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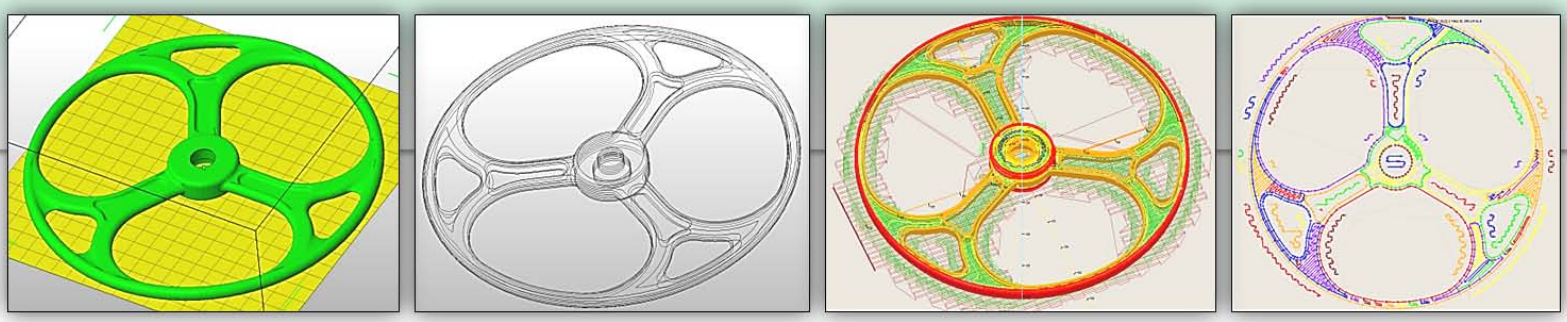

ROBOT SYSTEM FOR ADDITIVE MANUFACTURING OF LARGE PARTS

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Initial Situation

Model and mold making is affected by the great variety of products and options. Every modification of a product entails modifications of the mold and tool, which must be responded to quickly and cost effectively. The casting of small batches and prototypes constitutes an economic challenge since the requisite models and molds have to be made in numerous stages of complex manual labor. This is heavily influenced by the extensive labor required to make models for larger castings such as parts of wind turbines, marine propellers and machine tool bases, which often have to be produced in smaller quantities and in customized configurations.
In addition to the labor-intensive methods of manual model making, numerous rapid prototyping (RP) systems exist for model making, which are based on different physical principles (fusing, blanking, polymerizing, curing, etc.). Every method builds up models in layers. The process runs automatically based on the 3-D CAD models of a part. Established methods have numerous drawbacks however, which limit the use of equipment. Limited space means that only very small models can be made, model making consumes more time and surface quality is poor (e.g. because of aliasing). Combining rapid prototyping systems with high-performance industrial robots is a new approach that eliminates existing restrictions.

Technology

The Fraunhofer IFF has developed an industrial robot application that produces large and complex near net shape models and prototypes quickly and cost effectively.

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The application's heart is the combination of industrial robots with additive manufacturing systems with the following features:

- A robot-guided applicator head deposits layers.
- A special applicator system produces large-volume models
- High material throughput reduces production periods.
- IT systems completely map the production process. A common data set is used, from the 3D CAD model to the processing of data for lamination up through the robot control.
- Two-component epoxy resin pastes with good properties for subsequent processing are used.
- Large numbers of layers and different material-saving support structures allow using inexpensive filler material.

Together with the project partner MFSA GmbH, suitable materials were selected and applicator systems were developed, which facilitate fast and resource efficient model making. They can be combined with robot milling to produce geometrically accurate and customized models.

Benefits

The system allows directly producing large and complex models on the basis of 3D CAD data without intermediate steps that consume money, material and time. Industrial robots' working space and flexibility are used to optimal effect. The technology unleashes considerable potentials to optimize model making processes and constitutes an advance in manufacturing.

Outlook

The flexible robotics can be used to integrate other applications: e.g. to apply harder edge layers, to rework surfaces, to assemble individual models or install additional elements in models (e.g. temperature sensors, RFID chips and the like). Such upgrades increase the additive system's flexibility and attractiveness for many companies.

Project Partner

Modell- und Formenbau GmbH Sachsen-Anhalt, Magdeburg

Support

The joint projects "Prototype Generation with Robots Robo|Gen" was supported with funds from the European Union and the State of Saxony-Anhalt.

1 *Data preparation: 3D CAD model / vertical sections / applicator path / robot path*
2 *Deposition of a model's layers*
3 *Finishing of the model by a milling robot*
4 *Finished model for mold making*