scholar Jinsong Li (bottom)

## NEWS

permeability and impedance matching — properties that promote absorption of EM waves — as well as facilitate processing,” Chou says.

The researchers also demonstrated that graphene, a very thin layer of pure carbon, can be used as a substrate.

“The resulting composite exhibits exceptionally high wave absorption capacity even at a very low thickness,” Chou says.

The materials have applications in equipment-level shielding, protection from high-intensity radiation fields, anechoic chambers and human exposure mitigation.

The paper was co-authored by Jinsong Li (School of Physics and Nuclear Energy Engineering, Beihang University, China), Weibang Lu (Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences, China), Jonghwan Suhr (Department of Polymer Science and Engineering, Sungkyunkwan University, Republic of Korea), Hang Chen (UD Department of Physics and Astronomy), Xiao and Chou.

Article courtesy of: **UDaily**

## UPCOMING EVENTS

18  
Jul

### **A Short Course on Progressive Composite Damage Modeling in LS-Dyna Using MAT162**

Presented by: *Bazle Z. (Gama) Haque, Ph.D., Senior Scientist, UD-CCM*

Tuesday, July 18th, 9am-5pm

Cost: \$595 per person ( *Includes: Coffee, Lunch, Parking, CD with course content* )

#### **Description:**

Progressive damage modeling of composites under low velocity impact, and high velocity impact is of interest to many applications including car crash, impact on pressure vessels, perforation and penetration of thin and thick section composites. This course will provide a comparison between available composite models in LS-DYNA for shell and solid elements, e.g., MAT2, MAT54, MAT59, & MAT162.

[Click here for more information](#)

11  
Sept

### **CAMX**

September 11-14

Stop by Booth A62 to learn of the great opportunities to partner with CCM, a World Leader in Research, Education and Technology Transfer.

Contact Dr. Heider to make an appointment: [heider@udel.edu](mailto:heider@udel.edu) | 302-831-8898

[Click here for more information](#)

NEW  
HONORS

## CCM Students and Staff Honored

The Annual Student Achievement Day Awards were presented on May 5, 2017, at the University of Delaware's Center for Composite Materials.

CCM was honored to have the son of the late Professor R. L. McCullough, one of CCM's founding fathers, present this year's R. L. McCullough Scholars Award. Dr. McCullough presented his father's eponymous award, which recognizes original contributions to the literature on composite materials to Thomas A. Cender, Ph.D.M.E.

In his opening remarks, Dr. McCullough thanked the Center for inviting him to participate. "It is a rare and unique privilege for a son to have the opportunity to present an award dedicated to his father's memory and to his father's work," said McCullough. "Solid research... can truly change our understanding of the world around us... It is only through publication that research can fulfill its educational role for the public, demonstrate its relevance to government and industry, inspire new ideas and perhaps serve as the foundation for future research efforts, and maybe, just maybe, help to make the world a better place."

The awards and winners are as follows:



### R. L. McCullough Scholars Award

The R.L. McCullough Scholars Award recognizes original contributions to the literature on composite materials. The tribute is bestowed on a graduate student author of a paper accepted for publication in a refereed journal.

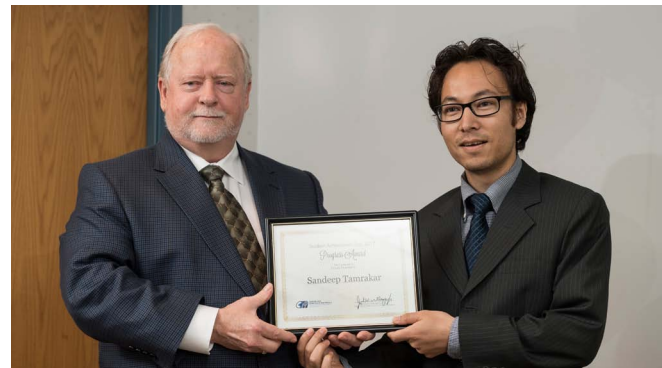
**Recipient: Thomas A. Cender, Ph.D.M.E.**  
*Advisor: Professor Suresh G. Advani*



NEW  
HONORS**Progress Award**

The Progress Award recognizes research contributions of students to the research goals of the Composites Center. The tribute is bestowed on a graduate student who has shown remarkable progress in their research.

