Auto-evolutionary and Protoplasmic Manufacturing – An Agile Engineering

Somnath Chattopadhyaya[1], Arnab Gupta[1], Vikash Kumar Singh[2], Firoz Alam[2]
[1]IIT (ISM) Dhanbad, India
[2]School of Engineering (Aerospace, Mechanical and Manufacturing) RMIT University Melbourne, Australia
E-mail: somuismu@gmail.com

Abstract

The intelligence related to the life on earth is the biggest mystery to mankind. Human being has made gallant attempts to solve this mystery of life throughout few thousand years of civilization but ultimately came with grand failures in most of the cases. The humongous hurdle of manmade products is primarily that they cannot remanufacture similar products like themselves without human intervention and in obvious consequence also cannot ultimately make offspring with enhanced features coming out of deep learning which are different and having advanced characteristics in comparison to the features of the creator product. The time when human being can achieve this kind of self-evolutionary and protoplasmic (life like) character is extremely difficult to predict. This article is a humble attempt to re-audit the latest technologies available in the world to achieve such ambitious objective. When this stunning attainment will be done it may be said without much ambiguity that ultimate stage of agile engineering is reached.

Keywords: agile engineering, hybrid-additive manufacturing, 3-D printing

1. Introduction

Hybrid additive manufacturing has been attracting a lot of attention over the past half a decade or so but it is still in its infancy with lot of technological hiccups that have to be adroitly addressed.

It refers to a new class of machine tool that brings the additive metal deposition nozzle capability of the latest three-dimensional printing together with the axis control and metal-cutting capabilities of modern machining centers.

This combination means that metal deposition can be performed along various axes.

The 3D printed material can be machined to precise tolerances at any stage in the process, even going back and forth between metal deposition and metal cutting as often as required.

This adroit combination of additive and subtractive manufacturing is the basis of the term: hybrid-additive manufacturing.

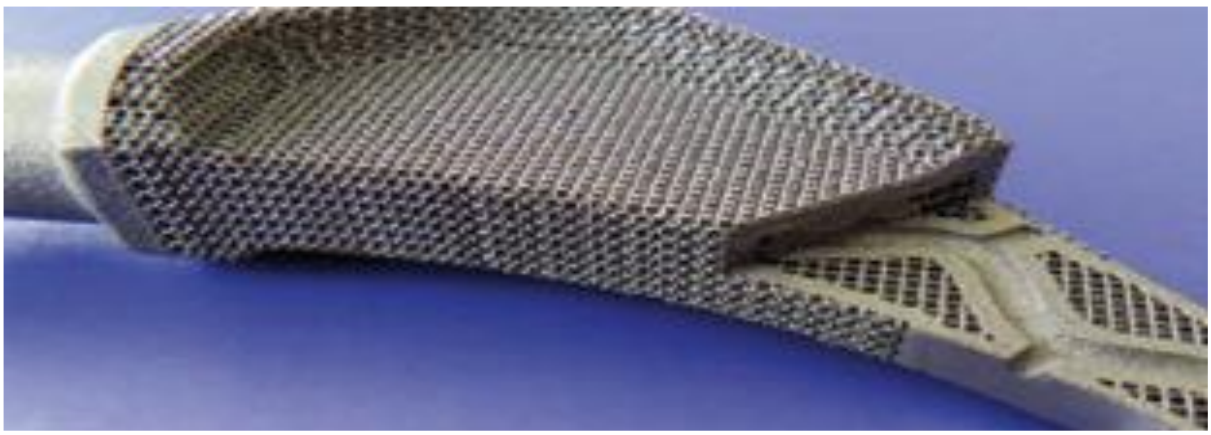

Fig. 1. Hybrid-additive manufacturing will fundamentally change the perception of manufacturing components

This powder deposition process allows one to place material in the desired composition exactly where one wishes to have it (and nowhere else).

One can manufacture things which are impossible to make in any other way, including:

Internal voids, webs, honeycombs and lattice structures

Internally-embedded components

Parts with custom nonhomogeneous (graded) materials

1.1 Importance Hybrid Additive Manufacturing

As a result, material composition and placement become design variables, and engineering part performance can be dramatically improved.

