LSAAT Meeting AGENDA

Thursday, May 22, 2025, Meeting Time: 8:00am-5:30pm

Presenter	Presentation Topic	Time
Dr. Aaron Birt	**(Welcome Remarks)**	**0800-0810**
Session 1: Moderator: Aaron Birt, Solvus Global		
1. Andrew Parlock, Space Phoenix Systems	The Importance of Manufacturing in Space	0810-0830
2. Steven Camilleri, SPEE3D	Developments in Large Format Cold Spray AM	0830-0850
3. Anastasios Gavras, VRC Metal Systems	Large Scale Additive with CSAM, Wire-DED, and FSAM	0850-0910
4. Neil Matthews, Titomic	Large Scale CSAM Heading to Huntsville	0910-0930
5. Michael Eff, EWI	Power Draw to Printing Parameters in HDR AFSD of Al	0930-0950
Exhibit Area	**BREAK AND NETWORKING**	0950-1010
Session 2: Michael Schmitt, HAMR		
6. Soumya Nag, ORNL	Integrating Materials and Mfg for Large-Scale Components	1010-1030
7. Brandon Saathoff, Wichita University	Rapid Qualification of AM 17-4PH SS for Ground Vehicles	1030-1050
8. Tyler Dolmetsch, FIU	PSP Maps, Complex Alloys, In Situ Sensing, Laser Wire-DED	1050-1110
Session 3: Moderator: Ken Ross, Pacific Northwest National Laboratory (PNNL)		
9. John O'Hara, Sciaky	Interpass Temp. Management Ti64 Electron Beam-Wire DED	1110-1130
10. David Garcia, PNNL	Additive Friction Surfacing of Structural Steels	1130-1150
11. Alex Michelson, Solvus Global	Growth and Scale of Qualified Large Scale AM	1150-1210
Exhibit Area	**LUNCH**	1210-1310
Session 4: Moderator: Michael Eff, EWI		
12. John Roth, Un. New Hampshire	Mobile Friction Stir Additive Manufacturing	1310-1330
13. Paul Allison, Baylor University	Lubricant Free Additive FSD w/ Round Feedstock	1330-1350
14. Jan Kondas, Impact Innovations	Niobium Alloy C-103 Aerospace Propulsion using CS AM	1350-1410
15. Scott Rose, Boeing	Enabling Friction Stir Process Improvements	1410-1430
Exhibit Area	**BREAK AND NETWORKING**	1430-1450
Session 5: Moderator: Richard Billo, Missouri S&T		
16. Nate Sena, Ohio State University	Metal Transfer Optimization in Functionally Graded GTA DED	1450-1510
17. Doug Bristow, Missouri S&T	Improving Robotic Accuracy of Wire Arc DED & Feedstock	1510-1530
18. John Bosker, BOND Technologies	Development of a Continuous Feed System for FSAM	1530-1550
19. Jeremy Schreiber, HAMR	Cracking and Crack Mitigation in Large Format CS AM	1550-1610
Session 6: Steven Camilleri, SPEE3D		
20. Pete Goumas, AML3D	Print Faster, Print Bigger in 2025	1610-1630
21. Michael Klecka, RTRC	Wire-Feed AM: High Strength and High Temp Materials	1630-1650
22. Kumar Kandasamy, Enabled Eng.	Mitigation of AM Feedstock Issues using SolidStir®	1650-1710
23. Kelly Smith & Shawn Huff, ES3	AFSD Advancement to Date and Challenges to Come	1710-1730
RECEPTION	**DCU Center Concourse (Poster Session–Exhibits)**	1730-1900

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Dr. Arvind Agarwal	Florida International University, FL	Academic Member

