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Abstract

Enhancing additive electronic manufacturing using verification tools

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The advent of additive manufacturing for electronic components and circuits enables the realisation of various new possibilities for developers, as the technology offers the potential to realise concepts that were previously considered impossible or only viable through considerable effort using conventional manufacturing techniques. The advantages of this include a reduction in size, the ability to design more complex nested structures or a reduced overall production time, particularly when working with small batch series or prototypes. The introduction of this new design freedom, however, also implies a corresponding increase in the parameter space, and thereby creating various risks and difficulties for developers, which may result in errors during the printing process. These errors may be a consequence of design flaws, slicing artefacts, or imperfect printing hardware, which can lead to suboptimal printing results. While the inherent inaccuracy in the 3D printing process can typically be accounted for and thus tolerated during the construction of mechanical components, inaccuracy in the printing of conductive traces can result in unexpected component behaviour, higher resistive traces or even disconnection of a circuit. This necessitates the implementation of a quality verification process following the printing stage, with the aim of enhancing the design process and ensuring the accuracy of the printed circuit. The typical verification tools employed for this task include electrical measurements, and tomographic imaging modalities.

In this work, a series of multi-dimensional coils were constructed to be used in in-house developed magnetic field generators, which form the basis of medical imaging systems [1,2]. The coils were additively manufactured using the Dragonfly IV of Nano Dimension. The conductive and dielectric materials employed were AgCite and Dielectric Ink 1092, respectively. Following the printing process, the printed results were subjected to a series of tests, including visual inspections, impedance measurements, high-resolution microscopy and µCT measurements. In some instances, destructive methods were employed in conjunction with microscopic analysis, although this approach carries the inherent risk of introducing additional errors into the device under test. The thorough analysis of the printed parts revealed different kinds of deficiencies, including cracks, poor connections, bending of embedded structures or interconnections between traces. Following the identification of these errors, redesigns were implemented, and printer parameters were adjusted to compensate for a majority of errors. These adaptions result in an overall improvement of quality in the finalised parts, a decreased completion time due to less redesigning iterations and a more comprehensive understanding of the influence of printing parameters

AUTHOR'S STATEMENT

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