

# Introduction to the Directed Energy Deposition Process – LAWS

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- Liburdi Automation Inc. History
- LAWS (Liburdi Automated Welding Systems) Line of Solutions
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- Industry 4.0 Ready and Applications

# **LIBURDI GROUP OF COMPANIES**

Solutions Powered By 

**Dundas, ON**  
(Headquarters)



- Liburdi Engineering
- Liburdi Turbine Services
- **Liburdi Automation**
- Liburdi Dimetrics

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## ► **Liburdi Automation History**

- 1979 LIBURDI ENGINEERING LIMITED founded**
- 1990 Sold first Liburdi Automated Welding System (LAWS)**
- 1994 Acquired Puls weld Corporation**
- 1997 Acquisition of Dimetrics Inc. Merrick Welding Systems, and Hobart Advanced Welding**
- 2002 Liburdi Automation expanded into its own company**
- 2017 Complete redesign of all LAWS platforms**
- 2022 Over 250 systems being used worldwide**

**LAWS 250**



**LAWS 500**



**LAWS 750**



**LAWS 1000 FA**



**LAWS 1000**



**LAWS 5000**



**Dabber Pro**



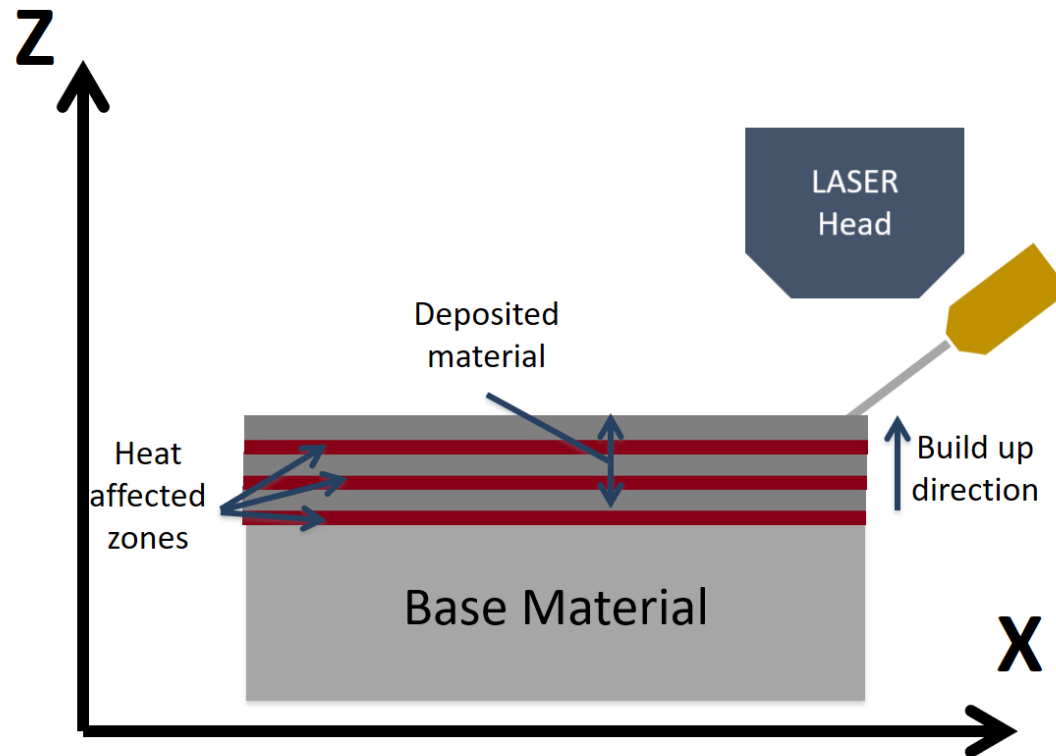
## ► **Liburdi Automated Welding Systems**

Custom Made Directed Energy Deposition Systems

- Variable working envelope
- Industry 4.0 technology
- Closed loop control
- Gantry style systems
- 5+ degrees of freedom
- Wire and powder ready
- Arc/plasma and laser ready
- Application Driven Design

