Geometric

Recent Additive Manufacturing Trends

Version 1.**0**
Nov, 2014

WHITE PAPER

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Introduction

Additive Manufacturing (AM) has been there for many decades now. It has seen greater attention and wide spread awareness in the past few years due to affordable machines, innovative materials and the rise of AM service providers. Today AM has a footprint in all major industries – from aerospace and automotive to medical implants and fashion. Additive manufacturing refers to a process by which digital 3D design data is used to build up a component in layers by depositing material. Additive manufacturing (AM) techniques such as Fused Deposition Modeling (FDM), Stereolithography (SLA), PolyJet (3DP), Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS) are used to manufacture parts. AM applications for non-engineering and domestic applications include hobbyist printing, gift article printing, ceramic printing, chocolate printing, bio-printing human organs, etc. For engineering applications, AM is mainly used for prototype manufacturing, tool manufacturing and end-use part manufacturing. Use of AM technologies for engineering applications will open up many new possibilities of improving the form, functionality and economics of a product. The most significant change that industries need to address today is the adoption of Additive Manufacturing (AM) in our design and manufacturing engineering processes. Use of AM is seeing new frontiers like printing bio-inspired light weight designs for aerospace and automotive applications, carbon fibre reinforced plastic printing, smart part manufacturing by 3D electronics printing and AM, hybrid machines with metal laser sintering and milling capabilities, electron beam melting for AM, laser melting and deposition, AM pattern printing for investment casting, etc. Let us look at some dimensions of the following AM techniques:

Bio-inspired light weight designs for engineering applications

The new lightweight parts created from AM take inspiration from human bone structure. Human bones have internal regions with different levels of porosity covered with hard outer layers with varying thickness. Regions where higher loads are frequently encountered have denser porosity levels and thicker outer layers. Similar methodology is adopted for designing parts to create lighter yet stronger parts. AM renders printing solid parts with internal honeycomb or scaffolds with few layers of outer skin. New analysis tools claim to optimize parts automatically with varying scaffold thickness and outer skin thickness in various regions depending on load conditions. There have been rapid improvements in this area and we may have a suite of new bio-inspired light weight parts in aerospace and automobile applications. Such methodologies will help designing parts to take unique advantages of AM process rather than printing parts that are designed for conventional manufacturing processes.

Carbon fibre reinforced plastic (CFRP) printing

Multi-material printers are capable of printing more than one material and make a composite structure consisting of two different materials such as a part with harder core and a rubbery outer layer. A recent advancement in multi-material printing is that a new AM machine can print CFRP with plastic extrusion printer that can lay up continuous carbon fibers in between layers. This has

opened up new avenues for printing much stronger materials using AM. This technology could bring in more automation in creating different types of reinforced plastics for aerospace and automobile applications in future. We could even envisage 3D FRP printers in future integrated with software technologies, taking 3D model as an input and automatically creating a fiber lay-up for a part depending on different loading conditions.

Smart part manufacturing with 3D electronics printing and AM

Smart parts, manufactured using AM, with integrated conformal 3D electronic circuits were demonstrated by printing the part with plastic extrusion and printing electronics on the 3D part by a leading AM technology company. Such technologies could mature in future to 3D print a complete part with electronic circuitry in a single integrated machine having software capabilities to facilitate integrated designing and printing of both the mechanical part and electronic circuits.

Hybrid AM and milling machines

Surface finish of additive manufactured parts has all along been an issue in successful adoption of AM technology for hard core engineering applications. Printed metal parts often require secondary operations. To counter this issue, leading precision machine tool companies are introducing hybrid machines with AM and milling capabilities. One such example is a machine with metal laser sintering unit that creates the part layer by layer and also has an integrated high speed milling head which can machine layer by layer during the additive layer processing itself. After every layer is created, the layer is machined to ensure smooth surface quality. This hybrid combination can be very useful in making molds with 3D conformal cooling channels and porous sections for gas venting which cannot be manufactured by other processes. We clearly see this technology maturing in future with CAM software capabilities to machine only selective regions in each layer, selective finish machining, etc.

Conclusion

AM techniques can be truly transformative for manufacturing organizations, cutting time, reducing waste, and bringing in unmatched efficiencies to create products. Geometric is taking its first steps in working with the ecosystem to address challenges in AM application for industrial systems and production use.

About the Author

Dr. Kannan has over 20 years of R&D experience in CAD/CAM, engineering software development, and manufacturing automation. He has a Ph.D. in computer integrated manufacturing and process planning. He has published multiple research papers in renowned international journals and conferences in related areas. His area of expertise includes product development and R&D for next generation CAD/CAM software products. He can be contacted at TR.Kannan@geometricglobal.com.

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