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Abstract

Physical model of a medical device component

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Additive manufacturing offers the possibility of visualizing complex information to improve comprehensibility. In the medical sector, this added value is used e.g. in patient-specific models for diagnosis, planning, therapy, teaching and training [1]. These advantages can also be used in the field of engineering to illustrate the complex and sometimes invisible interactions in products and devices [2].

Here, a model has been additively manufactured combining geometric, technical and physical information in one object for a field generator, which is an essential component in an magnetic particle imaging system [3]. The model contains the transmitting coil as well as several permanent magnets in two coaxial rings, which are positioned in an antiparallel Halbach dipole configuration, generating a gradient field with a linear field-free region. The finite element simulation results of this arrangement are integrated into the model as a surface representation in three orthogonal planes. The color-coded absolute value of magnetic flux density and the flux direction are shown in each plane. All information was combined using CAD Software (Solidworks, Dassault Systemes, France). The model was prepared for printing in GrabCAD Print, scaled down to 70% of the real size and produced on a J850 PolyJet 3D printer using the materials VeroBlackPlus, VeroPureWhite, VeroMagneta-V, VeroYellow-V, VeroCyan-V and VeroClear (Stratasys, USA). Colors are selected according to the technical details of the materials used or according to the selected colormap for the simulated magnetic fields. After printing, the model was minimally finished by polishing and lacquering the surface in order to increase the transparency of the surrounding shell.

The finished model allows for the representation of otherwise inaccessible system components and provides access to the non-visible functionality and the underlying physical processes in an understandable way. It offers the opportunity to show the interaction of the system components on a model object that is more realistic in terms of mass and volume than a simple and purely digital model, especially for explaining functionality and challenges in the design process of the system. It can also be used to improve the collaborative development of the system, as technical and physical aspects can be discussed with the directly visible representation of this complex component.

The additively manufactured model presented, allows the visualization of technical, physical and geometric information. In instrumentation, additive models offer a wide range of possibilities for presentation, understanding and planning.

AUTHOR'S STATEMENT

Authors state no conflict of interest.

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