



# UPDATE

February 2012

If “iFAB” is as successful as the other “i” products that have hit the market over the past decade, the time from concept to delivery for new military vehicles will be significantly reduced over the next several years.

## CCM contributes to major DARPA initiative for defense systems and vehicles

# ifab

An acronym for “Instant Foundry, Adaptive through Bits,” iFAB is one component in a major DARPA initiative known as

Adaptive Vehicle Make (AVM), a portfolio of programs that address revolutionary approaches to the design, verification and manufacturing of complex defense systems and vehicles.

The goals of AVM are to (1) shorten development times by five times for complex defense systems, (2) incorporate manufacturing and assembly considerations early in the design process, and (3) democratize the design process through crowd sourcing.

Researchers at the University of Delaware Center for Composite Materials are developing tools to incorporate manufacturability constraints and feedback for composite structures into the AVM toolchain.

“With the current paradigm, there are too many iterations in the cycle from design to production, and that translates into significant increases in development time and ultimately cost,” says Shridhar Yarlagadda, assistant director of research at CCM.

CCM is integrating its proven composite process models into a commercially available design and analysis environment (SimExpert) that will provide designers with up-front feedback on manufacturability of a component at various levels of fidelity or abstraction. This can range from simple – can you make this geometry? – to complex probabilistic assessments of process variables on defect rate and cost.

“The program will also provide recommendations to the designer to improve manufacturability based on the causes of process-induced defects,” Yarlagadda says. “While these tasks are generally the purview of a process engineer, our approach is to incorporate physics-based rules to automate design recommendations and address a majority of potential defect scenarios.”

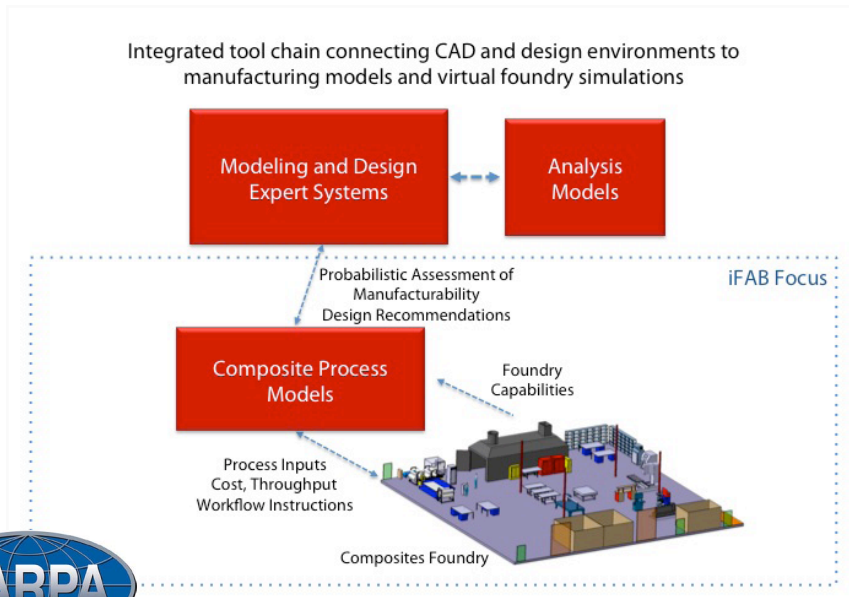
*(Continued)*

## TOP STORY

(Continued)

The initial work is tying CCM's Liquid Injection Molding Simulation (LIMS), developed by Prof. Suresh Advani (UD-ME) and his research group, to the design environment, but the long-term goal is to expand the program to include the entire spectrum of composites manufacturing methods, ranging from autoclave processing to compression molding, pultrusion and fiber placement. CCM's ultimate goal is to establish an integrated toolchain that enables a simulation-driven paradigm to reduce time to market of composite components and products.

Yarlagadda also points out that the proposed effort is assessing component manufacturability within a specific composite foundry's capability. CCM's Applications and Technology Transfer Laboratory (ATTL) hosts a complete liquid molding composite foundry that is being modeled in this work, led by Dan Molligan, CCM's assistant director for application development. "While we are modeling our foundry capability in this effort, anyone's foundry can be modeled, and we can go back and tell the designer, 'With this foundry's capabilities, this is what you can do,'" he says.



The program can be used not only in conjunction with design but also on a standalone basis, assisting in selection of the best process to meet a particular set of requirements. The customer will be able to ask questions about the quality obtainable from each process and the trade-offs among processes.

The crowd sourcing component of AVM—Fast, Adaptable Next-Generation Ground Vehicle, or FANG—is aimed at democratizing design through a crowd-sourcing infrastructure that will enable open-source development of complex systems. This stage of the project will include prize-based challenges culminating in a complete infantry fighting vehicle design competition.

"What we're doing now is just the start of something much bigger with the potential to revolutionize how new military platforms are designed and fabricated," Yarlagadda says.