## ► Directed Energy Deposition Principle

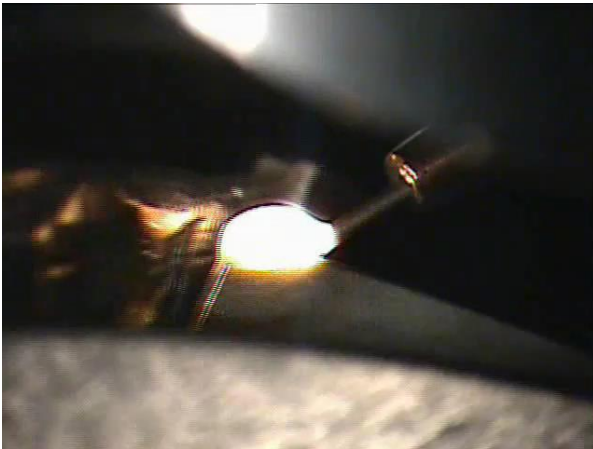
Laser Powder or Wire Deposition



- High deposition rates
- Superior part quality
- Light alloys – Superalloys
- Repair applications
- Manufacturing applications

## ► Directed Energy Deposition Principle

Laser Powder or Wire Deposition

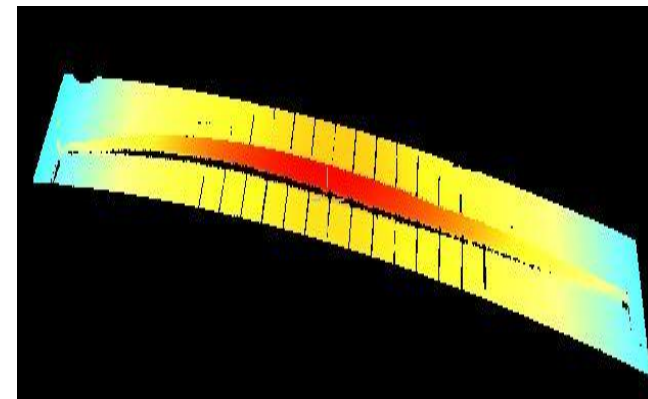
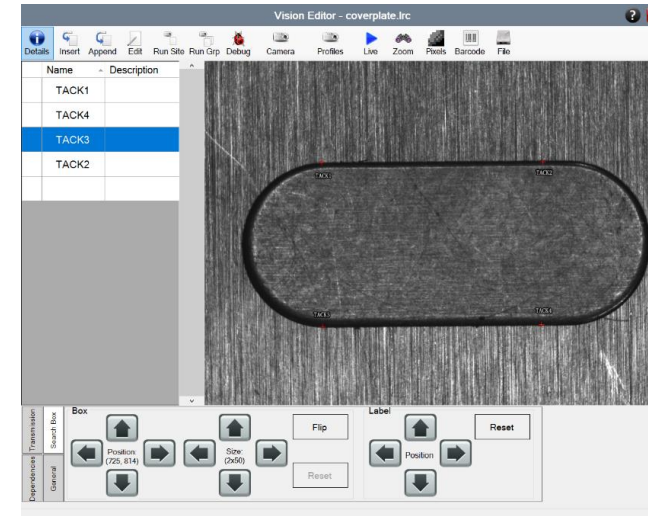
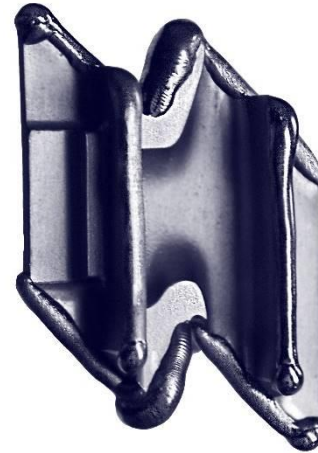
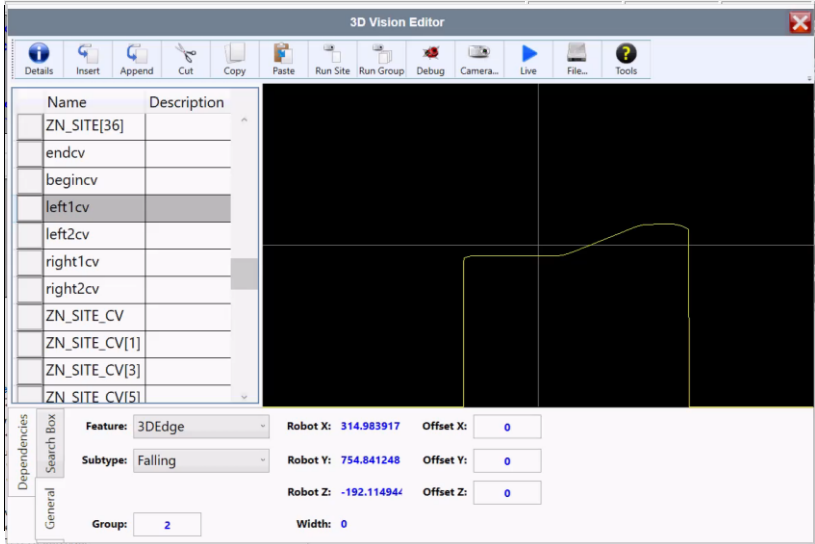
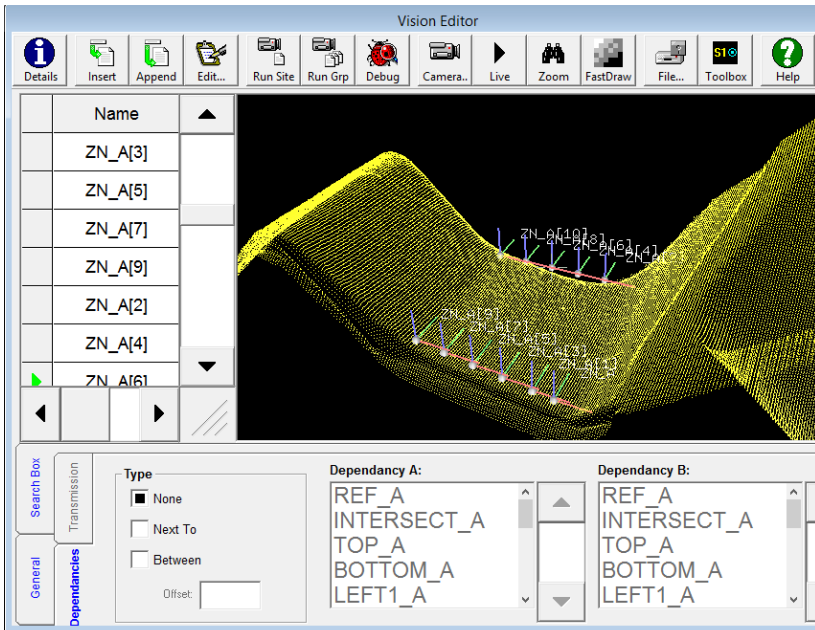