**Recipient:** Raja H. Ganesh, Ph.D.M.E.  
**Advisor:** Professor John W. Gillespie, Jr.

**Progress Award**

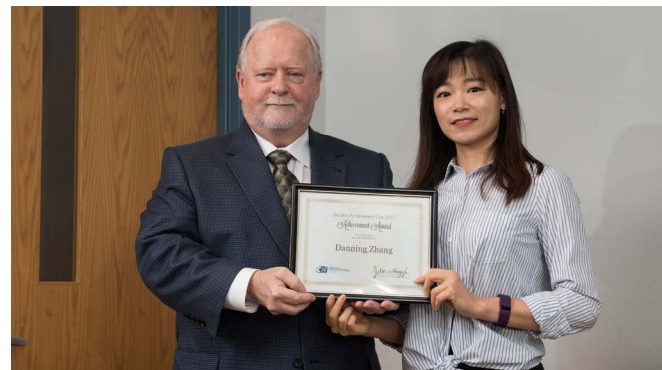
The Progress Award recognizes research contributions of students to the research goals of the Composites Center. The tribute is bestowed on a graduate student who has shown remarkable progress in their research.

**Recipient:** Sandeep Tamrakar, Ph.D.C.E.  
**Advisor:** Professor John W. Gillespie, Jr.

**Achievement Award**

The Achievement Award recognizes outstanding personal growth demonstrated by a Center-affiliated graduate student. The tribute is bestowed on a graduate student who has demonstrated superior achievement in their research.

**Recipient:** Preston B. McDaniel, Ph.D.M.S.E.G.  
**Advisors:** Professor John W. Gillespie, Jr. & Dr. Joseph M. Deitzel

**Achievement Award**

The Achievement Award recognizes outstanding personal growth demonstrated by a Center-affiliated graduate student. The tribute is bestowed on a graduate student who has demonstrated superior achievement in their research.

**Recipient:** Danning Zhang, Ph.D.M.S.E.G.  
**Advisors:** Professor John W. Gillespie, Jr. & Dr. Dirk Heider

NEW  
HONORS**Outstanding Senior Award**

The Outstanding Senior Award recognizes the contributions of students participating in the Undergraduate Research Program of the Composites Center. The tribute is bestowed on an outstanding senior for cumulative contributions to Center activities.

**Recipient:** Tess Carella, B.M.E.  
**Advisor:** Prof. Suresh G. Advani

**Outstanding Senior Award**

The Outstanding Senior Award recognizes the contributions of students participating in the Undergraduate Research Program of the Composites Center. The tribute is bestowed on an outstanding senior for cumulative contributions to Center activities.

**Recipient:** Michael A. Czerwinski, B.M.E.  
**Advisor:** Mr. Shashank Sharma & Dr. Shridhar Yarlagadda

**Outstanding Senior Award**

The Outstanding Senior Award recognizes the contributions of students participating in the Undergraduate Research Program of the Composites Center. The tribute is bestowed on an outstanding senior for cumulative contributions to Center activities.

**Recipient:** Andrew D. Koster, B.M.E.  
**Advisors:** Dr. Joseph M. Deitzel

NEW  
HONORS**Undergraduate Research Award**

The Undergraduate Research Award is bestowed on students who have demonstrated initiative, motivation and research aptitude while conducting independent research as recommended by their research advisor.

**Recipient:** Thomas F. Comiskey, B.C.H.E.

**Advisor:** Dr. Joseph M. Deitzel

**Undergraduate Research Award**

The Undergraduate Research Award is bestowed on students who have demonstrated initiative, motivation and research aptitude while conducting independent research as recommended by their research advisor.

**Recipient:** Aris D. Mardirossian, B.M.E.

**Advisor:** Professor Erik T. Thostenson

**CCM Scholarship Award**

The CCM Scholarship Award recognizes research contributions of Postdoctoral Researchers or Research Professionals affiliated with CCM. The tribute is bestowed on a researcher who has had an impact on the research community of composite materials.