## NEWS

### Mechanical engineering doctoral candidate receives Air Products Fellowship

**John Gangloff**, a third-year doctoral candidate in the Department of Mechanical Engineering at the University of Delaware, has been awarded the Air Products Graduate Fellowship for the 2011-2012 academic year. Gangloff is advised by Suresh Advani, George W. Laird Professor and associate director of UD's Center for Composite Materials.

Gangloff's research addresses processing of advanced composites. In particular, his work focuses on developing new control strategies to manipulate resin flow pressure, flow rate, and other variables to eliminate voids in liquid composite molding processes.

"If air is trapped within the composite and left to cure, the part will exhibit areas of porosity that can lead to stress concentrations under load and even premature failure," Gangloff says.

His work involves both the development of numerical tools to understand micro-length-scale physics as well as lab experiments to verify those tools.

"I have found John to be a very creative and highly motivated student who enjoys doing research and spreads his enthusiasm about it to other students," says Advani.

"He is always bubbling with new ideas to explore and develop process models to explain the behavior of bubbles and volatiles in resins so that one day we can make composite materials void-free at an affordable cost.

"He is an ideal candidate for the Air Products Fellowship, as in my mind he is a perfect graduate student who not only loves what he does but is able to excite young minds to follow in his footsteps and motivate others around him to work on interesting and important problems."

Click [HERE](#) to read the entire article.

**UDaily**



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**John Gangloff**, a third-year doctoral candidate in the Department of Mechanical Engineering.

## NEWS

### CCM Student Wins First-Place SAMPE Award

**James Sargianis**, a master's student in mechanical engineering affiliated with CCM, took home a first-place award for his presentation at the SAMPE Baltimore-Washington Research Symposium on Feb. 8, 2012. In addition to a \$500 cash award, Sargianis qualifies as a finalist for the student competition at the 2012 SAMPE National Conference in Baltimore, Md., in May. His expenses to the conference will also be covered by SAMPE.

Advised by Prof. Jonghwan Suhr, Sargianis is conducting research on natural material based sandwich composites with enhanced vibrational and acoustic performance.

"Composite sandwich structures offer superior mechanical properties at a low weight and are therefore quite popular in applications such as aircraft cabins and wind turbine blades," Sargianis says.

"However, these same properties translate into efficient noise radiation and thus poor acoustic performance. One idea for improving acoustic properties was to use sandwich composites based on natural materials."

"The advantage to using natural materials, as opposed to synthetic materials such as carbon or glass fibers," he adds, "is that we can essentially 'grow' our own materials. By growing our own materials, the carbon emissions resulting from synthetic material production would be reduced, along with other environmentally friendly benefits such as being recyclable and biodegradable."



The researchers have observed that with the use of these natural materials—which contain constituents such as cotton or bamboo fiber-based face sheets, or balsa and pine wood cores—acoustic performance can be substantially increased with only slight sacrifices in mechanical performance and weight.

In addition, they have found that coupling a natural fiber based face sheet with a synthetic foam core provides a 233 percent improvement in acoustic performance, with minimal sacrifices in mechanical performance.

"James is continuing a long tradition of our students taking top prizes at SAMPE competitions," says CCM Director Jack Gillespie, who serves as faculty advisor to the UD student SAMPE chapter. "We have been fortunate to attract top students to the Center, and in turn the environment here helps them reach their potential as researchers and leaders."

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James Sargianis (left),  
a master's student  
working with Prof.  
Jonghwan Suhr.

## JOB OPPORTUNITIES

1

The [Center for Composite Materials](#) in the College of Engineering at the University of Delaware is currently recruiting applicants to fill a **LIMITED TERM RESEARCHER** position in the areas of numerical analysis & design and/or process modeling and manufacturing science of composite materials structures. Qualifications include a Masters in engineering or related field with an emphasis on polymer composites. Applicants are required to be knowledgeable in finite element analysis and current state-of-the-art FEA software, possess a solid understanding of the basic principles of structural mechanics and be able to apply these principles to composite structures. Hands on experience in fabricating and testing of composites are also a plus. Good written and oral communication skills; ability to interact effectively with industrial and government sponsors, as well as other CCM staff and students.

2

The [Center for Composite Materials](#) in the College of Engineering at the University of Delaware is currently recruiting applicants to fill a **POSTDOCTORAL RESEARCHER** position in the areas of numerical analysis & design and/or process modeling and manufacturing science of composite materials structures. Qualifications include a PhD in engineering or related field with an emphasis on polymer composites. Applicants are required to be knowledgeable in finite element analysis and current state-of-the-art FEA software, possess a solid understanding of the basic principles of structural mechanics and be able to apply these principles to composite structures. Hands on experience in fabricating and testing of composites are also a plus. Good written and oral communication skills; ability to interact effectively with industrial and government sponsors, as well as other CCM staff and students.

To apply, please submit cover letter and resume to Corinne Hamed, [hamed@udel.edu](mailto:hamed@udel.edu).

3



[Leading Edge Composites, Inc.](#), located in Oxford, Pennsylvania is recruiting applicants to fill a **CAD ENGINEER** position.