- High deposition rates
- Superior part quality
- Light alloys – Superalloys
- Repair applications
- Manufacturing applications



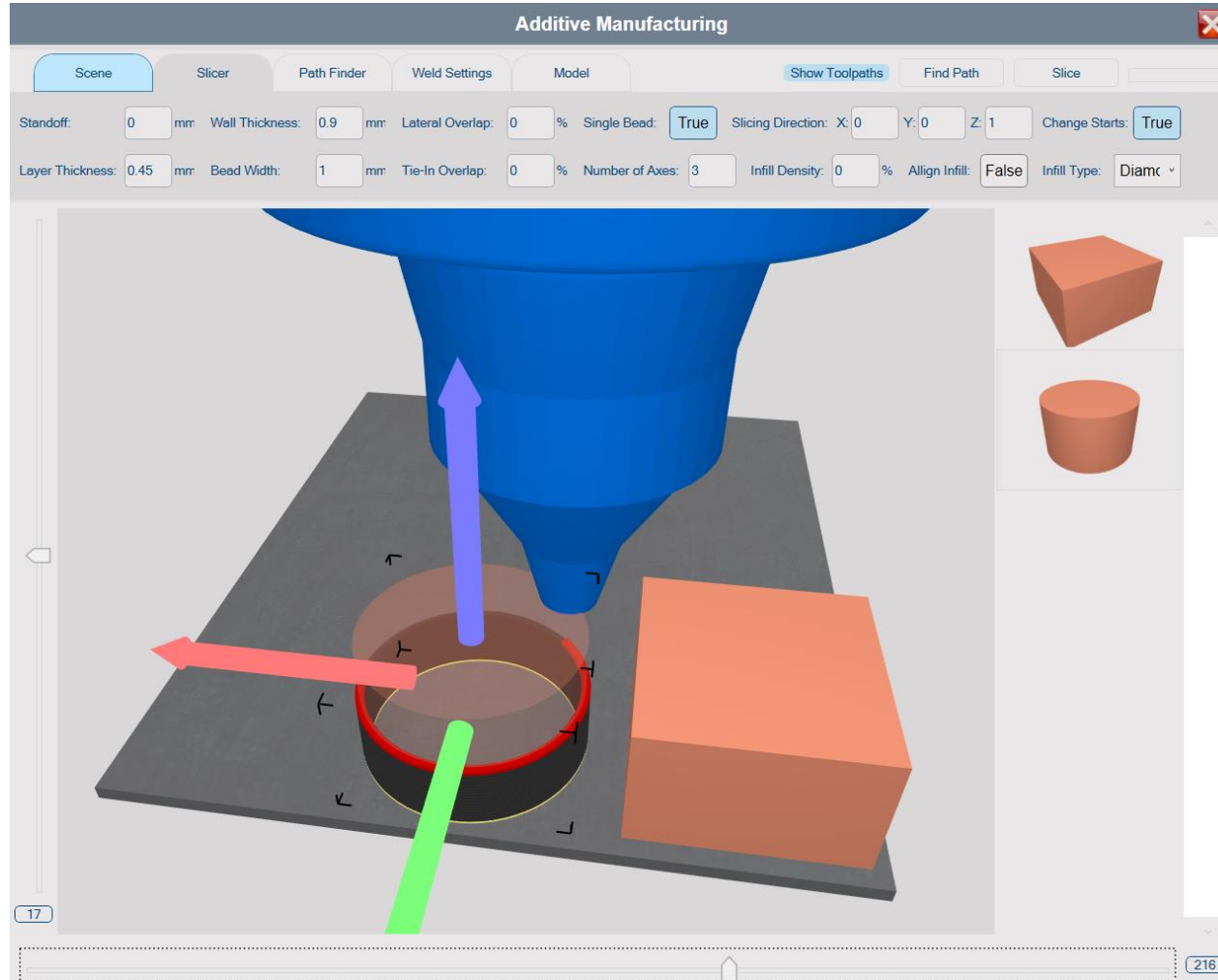
# Laser Generated Point Cloud for 3D Imaging System and Vision System