**Recipient:** Joseph M. Deitzel, Ph.D.

## NEW HONORS



### Directors' Award

The Directors' Award recognizes outstanding personal growth demonstrated by a Center-affiliated employee or student. The tribute is bestowed on an employee or student who has demonstrated superior progress.

Recipient: Mr. Alex M. Vanarelli, M.M.E.



### Directors' Award

The Directors' Award recognizes outstanding personal growth demonstrated by a Center-affiliated employee or student. The tribute is bestowed on an employee or student who has demonstrated superior progress.

Recipient: Shridhar Yarlagadda, Ph.D.

## Congratulations 2017 Student Achievement Day Winners



[CLICK HERE TO VIEW IMAGES FROM STUDENT ACHIEVEMENT DAY](#)

NEW  
HONORS

## Congratulations to Suresh G. Advani, George W. Laird Professor, Associate Director, CCM & outgoing Department Chair, Mechanical Engineering

Suresh G. Advani, with his transformative leadership, experience and commitment was instrumental as chair, which fostered the growth, success and national recognition of the Department of Mechanical Engineering at the University of Delaware during his five-year term. Under his leadership, the department forged and strengthened interdisciplinary research initiatives and projects, revised the undergraduate curriculum to emphasize the design component which received national recognition, and increased diversity by improving women enrollment in mechanical engineering over 25% by encouraging outreach to local schools so more girls can relate to female role models in mechanical engineering.

During his tenure as chair, Advani shepherded an increase in undergraduate enrollment and created opportunities for faculty to address new challenges with seed funding. In addition to improvements to teaching and research labs, his stewardship brought to fruition the Design Studio plans where students collaborate, innovate and empower themselves to convert their ideas and concepts into reality with all the tools and software that is made available for them 24/7. During his term, the department improved its ranking in the "The U.S. News & World Report" to be placed in the top 25% in the nation among universities offering doctoral degrees. The department also celebrated their 125th Anniversary in 2016-2017 showcasing all the past achievements of faculty and alumni and hosting an industry panel to share their vision with our current students.

In addition to running the department, Dr. Advani has continued to make a significant scientific impacts through a blend of research, education and leadership. He has mentored over 85 graduate students for which he was awarded the Graduate Student Mentoring Award. His leadership in the Composites Manufacturing area in particular has helped him earn a number of multi-million dollar grants over the last three decades, and has contributed to the success of the Center for Composite Materials. He was recently awarded the Outstanding Researcher Award by the American Society of Composites. He also serves as the North American Editor for one of the prestigious composites journals, *Composites Part A: Applied Science and Manufacturing*.

Advani has created an educational legacy as well. During his five-year term as department chair, significant improvements have been made to undergraduate education, including a renewed focus towards hands-on and interdisciplinary learning accomplished through the creation of maker space (i.e. the Design Studio), increased departmental funding for undergraduate researchers, and the integration of other engineering majors alongside mechanical engineering students in the Senior Design capstone course. During his term, Dr. Advani continued to teach his course on Composites Manufacturing for which he was recognized as the Educator of the Year by the Society of Plastics Engineers in 2015.

Advani's legacy is not just about setting up a particular program or process but also ensuring the incoming chair, Professor Ajay Prasad can effectively carry on the department's mission.

Advani plans to focus on his research during his sabbatical in Fall of 2017. He will be the distinguished invited Professor at the Ecole Centrale de Nantes, in Nantes, France where he will work on development of models and simulation methods for composites manufacturing processes. He also plans to visit and explore collaborations with other European universities and centers who are conducting research in composite manufacturing.



NEW  
HONORSUD-CCM's Subramani Sockalingam Awarded  
Outstanding Doctoral Dissertation Prize in  
Mathematical Sciences and Engineering**Allan P. Colburn Prize**

A prize of \$1,000 and a certificate of recognition is awarded by the Office of Graduate Studies for the outstanding dissertation in the Mathematical Sciences or Engineering (Mathematical Sciences, Computer Science, Operations Research, and all Engineering programs). This award is named for Allan P. Colburn, a nationally prominent chemical engineer who was chair of the UD department. He also served as acting-president of the University in 1950 and as provost from 1950 until his death in 1955.