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LSAAT Abstracts

Niobium Alloy C-103 Aerospace Propulsion using CS AM

Speaker: Leonhard Holzgaßner

Organization: Impact Innovations

Space propulsion applications require lightweight materials that can withstand high stresses at elevated temperatures. Niobium has a very low density compared to other refractory metals but high strength, i.e. a high strength-to-weight ratio. The material also shows high thermal conductivity and a low ductile-to-brittle transition temperature. This low transition temperature is advantageous for space applications because it shows excellent resistance to high-frequency vibrations at cryogenic temperatures. Furthermore, C-103, a niobium, hafnium, and titanium alloys used for space propulsion applications, have a high melting point at around 2.350°C and show strong stability at elevated temperatures, too. This study demonstrates the feasibility of C-103 large scale, thin wall space propulsion nozzle Cold Spray Additive Manufacturing (CSAM). The mechanical properties and microstructure of the cold spray deposit were evaluated on a rotary symmetrical deposit using identical feedstock and cold spray parameters. The results indicate UTS 315 MPa at 1% elongation in as-deposited state which can be significantly improved by subsequent heat treatment, reaching 466MPa UTS at >60% elongation. The deposition efficiency of the C-103 alloy 92% was measured at 4 kg/h deposition rate. Both properties make cold spray cost-effective for manufacturing large in-space propulsion nozzles with C-103 niobium alloy.

Interpass Temp. Management Ti64 Electron Beam-Wire DED

Speaker: John O'Hara

Organization: Sciaky

In large-scale part AM, heat build-up in the printed metal can cause the cooling rate of the printed metal to vary from layer to layer, producing inconsistent material properties. Instrumentation can be used to measure the temperature of the part during the printing process, which will allow this temperature to be controlled, adding consistency among the printed layers. In this experiment, some parts were printed using this temperature management and are compared to a control group. The tensile values of the two sets of parts demonstrate the expected results as of this point in time, but work is on-going.

PSP Maps, Complex Alloys, In Situ Sensing, Laser Wire-DED

Speaker: Tyler Dolmetsch

Organization: ColRAD - Florida International University (FIU)

FIU is pushing boundaries in large-scale additive manufacturing (AM) through process-structure-property (PSP) maps, compositionally complex alloy exploration, advanced sensor integration, and groundbreaking aluminum deposition via laser-wire DED. Our research develops PSP maps that link thermal histories and microstructures to performance, enabling faster qualification and reliability. By embedding advanced in-situ sensors, we achieve real-time monitoring, geared towards controlling defects, and ensuring repeatable, high-quality parts at scale, critical for large builds. Our pioneering aluminum work broadens the AM material toolbox while harnessing novel alloys. This synergistic approach sets the stage for transformative, cost-effective solutions in automotive, aerospace, and energy applications, while unlocking unprecedented design freedom.

Print Faster, Print Bigger in 2025

Speaker: Pete Goumas

Organization: AML3D

DED wire arc prioritizes faster deposition rates and larger build sizes. WAAM cell deposition rates are based on single-feed wire configurations. Commercially available WAAM cells will soon offer twin-wire deposition doubling the amount of material in the weld pool materially reducing print times driving component cost down. Current WAAM print volumes are limited by the reach of the robotic arm. To extend print volumes, the robotic arm is linked to a linear rail. Commercially available systems are now offered in 4m and 10m linear rail configurations matched to 24,000lbs and 40,000lbs positioners.

Cracking and Crack Mitigation in Large Format CS AM

Speaker: Jeremy Schreiber

Organization: HAMR

Cold spray additive manufacturing (CSAM) is an attractive alternative for production of long-lead large format castings and forgings. However, as sizes increase, the impact of toolpathing, and its interplay with material properties and component design for additive manufacturing (DFAM) becomes significantly more complex. This presentation covers experience in design, manufacturing, and testing of CSAM components for sea and land-based large format applications and challenges in scaling large component sizes. Emphasis will be placed on the roles of process parameters, residual stress, thermal gradients, green part strength, and part design on crack mitigation. The talk will finish with extension of these concepts to future components and broader maritime, air, and space applications for CSAM.

Additive Friction Surfacing of Structural Steels

Speaker: David Garcia

Organization: Pacific Northwest National Laboratory (PNNL)

Additive friction surfacing (AFS) is a solid-phase, near-net shape additive manufacturing (AM) technique with salient advantages for large scale AM of high temperature materials. Compared to similar friction stir-based techniques, AFS has a direct cost benefit as it does not require expensive tooling that is prone to wear in high temperature material deposition. Rather, AFS relies on direct deposition of the feedstock material. AFS uses readily obtainable, bulk feedstock without the need for lubricant. As a solid-phase technology, AFS has a lower energy input compared to fusion-based AM which leads to lower residual stress and a wrought-like microstructure due to dynamic recrystallization during processing. This work investigates AFS of structural steel alloys at build rates up to 20 kg/hr with a focus on increasing the mechanical properties, corrosion resistance, and mitigating the residual stress accumulation. After AFS, a two times improvement in yield strength is observed with full restoration of base properties after heat treatment. Furthermore, delamination due to residual stress is mitigated by optimization of the raster-pattern and in-line post-processing.

