Guideline for functional integration with AM

In the transition to a digital and connected industrial production of the future, additive manufacturing offers unique opportunities. The expectations of this group of manufacturing processes are equally high. In order to exploit the diverse potentials, it is necessary to rethink the entire product development process. Special features, such as the possibilities for function integration, must be consistently considered already in the concept and design phase. Within the scope of this project, a catalogue for supporting the conceptual and design tasks associated with function integration by means of additive manufacturing is to be developed and demonstrated specifically in the field of drive technology using application examples.

PROJECT OVERVIEW

DURATION

18 Month

PARTNER

- Fraunhofer Institute for Mechatronic Systems Design

FUNDED BY

- FVA – Research Association for Drive Technology

RESEACHER

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The process-specific characteristics of additive manufacturing (AM) offer many possibilities and the AM industry has recorded enormous growth rates in recent years. The high degree of design freedom and the cost-effective production of small quantities are only some of the advantages. The technology is now used across all industries for the production of prototypes or tools, but is also increasingly used in the production of series parts. In addition to the possibilities, the new processes are also creating unknown challenges that the users of this technology must consider.

Drive technology as a field of application

Drive technology components are used wherever a movement is to be generated. Due to increasing automation, drive technology is becoming more relevant. Innovation efforts in this field are correspondingly high, since in addition to functional optimisations, even small increases in the efficiency of these components can enable significant savings due to the high degree of use. In this context, additive manufacturing represents an innovative group of manufacturing processes that process-specific characteristics offer new possibilities for manufacturing that can be used to optimise the function and increase the efficiency of drive components.

New possibilities require new approaches

In order to use the given potentials, a corresponding development and optimisation process is required, which must be accompanied by a methodical procedure due to the variety of requirements and the complexity of the components. In this mostly iterative process, the requirements are identified and, via successive detailing, the designers are confronted with process-specific possibilities that do not exist in conventional manufacturing processes.

The functional and economic potential of additively manufactured components can only be fully exploited if suitable approaches are developed and applied already in the conception. Process-specific characteristics of additive manufacturing require a rethinking already in the concept phase. Due to the geometric design possibilities of additive manufacturing, complex components can be produced economically and thus enable a higher degree of functional integration. The possibility of implementing several functions in one component and thus saving material and assembly steps offers ecological and economic advantages.

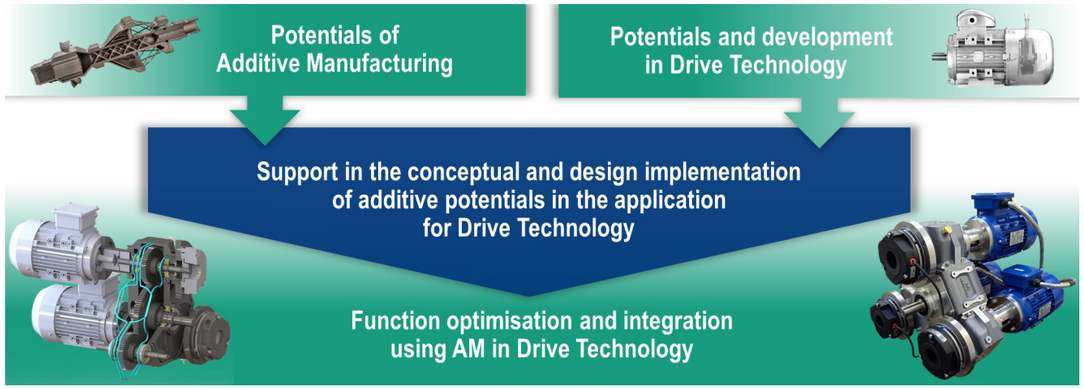

FIGURE 1 From the function to the AM part - identifying and exploiting potentials

Possible tools to support the new challenges in the design of additively manufactured components are active principles and design guidelines. The active principles represent basic solution approaches for concrete functions and are intended to describe promising possibilities in the early development phase. This can include conventional approaches, but also additive solution approaches that were previously not possible or economically uninteresting. Design guidelines describe the limits of manufacturing possibilities, boundary conditions and specifications which must be considered for a robust manufacturing process and safe application. These two tools support the user in the conceptual design and constructive implementation of new, additively manufactured functional components.

Research objective

The research objective is to develop a catalogue to support the designer in the context of conceptual and design-related challenges. The scope is focused on the possibilities of function integration in the application field of drive technology.
The consistent use of additive manufacturing still represents a major challenge for many companies. It is particularly difficult for small and medium-sized companies to build up experience in this area, as the barriers to entry are high due to investments and initial application attempts are evaluated accordingly critically. The catalogue with active principles and design guidelines is intended to serve as support for the user in this initial phase, but also beyond. This assistance in the conceptual and design development phase is intended to promote innovative and functional AM components and thus support the application of additive manufacturing. For highly specialised companies in particular, additive manufacturing offers the possibility of gaining a significant lead in international competition through the consistent improvement of components. To achieve this, the advantages of additive manufacturing must be exploited to the best possible extent and the disadvantages must be consciously minimised. This requires a comprehensive rethinking along the entire product development process.

To convey the AM-specific challenges and the resulting methodological aspects, a self-learning document is being developed. This training approach enables small and medium-sized enterprises to use the possibilities of AM with regard to function integration and to objectively identify risks in advance.