The Allan P. Colburn Prize for outstanding doctoral dissertation in mathematical sciences and engineering at the University of Delaware was awarded to Subramani Sockalingam at the 2017 Hooding Ceremony on May 26, where more than 184 doctoral candidates received academia's highest degree. Dr. Sockalingam who received his degree in Mechanical Engineering was co-advised by Professors Jack Gillespie and Michael Keefe from the department. His dissertation was entitled "Transverse Impact of Ballistic Fibers and Yarns" where he developed multi-scale models and unique experimental approaches to study the dynamic response and failure of Kevlar fibers subjected to multi-axial loading at the nanometer to micron length scales and microsecond to millisecond time scales.

"Through ground-breaking modeling, along with careful experimental and analytical work, Mani was able to provide new insights into the understanding of the response of fabrics to ballistic impact, and thus established a physical-basis for the failure mechanisms of a flexible textile protective fabric material under ballistic loading," Michael Keefe, professor of mechanical engineering, wrote in his letter of nomination. "...and all three elements of the work in his dissertation (modeling, experimental, analytical) have resulted in peer-reviewed archived publications. That breadth of accomplishment is truly exceptional in a dissertation."

"His research is having national and international impact. This work has prompted collaborations with scientists at the U.S. Army Research Laboratory, Southwest Research Institute, Sandia National Laboratory and Purdue University to study these

mechanisms at micron and microsecond scales for the first time," said Gillespie, director of the Center for Composite Materials. "Mani's dissertation is exemplary scholarly research with high impact that embodies unique multi-scale modeling and experimental approaches."

Dr. Sockalingam's research was supported by the Army Research Laboratory Materials in Extreme Dynamic Environments (ARL-MEDE) program as part of a nationwide university consortium led by Johns Hopkins University, CalTech, Rutgers University, and the University of Delaware. Dr. Sockalingam has joined the faculty at the University of South Carolina.

## Top-10 Most Cited Paper

A 2003 paper by the Tsu-Wei Chou, who is the Pierre S. du Pont Chair of Engineering at UD, and former research associate Chunyu Li is among the top-10 most-cited papers in the history of the *International Journal of Solids and Structures*. They join researchers from Harvard and other top academic institutions on the list. As of March 27, the paper, "A Structural Mechanics Approach for the Analysis of Carbon Nanotubes," had 910 citations and was fifth on the list according to the Scopus database. The work was published at a time when carbon nanotubes were beginning to attract attention as a novel material with potential application in a variety of fields. Chou and Li developed a structural mechanics approach for modeling carbon nanotubes, offering simplicity of concept and improved computational efficiency for analyzing deformation in these materials.

Article courtesy of: **UDaily**

NEW  
PUBLICATIONS

Meyer, C. S., Key, C. T., Haque, B. Z. G., & Gillespie Jr, J. W. "Initial Experimental Validation of an Eulerian Method for Modeling Composites." In *Dynamic Behavior of Materials, Volume 1* (pp. 103-110). Springer International Publishing. (2017). [http://dx.doi.org/10.1007/978-3-319-41132-3\\_14](http://dx.doi.org/10.1007/978-3-319-41132-3_14)

Sockalingam, S., Gillespie Jr, J. W., Keefe, M., Casem, D., & Weerasooriya, T. "Transverse Compression Response of Ultra-High Molecular Weight Polyethylene Single Fibers." In *Dynamic Behavior of Materials, Volume 1* (pp. 7-13). Springer International Publishing. (2017). [http://dx.doi.org/10.1007/978-3-319-41132-3\\_2](http://dx.doi.org/10.1007/978-3-319-41132-3_2)

Yun, M., Sas, H., Simacek, P., & Advani, S. G. "Characterization of 3D fabric permeability with skew terms" *Composites Part A: Applied Science and Manufacturing*. (2017). <http://dx.doi.org/10.1016/j.compositesa.2016.12.030>