Enabling Friction Stir Process Improvements

Speaker: Scott Rose

Organization: Boeing

As advancements in manufacturing processes develop, the codification of the requirements can potentially lead to delays in implementation for aerospace applications. The AWS D17J committee is adding details for both friction stir spot welding and additive friction stir deposition.

Improving Robotic Accuracy of Wire Arc DED & Feedstock

Speaker: Doug Bristow

Organization: Missouri University of Science & Technology (S&T)

Wire-Arc Additive Manufacturing (WAAM) has the potential to be an advantageous replacement, in certain applications, for both wrought and cast metals. However, a major limitation is the availability of high-quality feedstock, especially in compositions not standard to traditional welding practices. This study aimed to explore custom wire production, particularly the limitations of producing compositions not standard to traditional weld wire, like C96400, a copper-nickel. Results show, despite challenges with cold working in early production stages, successful creation of C96400 wire feed stock. Additionally, these results indicate high viability for future production of additional non-standard custom wire compositions.

Wire-arc additive manufacturing (WAAM) holds significant potential for fabricating large-scale metal components; however, its adoption is often constrained by deviations in robotic toolpath accuracy and variable deposition behavior, which lead to geometric inconsistencies. This study introduces a generalized approach to enhance robotic WAAM accuracy by implementing a layer-to-layer correction strategy that utilizes a laser scanner for in-process measurement and layer-based error compensation. By analyzing scan data and generating corresponding toolpath corrections, geometric deviations are systematically reduced, resulting in enhanced precision and process stability. The findings demonstrate improved geometric fidelity and process reliability, advancing learning control strategies for WAAM and broadening its applicability in high-precision manufacturing. Moreover, integrating these methods into production could pave the way for autonomous, unattended builds and substantially reduce current labor requirements for WAAM part fabrication.

Development of a Continuous Feed System for FSAM

Speaker: John Bosker

Organization: BOND Technologies

The friction stir deposition process has already demonstrated very high deposition rates as required for manufacturing very large parts for military applications with reduced lead time. Up to the present time, the full potential of this process not been realized due to the difficulty of managing a continuous flow of feedstock into a rotating spindle. The continuous feed system developed by Bond is a complete system approach allowing a bulk rod supply to be replenished from outside of the machine guarding to deliver a continuous flow of material to a five-axis machine. The system is intended to be quickly configurable for multiple configurations of feedstock. Controlled rate of feedstock delivery is maintained while achieving seamless force handoffs from one rod to the next. The path to overcoming remaining challenges for large scale production are also addressed.

Metal Transfer Optimization in Functionally Graded GTA DED

Speaker: Nate Sena

Organization: Ohio State University

Dynamic composition in directed energy deposition (DED) additive manufacturing enables bi-metallic, tri-metallic, and functionally graded features by mixing multiple feedstocks in the deposition pool. This approach can adjust wire mixing ratios in the weld and/or build direction, optimizing properties such as thermal expansion, corrosion resistance, or strength depending on service requirements.

Integrating multiple wires into a common gas tungsten arc (GTA) or plasma arc (PA) pool presents significant stability challenges. Wire feed speeds and positions relative to arc and pool geometry critically affect wire melting behavior and deposit uniformity. Irregular globular transfer (versus bridging) produces compositional fluctuations in deposits, especially in extreme mixing conditions where one wire is fed much faster than the other.

To improve metal transfer control in multi-wire GTA and PA DED, a wire melting rate and behavior model was developed that predicts metal transfer mode based on feedstock position and welding parameters. The model can optimize process conditions according to demanded deposit size, mixing ratio, etc. to minimize compositional fluctuation within each deposit. Validation employed novel computer vision analysis for high-throughput characterization of metal transfer dynamics.

The fully validated model will enable optimization of processing parameters to ensure homogeneous mixing previously unattainable. Current work focuses on refining heat source parameters and system integration for high-throughput data collection. This technology will enable DED fabrication of high-performance parts optimized for extreme service conditions.