FRAUNHOFER INSTITUTE FOR MACHINE TOOLS AND FORMING TECHNOLOGY IWU

PRESS INFORMATION

Fraunhofer IWU at Hannover Messe 2015:

Research Results from the Factory of the Future

At the HANNOVER MESSE 2015 from April 13 to 17, at the Fraunhofer-Gesellschaft's main booth (Hall 2, Booth C16), the Fraunhofer Institute for Machine Tools and Forming Technology will present the first results from the "E³-Forschungsfabrik Ressourceneffiziente Produktion". Visitors to the trade fair will experience how materials, energy and time can be saved in production through the use of extremely short process chains. There will also be a focus on the future of automotive manufacturing: an intelligent, self-learning software system supports the factory worker in the installation and adjustment of car body manufacturing facilities. Utilization of information in the production environment is a third key area: scientists will show how mobile it solutions can contribute to the optimization of production processes.

Barely a year after the opening of the "E³-Forschungsfabrik" at the Fraunhofer IWU in Chemnitz, scientists are unveiling first results of their research. In their model factory, in close partnership with industry, competitive solutions for future production are being developed in the areas of powertrain, car body manufacturing, and data and energy management.

Powertrain innovations: new ideas for gear shaft production

As a part of the Fraunhofer lighthouse project on E3 production, a demonstration process chain for production of geared hollow shafts by means of forming has been developed for the first time. In a vehicle transmission, these components are responsible for torque transmission in the powertrain. Faced with the need to achieve significant reductions in fuel consumption and emissions in the next generations of vehicles, the automotive manufacturing sector continues to conduct research into innovative solutions for lightweight construction concepts. Every kilo of weight saved leads directly to lower fuel consumption.

Production of these components normally involves the process steps of forging, turning and drilling, hobbing, heat treatment, hard machining and shot peening. In the new process chain, machining processes like deep-hole drilling and hobbing, which are expensive in terms of materials, time and money, are replaced by resource-efficient forming processes developed by Fraunhofer IWU, such as spin extrusion and gear

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rolling. Material loss in the form of metal shavings has been largely eliminated. A reduction of 12.5 percent in the required materials has been achieved to date, amounting to around 0.5 kg per component. In addition, the substantially smaller geometry of the component starting shape contributes to material efficiency. In this way, the material utilization rate from slug to finished product has been improved by 6.5 percent. Still, the potential for lightweight construction has not yet been exhausted: "By the end of the project period in 2016 we hope to have further developed and optimized the energy and resource efficiency of the new process chain and the resulting component properties. By utilizing our innovative forming technologies combined with load-oriented component design, we expect to see material savings of up to 30 percent for some component categories," says project director Dr. Udo Hellfritzsch.

Data and energy management: success with mobile IT

In manufacturing companies, employees are being confronted with increasing amounts of data and information in their routine work. The integration of mobile IT systems makes it possible to reshape value creation processes to create new business models and gain greater command of the growing production complexity. Faster, decentralized decision making and more efficient troubleshooting lead to wide-ranging cost and time savings as well as greater flexibility in production. Technical assistance systems for production management must sift through the wealth of available information to identify precisely what is needed and enable intuitive, user-friendly service and information displays. Such responsiveness has not been readily attainable up to now, since the first hurdles appear early on, in the data collection process during production: in terms of their data output, machines of varying ages and from different manufacturers also speak different languages.

In order to ensure a standardized acquisition of data, Fraunhofer IWU scientists have been developing a kind of translator: a flexible, upgradable "plant adapter". This intelligent connector will provide central control and upgrading of the interfaces, which can vary from machine to machine depending on the manufacturer. With the help of new approaches to information processing like linked data and semantic web technologies, data across an entire system can be collectively stored and networked. Data collection and processing will take place in a factory cloud developed at the Institute, known as "Linked Factory". The combined machine data are brought together with specific values from building control technology, logistics and relevant business parameters, and are interconnected and processed into useful information to support the user during production. How does the precise information required get from this cloud to the correct employee? "The key is context-based delivery," explains Dr. Andreas Schlegel, head of the Company Management Department at Fraunhofer IWU, "since a production manager's information requirements are different from those of a machine operator or maintenance engineer. Our goal is to make available the right information, at the right time, in the right place."

Demonstration software for mobile terminals has been created with this in mind. Terminals at different machines in the "E³-Forschungsfabrik" offer the user machine and process data as well as information from building control technology in real time. Using drag-and-drop, each employee can assemble an information dashboard appropriate to his/her role, only including the information s/he actually needs. Another software prototype is aimed at a different use scenario, delivering information based on employee context: using an in-house GPS, the software detects the user's current location and whether a tablet, PC or smart phone is being used for the information request. The employee's range of work is identified from a login. Information type and data output are adjusted to fit these variables.