Wang, J., Simacek, P., & Advani, S. G. "Use of Medial Axis to Find Optimal Channel Designs to Reduce Mold Filling Time in Resin Transfer Molding." *Composites Part A: Applied Science and Manufacturing* (2017). <http://dx.doi.org/10.1016/j.compositesa.2017.01.003>

Yeager, M., Simacek, P., & Advani, S. G. "Role of fiber distribution and air evacuation time on capillary driven flow into fiber tows" *Composites Part A: Applied Science and Manufacturing*, 93, 144-152 (2017). <http://dx.doi.org/10.1016/j.compositesa.2016.11.016>

Sockalingam, S., Gillespie, Jr. J. W., & Keefe, M., "Role of Inelastic Transverse Compressive Behavior and Multiaxial Loading on the Transverse Impact of Kevlar KM2 Single Fiber," *Fibers*, February 2017. <http://dx.doi.org/10.3390/fib5010009>

Chowdhury, S. C., Sockalingam, S., & Gillespie, Jr., J. W., "Molecular Dynamics Modeling of the Effect of Axial Compression and Transverse Compression on the Residual Tensile Properties of Ballistic Fiber," *Fibers*, 5, 9, February 2017. <http://dx.doi.org/10.3390/fib5010007>

Li, Y., Lu, W., Sockalingam, S., Gu B., Sun B., Gillespie, Jr., J. W., & Chou, T-W., "Electromechanical Behavior of Carbon Nanotube Fibers under Transverse Compression", *J. Phys. D: Appl. Phys.*, 50, 085303 (8pp), February 2017. <http://dx.doi.org/10.1088/1361-6463/aa587a>

Zhang, D., Heider, D., & Gillespie, Jr., J. W., "Void Reduction of High Performance Thermoplastic Composites via Oven Vacuum Bag Processing," *Journal of Composite Materials*, March 2017. <http://dx.doi.org/10.1177/0021998317700700>

Sockalingam, S., Chowdhury, S. C., Gillespie Jr, J. W., & Keefe M., "Recent advances in modeling and experiments of Kevlar ballistic fibrils, fibers, yarns and flexible woven textile fabrics—a review." *Textile research journal* 87.8 (2017): 984-1010. <https://doi.org/10.1177/0040517516646039>

NEW  
PUBLICATIONS

Ganesh, R., Sockalingam, S., Haque, B. Z., & Gillespie Jr., J. W. "Dynamic effects of single fiber break in unidirectional glass fiber-reinforced composites." *Journal of Composite Materials* 51, no. 9 (2017): 1307-1320. <https://doi.org/10.1177/0021998316669218>

Liu, H., Liu, K., Mardirossian, A., Heider, D., & Thostenson, E. "Carbon nanotube-based structural health monitoring for fiber reinforced composite materials." In *SPIE Smart Structures and Materials+ Nondestructive Evaluation and Health Monitoring*, pp. 101690H-101690H. International Society for Optics and Photonics, 2017. <https://doi.org/10.1117/12.2262262>

Ahmed, S., Doshi, S., Schumacher, T., Thostenson, E. T., & McConnell, J. (2017). Development of a novel integrated strengthening and sensing methodology for steel structures using CNT-based composites. *Journal of Structural Engineering (United States)*, 143(4), Page: 04016202. [https://doi.org/10.1061/\(ASCE\)ST.1943-541X.0001697](https://doi.org/10.1061/(ASCE)ST.1943-541X.0001697)

Simacek, P., & Advani, S. G. "Resin flow modeling in compliant porous media: an efficient approach for liquid composite molding." *International Journal of Material Forming* (2017): 1-13. <https://doi.org/10.1007/s12289-017-1360-9>

Heidary, H., Kermani, M. J., Prasad, A. K., Advani, S. G., & Dabir, B. "Numerical modelling of in-line and staggered blockages in parallel flowfield channels of PEM fuel cells." *International Journal of Hydrogen Energy* 42, no. 4 (2017): 2265-2277. <https://doi.org/10.1016/j.ijhydene.2016.10.076>

Lindemer, M. D., Advani, S. G., & Prasad, A. J. "Experimental investigation of heterogeneous hydrolysis with Zn vapor under a temperature gradient." *International Journal of Hydrogen Energy* 42, no. 12 (2017): 7847-7856. <https://doi.org/10.1016/j.ijhydene.2017.02.113>

Wang, J., Simacek, P., Yarlagadda, S. & Advani, S. G. "Integration of Composite Part Design and Processing Simulation in Liquid Composite Molding (LCM)." *SAMPE JOURNAL* 53, no. 3 (2017): 37-43.