It might not be too ambitious to say that this technology will be the important catalyst for the next industrial revolution.

The relevant software provides support for new hybrid-manufacturing technologies in which additive manufacturing (3D printing or metal deposition) is incorporated with subtractive (cutting) methods in a conventional machine-tool environment.

These manufacturing techniques will reform the way one thinks about manufacturing parts.

By building complex and complicated geometries, including internal cavities, and then machining them for close and challenging tolerances as they are manufactured, new classes of machine parts can be manufactured, or many setups may be compacted into one.

On the face of it, the dueling production techniques of additive and subtractive seem like they would be difficult to combine together, and, in some aspects, they are.

But if both additive and subtractive have been synchronized appropriately, they can offer powerful novel capabilities to manufacturing industries willing to comprehend these new manufacturing processes [1-3].

1.2 Potential of Hybrid Additive Manufacturing

- Enable new designs
- Machine internal areas during build
- Repair parts easily
- Tightly control tolerance during build
- Produce finished parts on one machine

2. Automatic and semiautomatic decomposition of parts into features for additive/subtractive operations

Fig. 2. Automatic and semiautomatic decomposition of parts into features for additive/subtractive operations

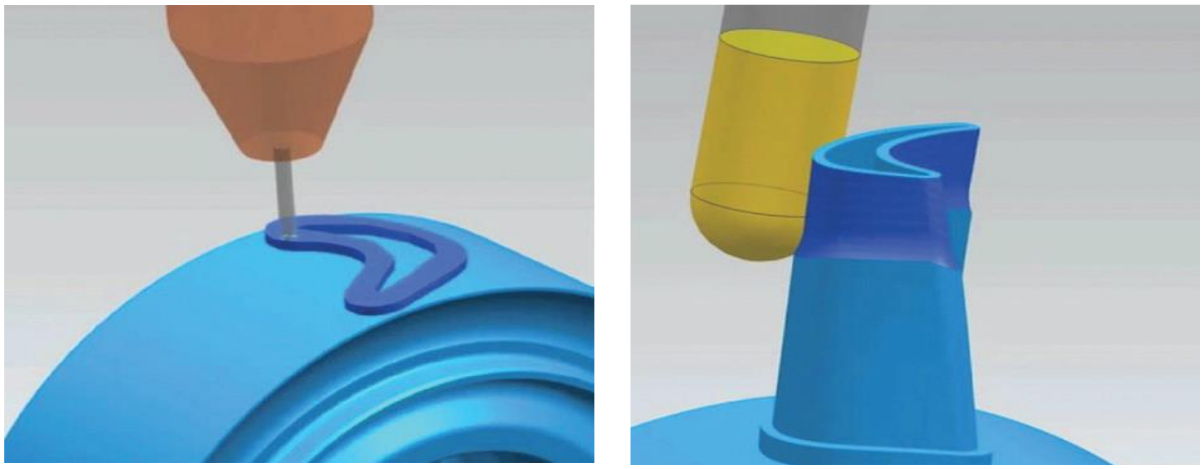

Fig. 3. In-process workpiece and verification works for both additive and subtractive modes

Fig. 4. Surfaces or features can be additively applied to a part that is otherwise machined

Table 1. Categorization of Additive manufacturing process with conventional methods

Additive Process	Characteristic	Process Combination
Laser Beam Melting	+ high complex part geometry - limited on plane building platform - risk of powder dust by opening the machine	- integration in process chain only
Laser Metal Deposition	+ build up on any freeform substrate + multimaterial production - risk of powder dust by opening the machine	- integration in process chain - integration in CNC milling and turning centers for a sequential process
Metal Powder Application	+ small heat input - risk of powder dust by opening the machine - patented by Hermle	
Gas Metal Arc Welding	+ high build-up rate + well known process - inadequate accuracy	

3. Conclusion

- Hybrid additive manufacturing is a new class of machine tool that brings the additive metal deposition.
- The 3D printed material can be machined to precise tolerances at any stage in the process.
- It can enable new designs, developed machine internal parts, repair parts, less tolerance with higher accuracy.

- It can made tough design as Internal voids, webs, honeycombs, lattice structures and Internally-embedded components.

4. References

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