## Precise Weld Head Positioning

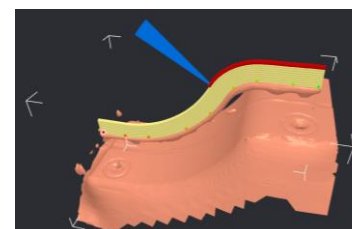
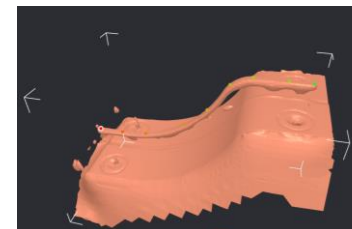
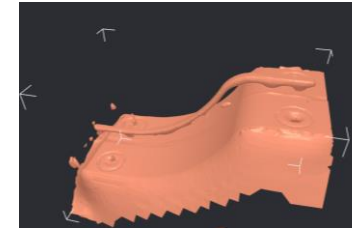
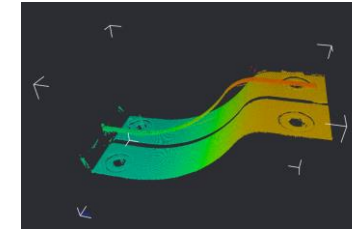




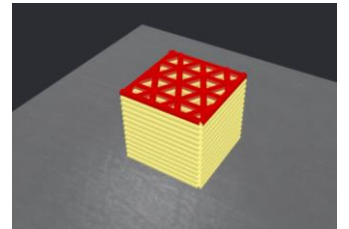
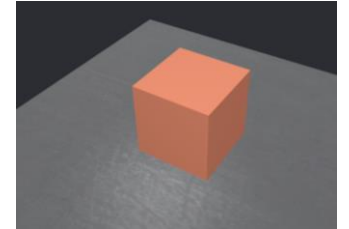
# ▶ LAWS AM Slicer