Li, J., Lu, W., Yan, Y., & Chou, T.W. "High performance solid-state flexible supercapacitor based on Fe<sub>3</sub>O<sub>4</sub>/carbon nanotube/polyaniline ternary films." *Journal of Materials Chemistry A* (2017). <https://dx.doi.org/10.1039/C7TA02008B>

Li, J., Lu, W., Suhr, J., Chen, H., Xiao, J. Q., & Chou, T-W. "Superb electromagnetic wave-absorbing composites based on large-scale graphene and carbon nanotube films." *Scientific Reports* 7 (2017). <https://dx.doi.org/10.1038%2Fs41598-017-02639-7>

Zhou, G., Byun, J-H., Oh, Y., Jung, B.-M., Cha, H.-J., Seong, D.-G., Um, M.-K., Hyun, S., & Chou, T.-W. "Highly Sensitive Wearable Textile-Based Humidity Sensor Made of High-Strength, Single-Walled Carbon Nanotube/Poly (vinyl alcohol) Filaments." *ACS applied materials & interfaces* 9, no. 5 (2017): 4788-4797. <https://dx.doi.org/10.1021/acsami.6b12448>

NEW  
PUBLICATIONS

Chen, D.-Z., Yu J., Lu, W., Zhao, Y., Yan, Y., & Chou, T.-W. "Temperature effects on electrochemical performance of carbon nanotube film based flexible all-solid-state supercapacitors." *Electrochimica Acta* 233 (2017): 181-189. <https://doi.org/10.1016/j.electacta.2017.03.009>

Gao, X., Li, C., Song, Y., & Chou, T.-W. "A semi-continuum mechanical model for analyzing the wrinkling of graphene sheet supported by an elastic substrate." *Computational Materials Science* 135 (2017): 152-159. <https://doi.org/10.1016/j.commatsci.2017.04.016>

Yu, J., Wang, M., Xu, P., Cho, S.-H., Suhr, J., Gong, K., Meng, L., Huang, Y., Byun, J.-H., Oh, Y., Yan, Y., & Chou, T.-W. "Ultrahigh-rate wire-shaped supercapacitor based on graphene fiber." *Carbon* 119 (2017): 332-338. <https://doi.org/10.1016/j.carbon.2017.04.052>

Zhang, D., Heider, D., & Gillespie, Jr., J. W., "Characterization of Interlayer Air Permeability of Thermoplastic Prepreg Stacks," *Journal of Composite Materials*, June 2017 <https://doi.org/10.1177/0021998317715089>

Yun, M., Carella, T., Simacek, P., & Advani, S., "Stochastic modeling of through the thickness permeability variation in a fabric and its effect on void formation during Vacuum Assisted Resin Transfer Molding," *Composites Science and Technology*, June 2017. <https://doi.org/10.1016/j.compscitech.2017.06.016>

NEW  
CONFERENCES

Ahmed, S., Schumacher, T., Thostenson, E., & McConnell, J. "Simultaneous life extension and crack monitoring of fatigue-damaged steel members using multifunctional carbon nanotube based composites." In *SPIE Smart Structures and Materials+ Nondestructive Evaluation and Health Monitoring*, pp. 101700J-101700J. International Society for Optics and Photonics, 2017. <https://doi.org/10.1117/12.2272206>

Yarlagadda, S., Heider, D., Tierney, J. J., Gama, B., Roseman, D., Shevchenko, N., & Gillespie, Jr., J. W., University of Delaware; Campbell, A., Keuthage, L., & Rinehardt, D., BMW Group; Fulk, D., & Meyers, R., National Center for Manufacturing Sciences, "Multi-Material Joining for Carbon Fiber Thermoplastic B-Pillar," 2017 SPE Antec Conference, Anaheim, CA, May 8-10, 2017, Accepted February 2017.

