COMBINATION AND INTEGRATION OF ESTABLISHED TECHNOLOGIES WITH ADDITIVE MANUFACTURING PROCESSES IN A SINGLE PROCESS CHAIN (KitkAdd)

The research project "KitkAdd" refers to the topic "Additive Manufacturing - Individualized Products, Complex Mass Products, Innovative Materials (ProMat_3D)" and was published in the announcement of the Federal Ministry for Education and Research (BMBF) on March 27, 2015. The project focuses on individualized products and complex mass products manufactured by additive manufacturing and aims to increase the economics of Selective Laser Melting (SLM) by combining it with established manufacturing processes. In order to achieve this, an interdisciplinary view of the areas of development, design, process chain integration and quality assurance will be focused.

PROJECT OVERVIEW

DURATION

01/2017 – 03/2020

PARTNER

- Siemens AG
- H&H mbH
- Eisenhuth GmbH & Co. KG
- GKN Powder Metallurgy
- John Deere GmbH & Co. KG
- Schübel primeparts GmbH
- Karlsruher Institut for Technology (wbk)
- Paderborn University (KAt)

FUNDED BY

Federal Ministry of Education and Research (BMBF)

RESEACHER

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Federal Ministry of Education and Research

Motivation

Due to the dynamic competitive environment in industry, there is an increasing urge for shorter product development times, high functional integration and individualized products. As a result, additive manufacturing processes are gaining increasing industrial significance. In this area, Selective Laser Melting (SLM) as an additive manufacturing process should be emphasized, since it is already an established process in the area of prototyping and small series production, which is on the threshold of being used in series production. The main obstacle to a further spread of this technology has hereto been the low cost-effectiveness, which can be attributed to three essential criteria: the low productivity of the process, the insufficient process capability, e.g. insufficiently replicable component properties and a product benefit that does not live up to expectations due to the lack of consistency in exploiting design freedom.

Approach

As an approach to increasing productivity, individual components of a part or system in which SLM can offer added value can be manufactured additively. By contrast, primary forming and machining processes are always used where they remain more economical or where the application field cannot yet be covered by the conditions of series production by SLM. A contribution to the increase of the process capability can be made by innovative measuring technology as well as by adapted quality assurance measures, as a high process integration allows dynamic process control loops. Previous process-integrated methods are merely limited to the two-dimensional monitoring of the uppermost process layer and do not offer any approaches for the reliable monitoring of internal structures of the manufactured components. In order to enable the available SLM characteristic design freedoms in a targeted manner, an optimum must be found from the available design freedom with simultaneous consideration of existing requirements by the SLM process and new restrictions by combination with established manufacturing processes.

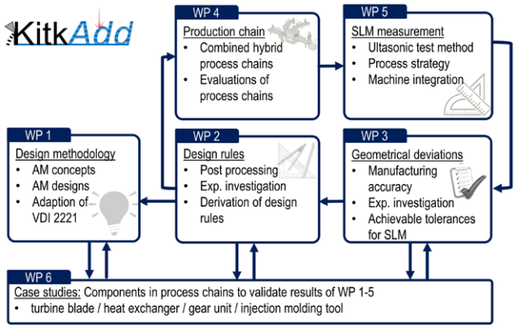

FIGURE 1 Work packages of the KitkAdd project

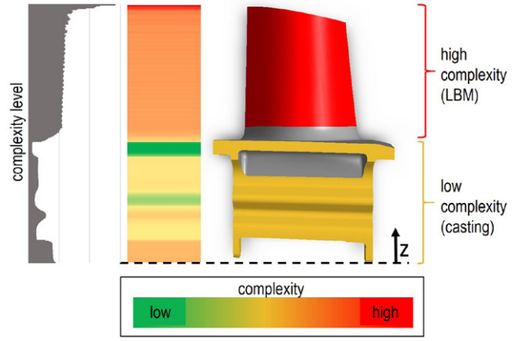

FIGURE 2 Complexity analysis of the turbine blade to identify LBM areas in hybrid manufacturing (Siemens: casting – LBM)

Objectives and results

The development of innovative methods and design guidelines is one way to make this challenge manageable in industrial applications. In view of these challenges, in particular individualized products and complex mass products, new development processes as well as intelligent processes, machines and plants are to be addressed as the main topics of the ProMat3D call for tenders of the Federal Ministry of Education and Research.

The overall objective of the project is to increase the productivity of SLM process chains significantly. This is achieved by:

- Integrative consideration of the entire process chain of SLM with post-processing and further processing by established production methods,
- a design methodology adapted to the entire SLM process chain by complementing relevant design guidelines and achievable manufacturing accuracies, as well as
- a measurement technology developed for the quality-critical SLM process for component monitoring during the design process.

As a result, a design method for SLM components and their processing steps is available which, in addition to a design that is suitable for production and load, also intuitively conveys and takes into account the necessary post-processing and the innovative potential of the manufacturing processes. Furthermore, geometric deviations can already be limited by specifying realistic tolerances in the drawing entry.
For the applications considered, statements are available regarding the effects and relationships between relevant influencing parameters and suitable evaluation parameters, above all the quality and costs of the SLM process in series production. In addition, a measurement system will be developed and integrated into the SLM process, which is suitable for innovative process control approaches as well as for verification of design methods, design guidelines and tolerances to be developed. The project pursues an interdisciplinary approach of product development, production planning and quality assurance.