## Part Repair Hybrid Manufacturing Go / No-Go



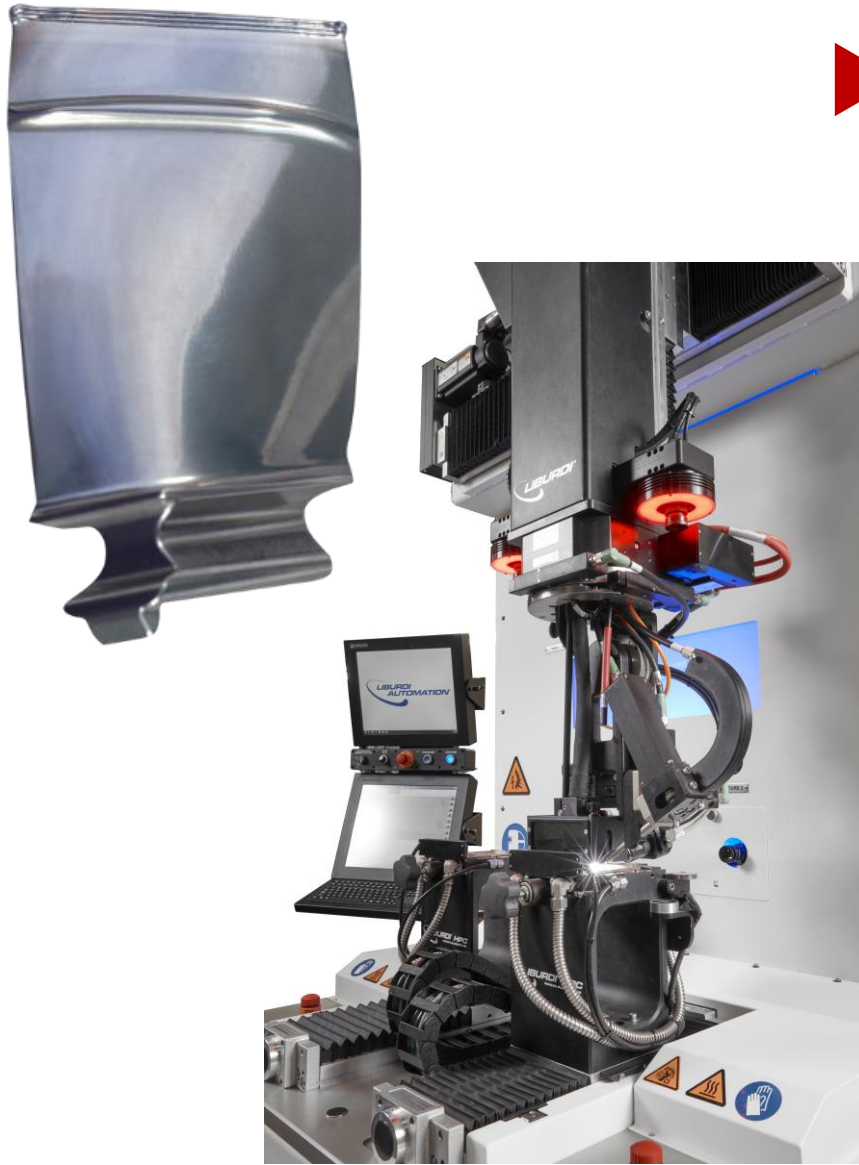
## Part Manufacturing



## ► Blade Tip Repair Applications

LAWS 500 / LAWS 1000

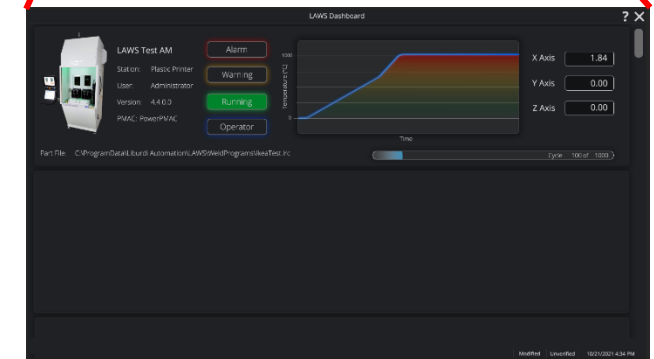
