Revolutionizing Production of High Performance, Hybrid Composite Structures with Stratasys Additive Manufacturing

IMTS Conference
11 – September - 2018
AGENDA

Stratasys leadership in Additive Manufacturing
Addressing Challenges in Additive Manufacturing
Future of Additive Manufacturing
For more than 25 years, Stratasys has been at the forefront of 3D printing and additive manufacturing innovation.

**HEADQUARTERS**
Eden Prairie, MN and Rehovot, Israel

**OVER 1,200 GRANTED OR PENDING ADDITIVE MANUFACTURING PATENTS GLOBALLY**

**$673 MILLION REVENUE (2016)**

**OVER 30 TECHNOLOGY AND LEADERSHIP AWARDS**

**PUBLICLY TRADED ON NASDAQ (SSYS)**

**PROVIDING SOLUTIONS FOR AERO, AUTO, HEALTHCARE, & CONSUMER GOODS**
The Stratasys Mission

Apply our 30 years of 3D printing experience and purposeful innovation to enable future-ready leaders to transform their design and manufacturing processes.
HELPING COMPANIES LEVERAGE ADDITIVE MANUFACTURING

Strategic Partners

Customer Applications

Stratasys Direct Manufacturing & Strategic Consulting

Materials

GrabCAD Software

3D Printers

CUSTOMERS
3D PRINTERS AND MATERIALS

Desktop to production 3D printers provide options for virtually any application

Lights-out operation, mess-free materials, easy support removal and little-to-no post processing

Widest range of materials in the 3D printing world

Clear, rubberlike and biocompatible photopolymers, to tough, high-performance thermoplastics

Advanced material science for development of new solutions
Today's Applications

Manufacturing

Functional/Fit

Manufacturing Aids

Metal Forming Tools

Customization

Aerodynamic

Thermoforming Tools

Composite Tools

Light-Weighting

Prototyping

Tooling

Production Parts
Additive Manufacturing Barriers/Challenges

**SYSTEM CAPABILITY**
- Robotic System Repeatability & Reliability
- System diagnostics and prognostics
- In-situ process monitoring and inspection
- Sensors and analytics to reduce variability and closed loop control to enable certification of part quality

**Materials & Processes**
- Application-driven
- Composites
- Multifunctional
- Metals
- Full characterization
- Certifiable and backed by a robust and traceable supply chain

**Scalability & Flexibility**
- Modular system architecture
- Intelligent automation
- Higher order motion control
- Hybrid manufacturing solutions tailored to application-specific needs

**Design & Integration**
- Design, modeling and simulation, analysis
- Part tracking, traceability and archiving
- PLM and security tools
- Industry-standard protocols and interfaces for MES/MOM and ERP
THE TRANSFORMATION

Digitization of production – changing the way products are realized…

- Additive manufacturing
- Intelligent automation
- Advanced robotics
What Comes Next

Today

- Tooling
- FDM Composite Parts

The Future of FDM

- Robotic Composite 3D Platform
THE VISION

Scalable, extensible multi-process manufacturing platform that provides the integrated solutions needed to go from CAD to final finished part, assembly, or product in one cell.
IMTS Demonstrator – 2016

**Strength**
Directional Composites

**Speed**
Support Elimination

**Flexibility**
Hybridization

**8-Axis Motion & PLM Workflow**
SIEMENS

Robotic Composite 3D Demonstrator
Advancement of Multi-Axis Solution

Hybrid Multi-Axis Solution with Integrated Workflow on a Scalable Motion System

**Strength**
Build complex, unique, multi-directional composite structures

**Speed**
Build structures fast due to support elimination and integrated secondary operations

**Flexibility**
Scalable & configurable build environment capable of producing large parts while allowing future enhancements

**Connectivity**
Traceable end-to-end industrialized workflow preserves data integrity from design through production
THE ARCHITECTURE

Hybrid, scalable, flexible, extensible

Additive Manufacturing
- Liquefier Extrusion
- Screw Extrusion
- Continuous Fiber
- Metals

Secondary Processing
- Milling & Drilling
- Cutting
- Welding
- Sanding
- Painting

In-line Inspection
- Metrology
- Thermography

Motion
- Tilt/Rotary Table
- Linear Rail
- Gantry
- Cradle
APPLICATION SCENARIOS

Composite Structures

- Brackets, panels, doors, fairings, skins, chassis
- High strength parts with very low variability
- Factory integrated production at rate
- A wide range of part sizes from centimeters to meters
Hybrid Composite Structures - Automotive Example

Composite Seat Frame
- Unidirectional, continuous fiber composite shell
- Chopped fiber injection molded structural ribs

FDM: Chopped Fiber
FDM (AFP): Continuous Fiber
Siemens industrial motion control hardware and PLM software integrate with Stratasys advanced additive manufacturing technologies to reimagine how strong, lightweight parts are manufactured.
THE WORKFLOW

DESIGN & ANALYZE

- FUNCTIONAL PART DESIGN
- FILE PREPARATION

DECOMPOSITION

- ADDITIVE STRATEGY
- SUBTRACTION
- INSPECTION

OPERATIONS PLANNING

TOOLPATH GENERATION

- MULTI-AXIS PATH GENERATION & CONTROL
- VIRTUAL TWIN OF MACHINE PERFORMANCE

MACHINE SIMULATION

POST

- TOOLPATH TO ROBOT PATH CREATION
- PRECISION EXTRUSION
- PRODUCT EXECUTION
- PART VALIDATION

MANUFACTURE

CAD/CAE/CAM

MOTION & EXTRUSION CONTROL

DATA, PROCESS AND MANUFACTURING OPERATIONS MANAGEMENT
RADOME USE CASE

Part currently manufactured by hand layup methods

Multi-axis composite deposition system enables:
• Reimagine part design and manufacturing
• Conformally print complex structures
• Manufacturing process for optimized structures
• Ability to deposit tailored materials
• Open up applications not previously possible
THE USE CASES: RADOME – Design for Additive Manufacturing
THE RESULT

A new way to manufacture structures

- Speed: Faster build time
- Flexibility: Better reachability, Print large parts
- Efficiency: No support structures
- Quality: Better surface
THE DIRECTION

Customizable work cells

**Demonstration**
Hybrid Multi-Axis Approach with Integrated Workflow

**Product Launch**
Additive and Inspection End Effectors, Subtractive architecture (auto tool-change) on a scalable motion system

**Expanded Capabilities**
End Effectors, motion systems, and material systems

**Additional Disruptive Capabilities**
Advanced composite material approaches and scale toward integrated manufacturing cells

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**Applications**

**RC-3D Demonstrator IMTS 2016**

- Lightweight Complex Structure
- Development/Qualification Systems

- Interior Panels
- Expanded Tooling and Light Structure Applications

- Large Structure
- Prosthetics
- Turbine Blades
- Complex Integrated Structure
- Hybrid & Hot Structure
- Combined Tooling/Layup
THANK YOU

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