ADDITIVE MANUFACTURING

MEET OUT SPEAKERS

Experts from Lockheed Martin and Lawrence Livermore National Laboratory
WELCOME

Dear Manufacturing Expert -

At the 2nd Additive Manufacturing for Government Summit, you’ll be able to engage with business executives, engineers, government officials and scientists who are at the forefront of the AM revolution.

To preview the type of knowledge sharing that will take place at the event, we wanted to share interviews with two of our speakers. These two speakers will bringing an engineering perspective to the event. If the opportunities and challenges that these experts face are the same as yours, then you’ll fit right in at the Summit, which will be held in Washington, D.C., from December 8-10. We hope you enjoy these interviews.

Shawn Siegel
Digital Content Director
IDGA

INTERVIEWS

AM is Changing How We Build Aircraft
Mark Skeehan, Staff Engineer, Wind Tunnel & Additive Manufacturing Group, Lockheed Martin

Architected Materials to Overcome Any Challenge
Chris Spadaccini, Research Engineer/Scientist, Lawrence Livermore National Laboratory
Can you discuss one of the most exciting additive manufacturing projects you’re working on?

The large scale additive manufacturing development program – Large scale loft tools are required to make windswept surface skins on aircraft. Lockheed teamed with Oakridge National Labs to develop a 3 axis machine which extrudes carbon fiber filled ABS plastic from pellets. A large, near net shape test tool of a wing leading edge section measuring 4’ x 6’ x 5’ was formed with the machine. The tool will later be machined smooth allowing carbon fiber composite tooling to be formed on its surface.

What are the benefits of using additive manufacturing for wind tunnel modeling?

Forming the skins of low speed wind tunnel models (wind speeds less than 300 mph) using additive manufacturing has changed the way these models are designed and built. As much as 60% can be saved compared with traditional methods of making these models. By creating a simple metal skeleton and then attaching complex additive manufactured skin shapes that have built in locating and attachment features, much of the labor of making these models had been eliminated.

What are the pros and cons of the Fused Deposition Modeling (FDM®) technology?

The pros are durability, toughness, accuracy, ease of use, reliability, and large size. This is the sweet spot for aircraft tooling. The Cons are rough surface finish, lack of fine feature definition (without a time penalty) and Z layer strength (less than XY strength).

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What potential AM development on the horizon is the biggest game-changer for aircraft development?

We will see large loft tools (greater than 6 x 6 feet in size) made with extruded plastic technology within 2 - 3 years. For metals, machines that combine additive and subtractive technologies are being
developed. Additive welding or directed energy deposition combined with CNC milling minimizes the weight ratio of raw material to final product. Large AM metal parts for primary manned aircraft structure are still several years away. Machines that are able to tailor material properties on the fly between lightweight materials (such as carbon fiber composites) and heavy metallic materials is perhaps the biggest challenge of additive manufacturing and is more than 10 to 15 years away.

**In your opinion, what is the biggest impediment to additive manufacturing reaching its massive potential?**

Large scale additive manufacturing will occur as soon as there is a pull from industry that will allow large investments into new game changing AM technologies. We see this now with some of the aircraft engine manufacturers. New materials and new ways of depositing them in place will be developed in the years to come. Industry acceptance of large metal AM parts will occur after long test programs dealing with fracture and fatigue are completed. AM standards written by ASTM/ISO F-42 committees will complete the body of standards required for acceptance in mainstream industry. The high cost creating large volumes of test data that is required for manned aircraft take the longest to complete but work is underway on high priority metals.

**Why is it so important to share your AM expertise with others?**

Additive manufacturing will be critical in the future of aircraft development by providing a direct connection to the digital thread that defines all the parts of the products we produce. Reducing the cost and number parts in an aircraft while enabling higher complexity will be of great value in coming years.

**Can you briefly preview your session at the event?**

The subject presentation “Additive manufacturing: Changing the Way We Build and Test Aircraft” explains some of the uses for additive manufacturing at a major assembly plant at Lockheed Martin Aeronautics Company. Real examples are given that show real cost savings over traditional methods of tool making, wind tunnel model fabrication, and flight test hardware fabrication.
An Interview with Chris Spadaccini

Research Engineer/Scientist, Lawrence Livermore National Laboratory. At the Summit, Chris will discuss: Creating and designing architected materials and multimatetals to overcome any functional challenge

Can you briefly discuss some of the recent accomplishments of your research team at LLNL?

There has been a lot of activity at LLNL over the past couple of years in this field. Specifically, on my research team we have been able to demonstrate new processes with micro-, and in some cases, nano-scale features as well as mixtures of materials ranging from polymers to metals and ceramics. We have been able to fabricate and characterize lattice materials with unique properties such as ultra-high stiffness with near record low weight as well as lattice materials with negative stiffness. Others at LLNL (on other research teams) have been working on computational modeling of metal laser powder-bed fusion with tremendous success and are moving toward modeling the entire process, from particles to part, in the computer.

What are the limits of how stiff lightweight 3d printed materials can get?

The micro-lattices that we have printed were of roughly the same density as aerogel but with 4 orders of magnitude more stiffness. It is this combination of stiffness and ultra-low weight that is unique.

Why is improving heat transfer of AM materials important for furthering their practical uses?

AM provides for tremendous geometric flexibility. As a result, these methods are well positioned to have great impact on unique heat transfer systems and heat exchangers which previously could not be fabricated. In order to realize this possibility, the heat transfer properties of these materials need to be comparable to bulk properties. In metals, I believe this is already approximately true.

What potential AM development on the horizon is the biggest game-changer?

Truly mixed material printing for multi-functionality could be a huge step forward. Additionally, higher throughput systems will make a big
impact in the near term.

In your opinion, what is the biggest impediment to additive manufacturing reaching its massive potential?

Throughput on current systems is still too low for widespread adoption and even more importantly, part qualification/certification for high value applications is critical and to date, not well addressed.

About the Event

The Additive Manufacturing for Government Summit, December 8-10 in Washington, D.C., features two days of case studies, panel discussions and networking sessions. Chris and Mark are just two of the great speakers at the event, and will be joined by experts from NASA, Raytheon, GE Global Research, America Makes, the Joint Strike Fighter Program and more.

For more information about the Summit and the schedule of events, please download the brochure.

If you have any questions, please email us at enquiryiqpc@iqpc.com, call us at 1-800-882-8684 or visit us at AdditiveManufacturingGovernment.com

The entire AM for Government team looks forward to seeing you there!