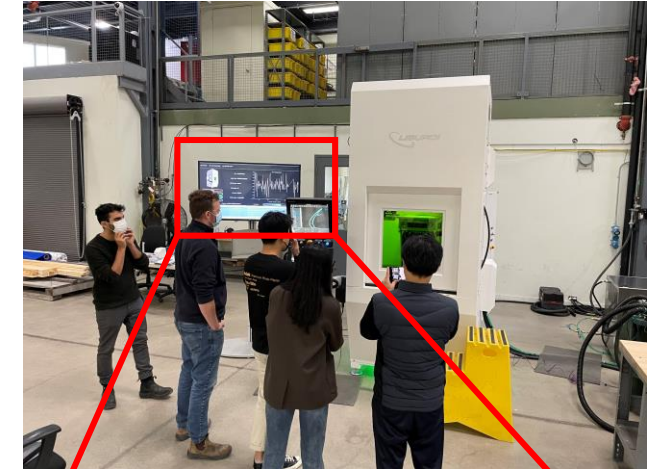
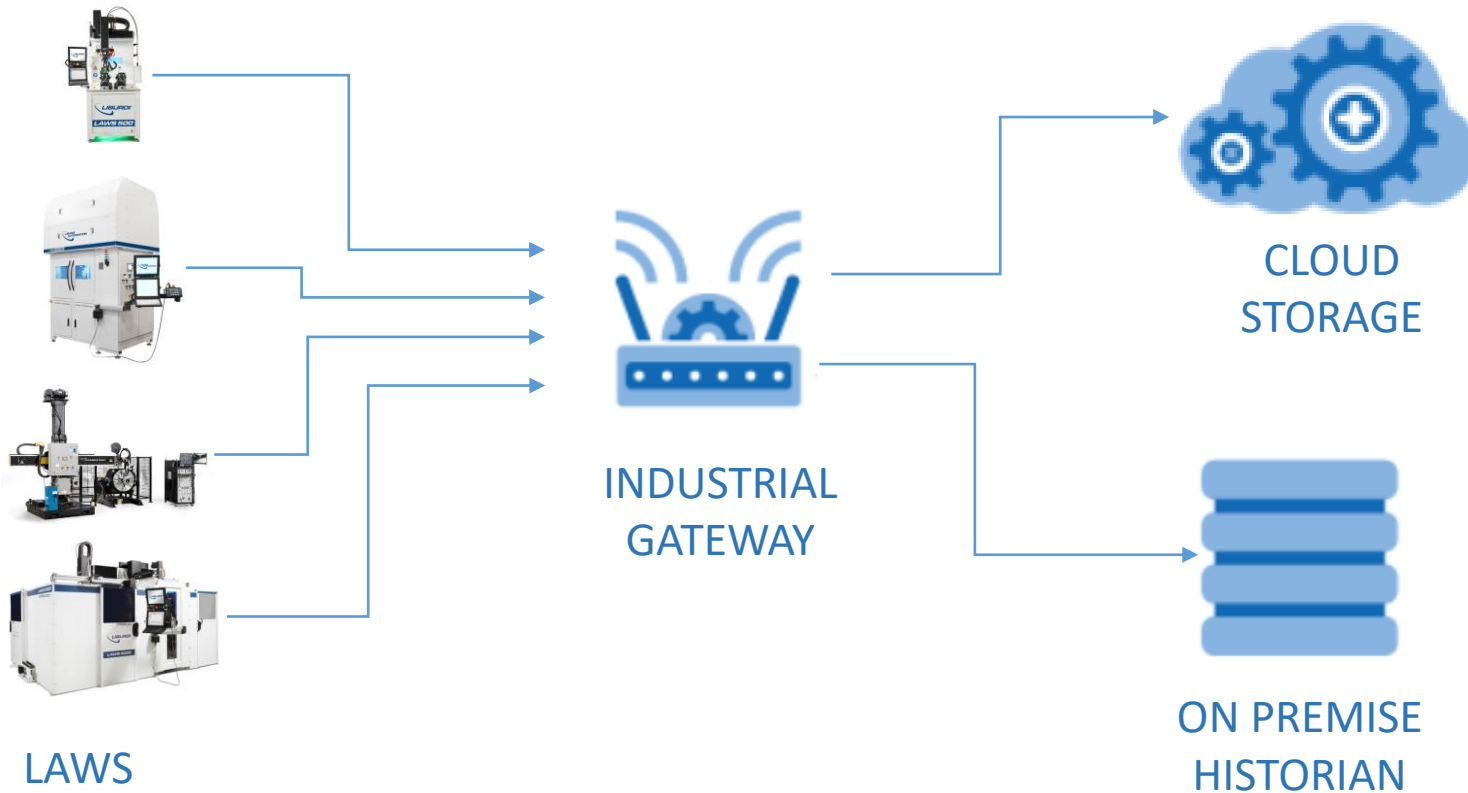
- 30+ Year experience
- 50+ Million blades processed
- Automated repair – highly repeatable
- Most recent jet engines (GEnx, LEAP, GE90 etc.)