Flexible and intelligent car body construction: a software that learns

An increasing number of variants and shorter product life cycles are the drivers of development in production technology. The automotive industry in particular is expected to design highly complex production capabilities for new and modified models as rapidly as possible in order to meet market demands.
Further advances in flexibility are made especially difficult in high-precision production by the high degree of automation and the related time-intensive installation of production facilities. Manufacturing errors lead to time- and cost-intensive interruptions in production – the necessary adjustments must often be performed manually and in areas that are difficult to access. Through the development of intelligent software assistance systems linked directly to innovative system technology, quality control loops can be shortened and necessary adjustments by plant workers significantly simplified. People will be more efficiently supported in their role as creative problem solvers.

In order to assemble individual elements like a car door or side panel, the components are clamped in type-specific fixtures. Here precision is measured in tenths of a millimeter so that the clearance on a finished automobile exactly matches the specifications. A component that is not yet firmly welded is an unstable structure – if one area is adjusted, another sags. This is why employees must calibrate the clamping elements exactly. The process is complex and the success of the adjustment is heavily dependent on the worker's level of experience. Every changeover to a new car model can involve several months, and even in the case of deviations in the geometry of construction groups of the same model, it can take several minutes until the system is once again optimally configured. This protracted quality loop, manual readjustment and the consequent disruptions to production are very time-consuming and clearly diminish the productivity of a plant.

At Fraunhofer IWU, a prototype for a software assistance system for automatic adjustment of fixtures in car body construction has been developed in cooperation with industry partners. The previous experience-based adjustment process is being replaced by an intelligent IT system to support plant workers. The software initially "observes" the adjustments made by employees and builds a database of optimal settings. The system then presents a recommendation for adjustment, currently after around 30

sample data sets. The adjustment assistant is linked to another recent development: electromechanical adjustment axes replace the manual adjustment elements. With the push of a button, the recommended corrections are transferred directly to the clamping fixture. The entire system allows for a new, shorter quality control loop and should not only be applicable for components of the same model but also significantly shorten installation time during model changeover. Marko Pfeifer, head of the Assembly Engineering Department at Fraunhofer IWU, describes the solution's potential: "With the alignment assistant we want to reduce installation time at start-up from months to days, and the necessary readjustment in the event of errors during operation from minutes to seconds."

Print-quality color images available from:
http://www.iwu.fraunhofer.de/en/press.html

Image: The shortened demonstration process chain depicts all steps for the production of geared hollow shafts by means of forming. Source: © Fraunhofer IWU.

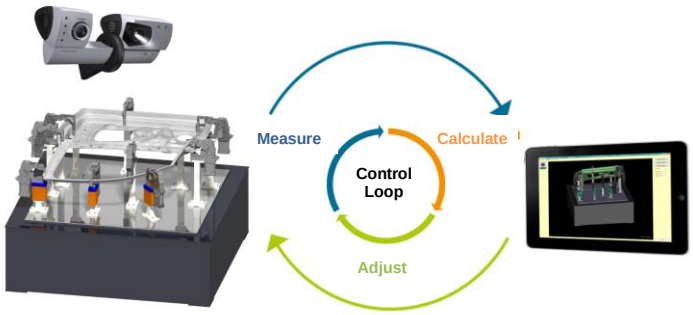

Image: Through intelligent software assistance systems, plant workers can be supported in the adjustment of car body parts during production. Source: © Fraunhofer IWU.

Image: The right information, at the right time, in the right place – at Fraunhofer IWU, solutions are created for context-based provision of information in production and factory settings. Source: © Fraunhofer IWU.

For further information and a virtual tour of the E³ factory, go to:
www.e3-fabrik.de
www.iwu.fraunhofer.de

"Research for the Future" is the motto of the Fraunhofer Institute for Machine Tools and Forming Technology IWU. This is exemplified by the Institute's strong emphasis on application-oriented research and development in the field of production technology for the automotive and mechanical engineering sectors.
With an annual budget of about 37,2 million euros and over 620 highly qualified engineers and scientists, combined with laboratories for machine tools, forming and joining technology, mechatronics, precision technology and Virtual Reality in Chemnitz, Dresden, Augsburg and Zittau, Fraunhofer IWU is recognized as one of the leading contractual research and development institutions across Germany in our specialized fields of work.

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