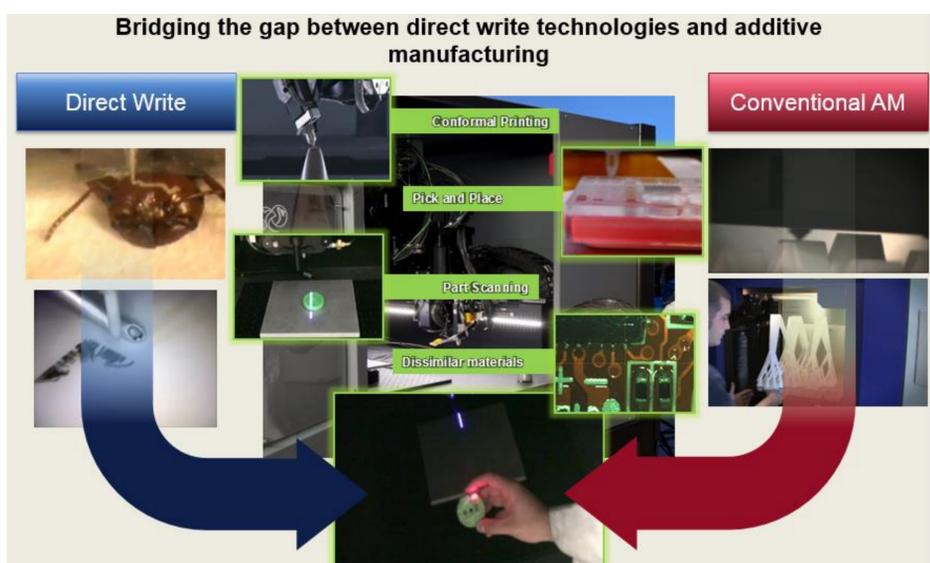


**S&T Campaign: Materials Research**  
*Manufacturing Science*  
*Advanced & Additive Manufacturing*

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## Research Objective

- Control material-process-property relationship for lightweightening and multifunctionality of critical warfighter components
- Process characterization to feed process modeling that will aid in the prediction of effects of AM
- Apply research to field-ready applications to reduce the Army's logistical burdens



## Challenges

- Many current COTS materials are not applicable to future Army systems
- In-situ characterization is complicated by processing energies and environments required in these manufacturing systems
- Process modeling and simulation is slow to catch up to processing technologies

- Line Scanning of 3D objects
- Thermoplastic Extrusion (up to 400°) of filament, powder or pellet feedstock
- Thermoset Deposition
- Ink Deposition
- 6-Axis Motion Control
- Tool Switching
- Pick-n-Place
- Micro-milling
- Laser Sintering
- Aerosol Deposition
- Micro Cold Spray Deposition

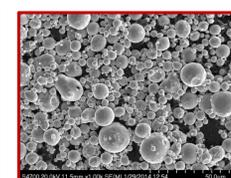
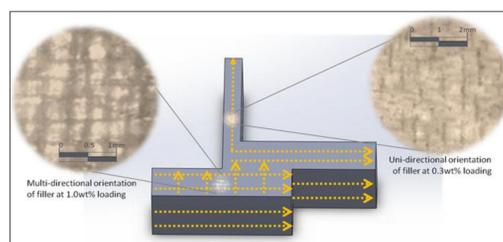
Illustration of the powder bed fusion process (i.e. DMLS), with single trace bead formation through variance in processing parameters and shear punch characterization specimen matrix

Hatching Distance: 25 μm, 50 μm, 75 μm, 100 μm

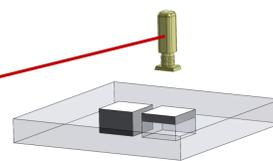
Laser Speed: 50 mm/s, 150 mm/s, 250 mm/s, 350 mm/s

## ARL Facilities and Capabilities Available to Support Collaborative Research

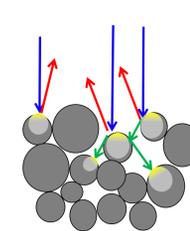
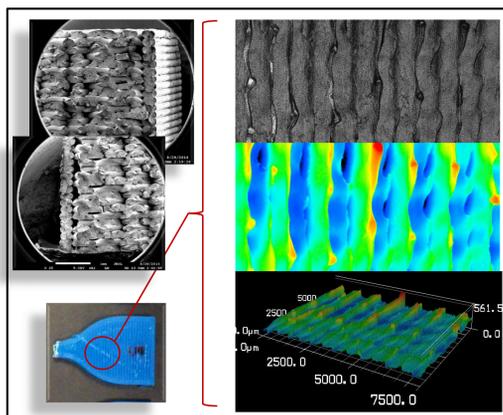
- Full and open access to ALL of the processing parameters for all of the DW and AM equipment in the MiCRO lab
- Feedstock pedigree is 100% verifiable for the AM compliant polymers, metals, and ceramics that are created in-house
- Laser sintering/melting of metals, polymers and ceramics in one platform
- Field-aided vat polymerization for tailored internal structure of 3D composites
- Fiber reinforced thermoplastic micro-extrusion
- Multi-material vat polymerization
- Capillary Cold Spray
- FDM, SL, DLP-SL, SLS, DMLS, LOM



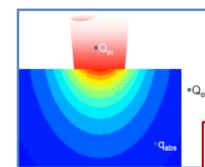
Typical metals powders are spherical and have dimensions proportional to the incident radiation's wavelength therefore Mie scattering is present



Built in powder bed imaging will gather actual powder particle geometries that will be built into electromagnetic model.



An understanding of a powder's interaction with incident electromagnetic energy will allow for a better understanding of how efficiently thermal energy is dissipated during a part's build



Coupling the electromagnetic model with a rigorous thermal-fluidic model, build parameters could be adjusted accordingly for any particle, of any material

## Complementary Expertise / Facilities / Capabilities Sought in Collaboration

- In-situ characterization of matter-energy interaction
- Process modeling for geometric, topological and on-the-fly optimization
- Field-aided processing: electric field, magnetic field, acoustic field, etc.
- Materials and process development: conductive (5+ μΩ/sq), dielectric (50+ κ), exotic, etc.
- Design/development of conformal and awkward passive devices