# ► Industry 4.0 Ready

## Understanding Big Data

OPC UA  
MT CONNECT







**Thermal Imaging**



**IR Probe**



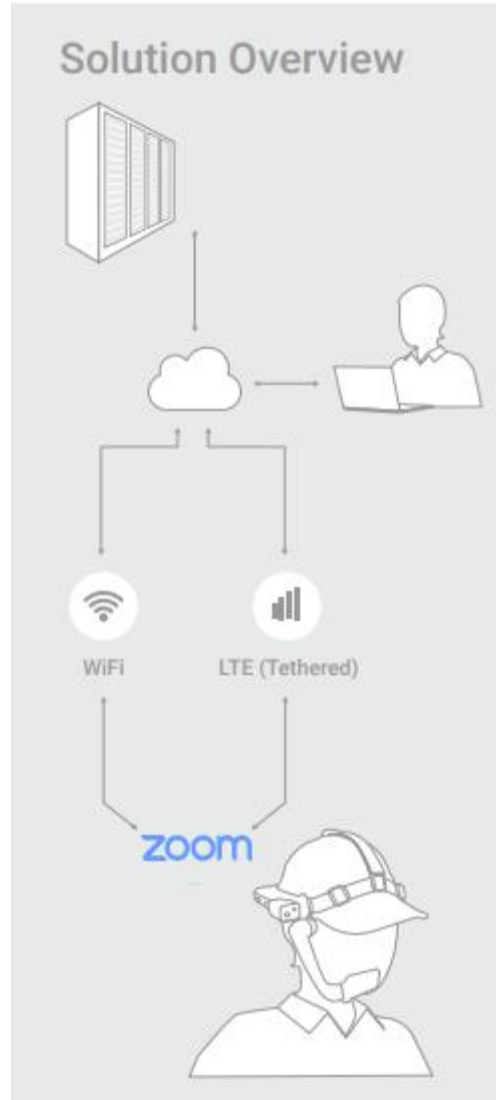
**Acoustic Sensors**

## ► **Sensor Feedback**

Closed Loop Control Capabilities

- Precise control of heat input
- In-situ monitoring of deposition parameters
- Real time detection of defects
- Custom in house software integration solutions

## ► LAWS Connectivity



## ► Z Notch Hard Facing of LPT blades

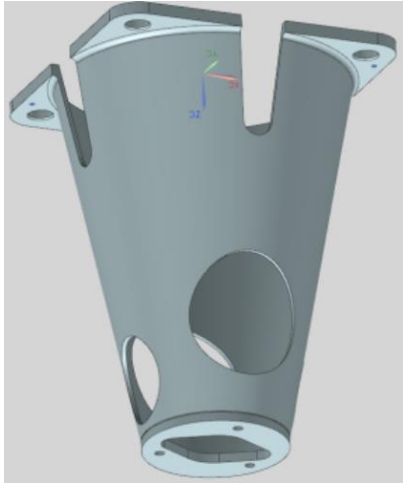
LAWS 1000 FA



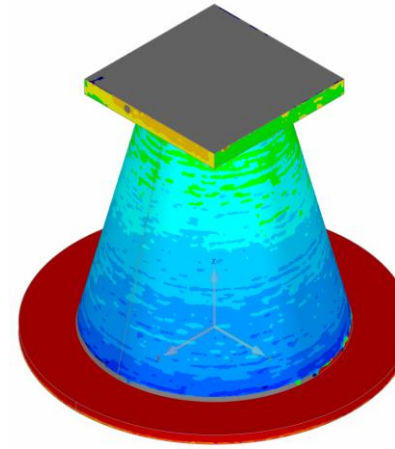
- Fully automated loading/un-loading
- Bar code reading capability
- OCR for part serial # recognition
- RFID capability
- Blade tray loading without interrupting welding process
- Key Process telemetry feedback and capture



**CAD Model**



**Printed Part**



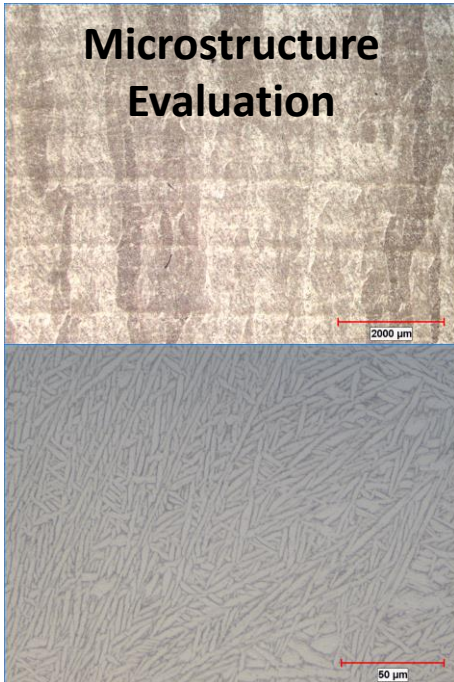
**CMM Inspection**

## ► Additive Manufacturing of a Space Component

LAWS 1000 FA

- Optimization of deposition parameters
- Destructive testing
- Non destructive testing
- Near-net-shape output: Material waste reduction

