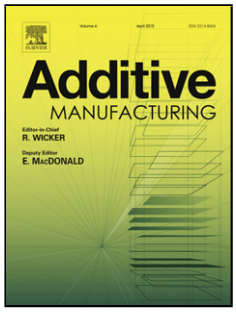

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PII: S2214-8604(16)30338-4
DOI: http://dx.doi.org/doi:10.1016/j.addma.2017.06.010
Reference: ADDMA 190

To appear in:

Received date: 6-12-2016
Revised date: 22-6-2017
Accepted date: 27-6-2017

Please cite this article as: S.S.Gill, Hemant Arora, Jidesh, Viren Sheth, On the Development of Antenna Feed Array for Space Applications by Additive Manufacturing Technique (2010), http://dx.doi.org/10.1016/j.addma.2017.06.010

On the Development of *Antenna Feed Array* for Space Applications by Additive Manufacturing Technique

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Abstract

Space agencies are looking for advanced technologies to build light weight and stiff payload components to bear space environment and launch loads. Additive manufacturing (AM) techniques like Direct Metal Laser Sintering (DMLS) is one of the suitable option which can be explored for space applications. This paper highlights the development process of Antenna Feed Array (AFA) using DMLS as an Additive Manufacturing (AM) technique. A high efficiency horn element is used in the array. Such horns are preferred for this development as they are the prime choice for feed elements in High Throughput satellites (HTS) that employ Multibeam Antennas. A brief description of Multibeam antennas along with the RF design process for the high efficiency horn is presented. In the development process, certain design rules of AM are adopted based on consideration to produce self-sustaining structures. AFA realized by DMLS is evaluated by functional testing, vibration testing for space qualification test levels. Test results shows its structural intactness which proves its space worthiness. Procedures are very well established for further development of space payload components.

Keywords: Antenna Feed, Additive Manufacturing, DMLS, Space Payload

Introduction:

The space payload components are required to be designed and analysed with extreme care because they are irreparable and required to be maintenance-free. Payload components are designed to withstand extreme space environment and launch loads. The components should be light weight and highly stiff to withstand such loads. In order to fulfil these requirements, the payload subsystems are required to be built in a single set up avoiding any alignment errors. Payload assemblies are targeted to have minimum number of parts which will lead to assembly time saving, reducing joints and fasteners, decreasing RF leakage, mass saving and minimizing the alignment issues.

To meet the above requirements, new technologies like DMLS [1] is explored for realizing space worthy components. Specifically, for space payload structures which are produced as thin shell and light weight, DMLS is an advantageous option in terms of material and machining time saving, compared to conventional machining techniques. For realization of these parts by conventional techniques 80-90% of material is scooped out whereas DMLS deposits material wherever needed. Producing complex geometries [2] at no added cost is another advantage. Initially few test samples and parts were built with AlSi10Mg powder [4] using DMLS to have insights into the technology. The test samples are qualified for physical and chemical properties, electrical conductivity, outgassing, CVCM (collected volatile condensable materials), thermo-vacuum test and other environmental tests necessary for space use qualification.

This paper intends to highlight the development process of a specific Space Payload component viz. Ka band Antenna Feed Array (AFA) using DMLS. AFA is a set of antenna feeds arranged in a 4x4 array as shown in Fig. 1 which will be used for Ka band Antenna communication in ISRO's GSAT series of Satellites. AFA is designed to build up in a single