### Requirements are listed as follows:

- Minimum 2 years Experience with a 3D CAD design software package (Solidworks Preferred)
- Experience in creation, modification, and interpretation of technical engineering drawings
- Basic knowledge of composites manufacturing techniques, materials, and terminology
- Experience with shop tools and measurement equipment commonly used in composite part fabrication
- Familiar with CNC machining principles
- Ability to effectively communicate with customers and various shop personnel
- Willingness to learn and research current and future processes and technologies related to composites
- Ability to work well under pressure and short timelines when necessary

### Additional Qualities Preferred (not required):

- Experience in composite tooling design
- Knowledge of ISO9001 quality control practices
- Experience with CNC operation and/or programming

Please visit their website [www.lec-composites.com/jobs.html](http://www.lec-composites.com/jobs.html)

Founded in 1974 within the University of Delaware's College of Engineering, the Center for Composite Materials (CCM) is an internationally recognized, interdisciplinary center of excellence for composites research and education. UD-CCM has extensive capabilities ranging from basic research through specific applications, clearly encompassing applied research that serves to transition basic research to products and applications. The Center has a broad range of state-of-the-art advanced equipment housed in two dedicated buildings for composites basic and applied research. Sponsored research expenditures are over \$12M annually. CCM is host to seven (7) NSF/DoD Centers of Excellence since 1986.



## New PUBLICATIONS

# JOURNALS

McAllister, Q. P., J. W. Gillespie, Jr., and M. R. VanLandingham, "[Non-Linear Indentation of Fibers](#)," Journal of Materials Research, doi: 10.1557/jmr.2011.336, 27 (1), pp. 197-213, 2012. journals.cambridge.org/article\_S0884291411003360

Sun, Z., J. M. Deitzel, J. Knopf and J. W. Gillespie, Jr., "[The Effect of Solvent Dielectric Properties on the Collection of Oriented Electrospun Fibers](#)," Journal of Applied Polymer Science, doi: 10.1002/app.35454, January 2012.

Nilakantan, G., E. D. Wetzel, T. A. Bogetti, J. W. Gillespie, Jr., "[Finite Element Analysis of Projectile Size and Shape Effects on the Probabilistic Penetration Response of High Strength Fabrics](#)," Composite Structures, doi:10.1016/j.compstruct.2011.12.028.

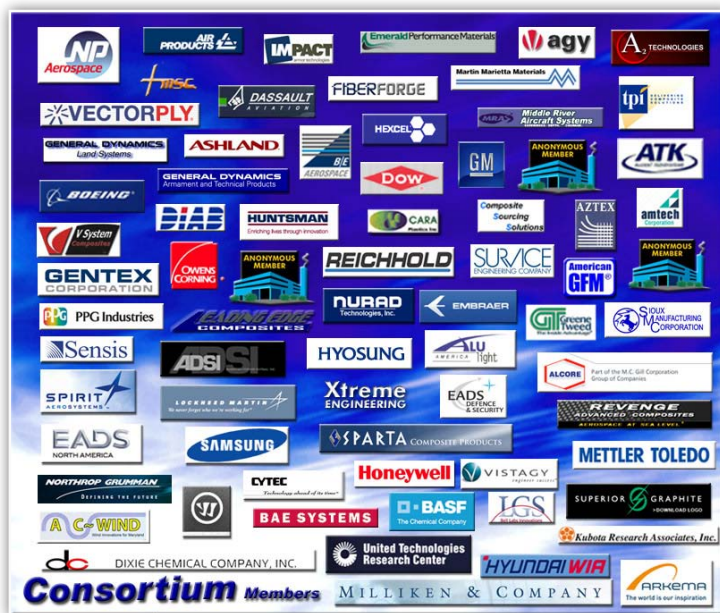
Zu, M., Q. Li, Y. Zhu, M. Dey, G. Wang, W. Lu, J. M. Deitzel, J. W. Gillespie, Jr., J.-H. Byun, and T.-W. Chou, "[The Effective Interfacial Shear Strength of Carbon Nanotube Fibers in an Epoxy Matrix Characterized by Microdroplet Test](#)," Carbon, doi: 10.1016/j.carbon.2011.10.047, 50, pp. 1271-1279, 2012

Nilakantan, G., M. Keefe, E. D. Wetzel, T. A. Bogetti, and J. W. Gillespie, Jr., "[Effect of Statistical Yarn Tensile Strength on the Probabilistic Impact Response of Woven Fabric Structures Using a Finite Element Analysis](#)," Composites Science and Technology, doi:10.1016/j.compscitech.2011.11.021, 72 (2), pp.320-329, 2012.

## CONSORTIUM NEWS

We wish to thank [United Technologies Research Center](#) and [Dixie Chemical](#), for their recent membership, as well as our many other 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 [www.ccm.udel.edu/Consortium/benefits.html](http://www.ccm.udel.edu/Consortium/benefits.html)



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1974-2009

*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)