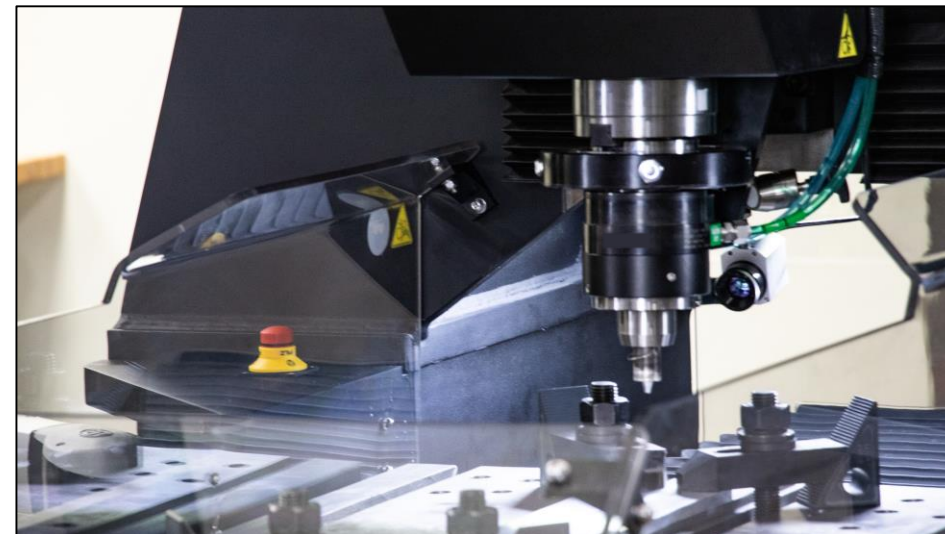
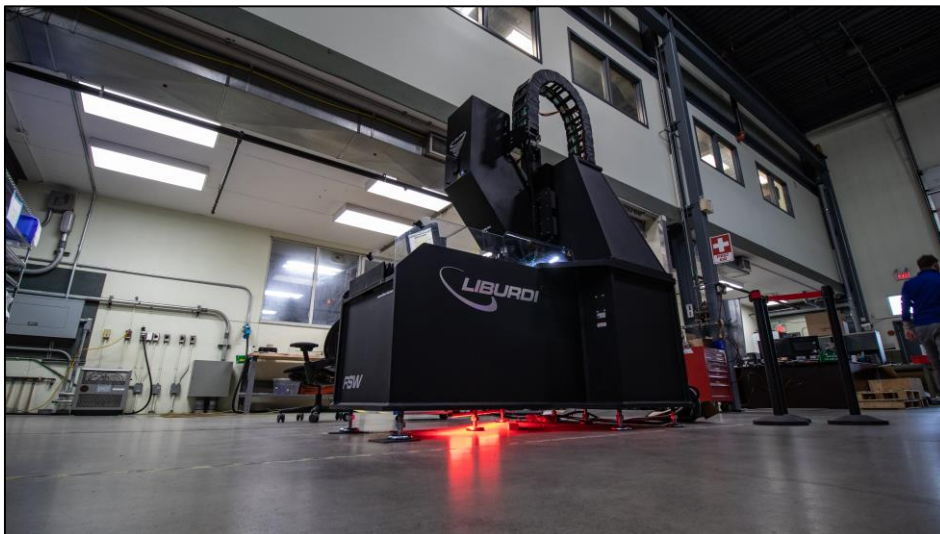
**Microstructure Evaluation**



**Mechanical Properties**



**Final Machining**



## **Conclusion**

- Repair of critical engine components at reduced cost
- Manufacturing of new parts
- Wide range of available feedstock materials – Wire and powder
- Industry 4.0 systems
- Closed loop control
- Custom working envelopes



► Thanks!



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**30+**

Years Experience



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