Keuthage, L., (BMW AG Germany), Heider, D., Gillespie, Jr., J. W., Haque, B. Z. (Gama), Tierney, J. J., & Yarlagadda, S., (University of Delaware, USA), Campbell, A., (BMW AG Germany), Rinehardt, D., (BMW North America, USA), "Thermoplastic Carbon Fiber Reinforced Body-in-White Structures for Vehicle Crash Application," *ESV2017, 25th International Technical Conference on the Enhanced Safety of Vehicles (ESV)*, Detroit, Michigan, June 5-8, 2017.

NEW  
CONFERENCES

Chowdhury, S. G., & Gillespie, Jr., J. W., "Modeling of Glass Fiber with Surface Cracks – A Molecular Dynamics Simulation Study," ASC 32nd Technical Conference, Purdue University, West Lafayette, IN, October 22-25, 2017.

Heider, D., Gillespie, Jr., J. W., University of Delaware; Keuthage, L., Campbell, A., & Rinehardt, D., BMW; Myers, R., National Center for Manufacturing Sciences, "Demonstrating Computational Design Capabilities for Thermoplastic Carbon Fiber Reinforced Body-in-White Structures in Vehicle Crash Application," 25th International Technical Conference on the Enhanced Safety of Vehicles (ESV), Detroit, MI, June 5-8, 2017.

Sockalingam, S., McDaniel, P., & Gillespie, Jr., J. W., University of Delaware; Casem, D., & Weerasooriya, T., US Army Research Lab., Aberdeen MD, "High Strain Rate Transverse Compression Response of Ballistic Fibers," 2017 SEM Annual Conference & Exposition on Experimental & Applied Mechanics, Hyatt Regency Indianapolis, Indianapolis, Indiana, June 12-15, 2017.

Sockalingam, S., McDaniel, P., & Gillespie, Jr., J. W., University of Delaware; Casem, D., & Weerasooriya, T., US Army Research Lab., Aberdeen MD, "High Strain Rate Transverse Compression Response of Ballistic Fibers," 2017 Mach Conference, Johns Hopkins University, Baltimore, MD, April 5–7, 2017.

Bonyi, E., Lansiquot, C., Kioko, B., Adesina, O., Meyer, C. S., O'Brien, D. J., Haque, B. Z. (Gama), Gillespie, Jr., J. W., & Aslan, K., "Assessment and Quantification of Ballistic Damage of a Plain-weave S-2 Glass Epoxy Composite," 2017 Mach Conference, Johns Hopkins University, Baltimore, MD, April 5–7, 2017.

Bonyi, E., Lansiquot, C., Kioko, B., Adesina, O., Aslan, K., Morgan State University; Meyer, C. S. & O'Brien, D. J., US Army Research Lab; Haque, B. Z. (Gama), & Gillespie, Jr., J. W., University of Delaware, "Quantitate Assessment of Ballistic Damage of a Plain-weave S-2 Glass Epoxy Composite," 3rd International Conference and Expo on Ceramics and Composite Materials, Madrid, Spain, June 26-27, 2017.

Meyer, C. S., Haque, B. Z. (Gama), Lawrence, B. D., Bonyi, E., O'Brien, D. J., Gillespie, Jr., J. W., & Aslan, K. "Mesomechanical Modeling of Tensile Damage Modes in Single Layer Plain Weave S-2 Glass/SC15 Composites," SAMPE 2017 Conference, Washington State Convention Center, Seattle, WA, May 22-25, 2017.

Chowdhury, S., Elder, R. M., Sirk, T. W., & Gillespie, Jr., J. W., "Molecular Modeling of Glass Fiber Sizing Interphase Layer," MACH Conference, Annapolis, MD, April 5-7, 2017.

