CTMA TECHNOLOGY COMPETITION

Finalist

Additive Manufacturing-Hybrid Technologies for DoD Part Repair
Concurrent Technologies Corporation
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Problem

• Worn, deformed or broken metallic parts are often difficult to source, expensive and/or require long lead times to repair/replace
  – Large, single-piece parts do not lend themselves to production by powder bed additive technologies
  – A large number of alloys exist among military assets

• Today: separate machines are used to complete various processes needed for repair; in other instances, the part is replaced

• Current methods are to ground the associated asset until certified replacement part is obtained
  – This leads to part scavenging from the disabled asset
Solution

• Hybrid directed energy deposition (DED) system
  – Chuck Part -> Prepare Surface -> Confirm Geometry -> Add Metal -> Machine -> Inspect -> Finished Part

• Play video  (on next slide)

• Key participants
  – CTC
    – Hybrid Manufacturing Technologies: OEM of AMBIT™ DED hybrid AM production equipment
    – DoD entity TBD

• Add metal alloys from commercially available powders

• Single set-up for AM and finished machining

• Uses G or M code: well known in CNC community
Benefits

• Reduce repair cycle time
  – Build & machine in single set-up
  – Typical turnaround time 1–3 hrs/part (but part dependent)

• Allows for reuse of existing parts, reducing impact to environment

• Adaptable to existing CNC machine tools
  – Limited new hardware needed
  – Working volume dictated by that of CNC machine tool

• IN718 tensile properties & hardness comparable to wrought

• Build rates: fine to 0.7 kg/hr; rapid to 2.5 kg/hr
Challenges & Risks

• Metallurgical and structural integrity
  – Must use good process condition (laser power, speed, etc.)
  – Optimum process conditions yet to be determined for all alloys and geometric features of value to DoD

• No qualification standards yet developed

• Limited history

• No DoD champion yet identified

• Definition of acceptance criteria
Innovation Status

• Technology has been demonstrated to MRL Level 7/8

• Most effective location for technology is at the depot repair level
  – Potential in-field use

• Obstacles include qualification, identifying optimum process conditions for all alloys of interest

• Outcomes include reduced orders for new parts, reduced inventory of parts

• Alternative solutions include: other forms of AM, cold spray, large part inventory, source replacements from OEMs
Vision / Final Thoughts

• Using existing CNC machine tools, integrate the support hardware required for use of the system
  – Gas and powder metal supply
  – Power source for laser

• Further Development Required
  – Qualification/Certification

• In-situ inspection possible

• Enhancement of technology in high-growth mode
Questions

Multi-tool selection rack

Stator Vane Section

Material Deposition

CTC's AMBIT system in a Haas 5-axis machining center
Working volume 120” x 40” x 30”