NEW  
CONFERENCES

Meyer, C. S., Key, C. T., Haque, B. Z. (Gama), & Gillespie, Jr., J. W. "Initial Experimental Validation of a Eulerian Method for Modeling Composites," *Conference Proceedings of the Society for Experimental Mechanics Series, Dynamic Behavior of Materials, Vol 1*, pp. 103-110, 2017. [https://doi.org/10.1007/978-3-319-41132-3\\_14](https://doi.org/10.1007/978-3-319-41132-3_14)

Sockalingam, S., Gillespie, Jr., J. W., Keefe, M., Casem, D., & Weerasooriya, T., "Transverse Compression Response of Ultra-High Molecular Weight Polyethylene Single Fibers," *Conference Proceedings of the Society for Experimental Mechanics Series, Dynamic Behavior of Materials, , Vol 1*, pp. 7-13, 2017. [https://doi.org/10.1007/978-3-319-41132-3\\_2](https://doi.org/10.1007/978-3-319-41132-3_2)

Heider, D., (University of Delaware, United States), Keuthage, L. (BMW AG, Germany), Gillespie, Jr., J. W., Yarlagadda, S., Tierney, J., Haque, B., Shevchenko, N., (University of Delaware, United States), Campbell, A. (BMW AG, Germany), Rinehardt, D. (BMW of North America, United States), & Myers, R. (National Center for Manufacturing Sciences, United States), "Demonstrating Computational Design Capabilities for Thermoplastic Carbon Fiber Reinforced Body-in-White Structures in Vehicle Crash Application," *25th International Technical Conference on the ESV, Detroit, MI, June 5-8, 2017.*

Ahmed, S., Doshi, S., Schumacher, T., Thostenson, E. T., & McConnell, J. (2016). Novel self-sensing carbon nanotube-based composites for rehabilitation of structural steel members. In *AIP Conference Proceedings*, edited by Dale E. Chimenti, and Leonard J. Bond, vol. 1706, no. 1, p. 120004. AIP Publishing, 2016. <http://dx.doi.org/10.1063/1.4940589>

Ahmed, S., Doshi, S., Schumacher, T., Thostenson, E. T., & McConnell, J. (2015). Novel fiber composites for simultaneous strengthening and structural health monitoring of steel structures. *SAMPE Conference Proceedings*. Baltimore, MD, May 18-21, 2015. Society for the Advancement of Material and Process Engineering.

Ahmed, S., Doshi, S., Schumacher, T., Thostenson, E. T., & McConnell, J. (2016). "Coupled Fatigue-Life Extension and Crack Monitoring of Damaged Steel Bridge Members Using Carbon Nanotube-based Composites", *Conference Presentation. NDE/NDT for Highways & Bridges: SMT 2016, Double Tree by Hilton, Portland, Oregon, Double Tree by Hilton, Portland, Oregon.*

CONSORTIUM  
NEWS

We would like to thank [Composites Automation, LLC.](#), [Ford Research & Innovation Center](#), [Leidos](#), [Michelman](#), and [National Center for Manufacturing Sciences](#) for becoming our newest Consortium members.

We would also like to thank [NETZSCH Instruments North America, Inc.](#), and [Orbital ATK, Inc.](#) for their membership renewal, and all our current members 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 <http://www.ccm.udel.edu/industry/industry-partnerships/>



**CENTER FOR  
COMPOSITE MATERIALS**  
*Internationally Recognized Excellence*  
1974-2017

**CELEBRATING OVER 43  
YEARS OF SIGNIFICANT  
CONTRIBUTIONS TO  
COMPOSITES SCIENCE AND  
TECHNOLOGY,  
THE EDUCATION OF  
STUDENTS, AND THE  
CREATION AND  
TRANSFER OF  
TECHNOLOGY TO  
INDUSTRY.**

This is a newsletter publication of the  
University of Delaware  
Center for Composite Materials

201 Composites Manufacturing  
Science Laboratory  
University of Delaware  
Newark, DE 19716-3144  
P: 302.831.8149  
F: 302.831.8525  
W: [www.ccm.udel.edu](http://www.ccm.udel.edu)

Follow us on:

