Self-programming paint booth

Automated painting of individual pieces

Reductions of 20 percent in paint use, 15 percent in energy consumption and 5 percent in production time – the SelfPaint automated painting system offers significant advantages compared to manual painting operations, which have previously been the preferred option. SelfPaint's biggest advantage could well be that it is also suitable for painting individual pieces, known in industry as batch size 1.

Regardless of the industry, products are becoming increasingly customized; in the long term, production is set to be characterized by batch size 1. When it comes to the painting process, however, businesses are still up against some major challenges in this respect. After all, automation and customized paintwork have never exactly gone hand in hand. Only if numerous identical components need to be painted is it worth programming a painting robot to do the job. But today, such cases are becoming increasingly rare. In fact, in many industries well over half of all components are painted manually – because the extent of variety is simply too great for automation.

Automating painting while conserving resources

Now, the self-programming SelfPaint booth offers companies a solution to this problem for the first time – and opens the door to a wealth of savings. SelfPaint was developed by the Fraunhofer Institutes for Manufacturing Engineering and Automation IPA and for Industrial Mathematics ITWM together with the Fraunhofer-Chalmers Research Centre for Industrial Mathematics FCC in Sweden. "Our SelfPaint technology enables the automated painting of small batches and even single pieces," says Dr. Oliver Tiedje, IPA group manager and coordinator of the project. "Thanks to this new technology, we save up to 20 percent in paint. This in turn reduces solvent emissions by 20 percent. What's more, the booths consume 15 percent less energy and complete the work 5 percent faster than conventional painting processes." A further benefit is that the automated process also outperforms manual painting operations in terms of reproducibility.

Using simulations to produce perfect paintwork

Automated painting is a five-step process. First of all, the researchers use robust state-of-the art systems to produce a three-dimensional scan of the component. Data

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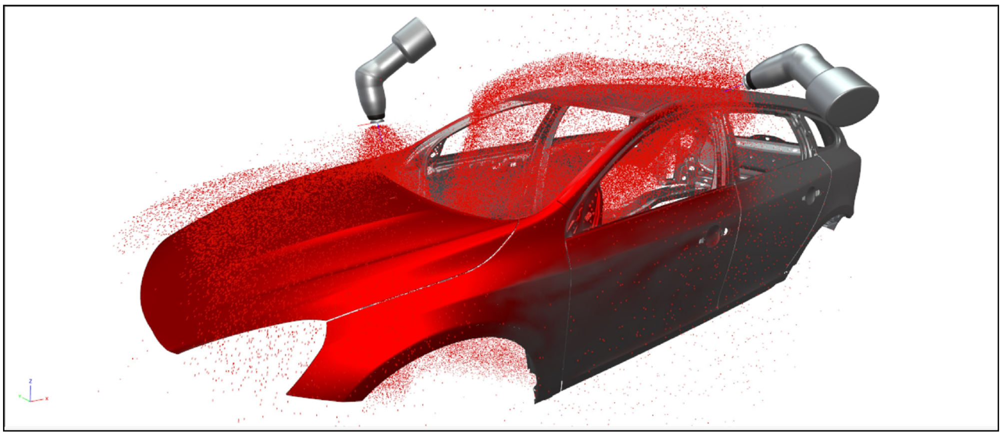
from this scan forms the basis for a fluid dynamic simulation: customized software simulates the trajectory of the paint particles and then determines the optimum volume of paint and air needed to achieve the required coating thickness. In the third step, the system uses the simulation data to plan the robot path for the painting process. The painting process itself is then carried out. In the fifth and final step, the quality of the paintwork is inspected to check that the required coating thickness been achieved. “For the quality control checks we apply terahertz technology, in other words a beam of light at a wavelength that lies between microwave and infrared. This enables us to measure wet, colored paint without actually touching it,” says Joachim Jonuscheit, deputy department head at Fraunhofer ITWM. The idea is for this whole process to be automated in everyday painting operations: robots will scan, paint and check the quality of the paintwork – all without human intervention.

While researchers from Fraunhofer IPA are coordinating the project and focusing on both the painting technology and the simulation of paint particles close to the atomizer, their colleagues in Sweden are simulating particle behavior close to the work piece and working on the automated path planning. More specifically, they are calculating how the droplets of paint move through the air, where they lay down on the target object and the thickness of the resulting layer of paint. At Fraunhofer ITWM, researchers are pursuing the 3D scanning technology and measurement of the coating thickness for quality control purposes. The individual modules are already complete. Now, the researchers are working to combine the individual steps to form one fully automated process. Expected to be completed in late 2018, the finished prototype is set to help increase the degree of automation and flexibility of painting technology in production.



Multi-physical simulation of a high-rotation atomizer with internal charging. In this example, the simulation is being used to calculate the drop trajectory on the car body of a Volvo V60.
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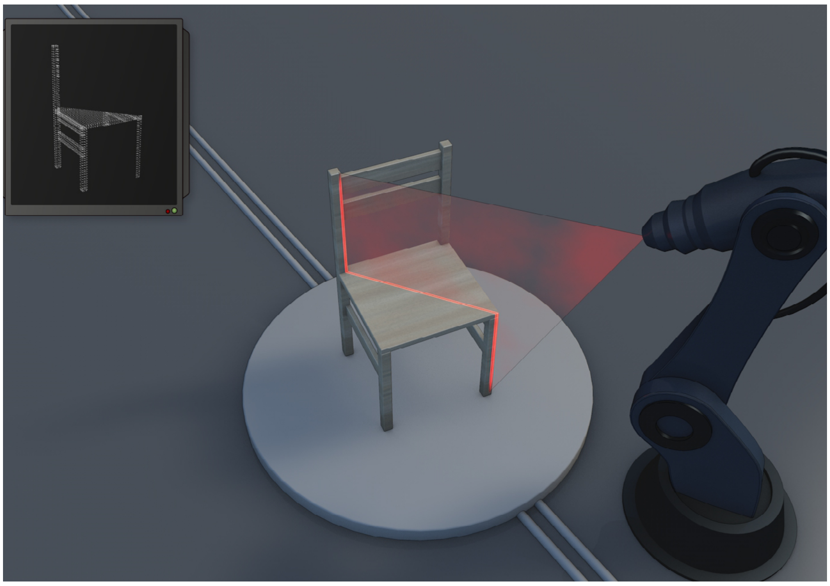

Schematic representation of the 3D scanning process, in this example for a chair.
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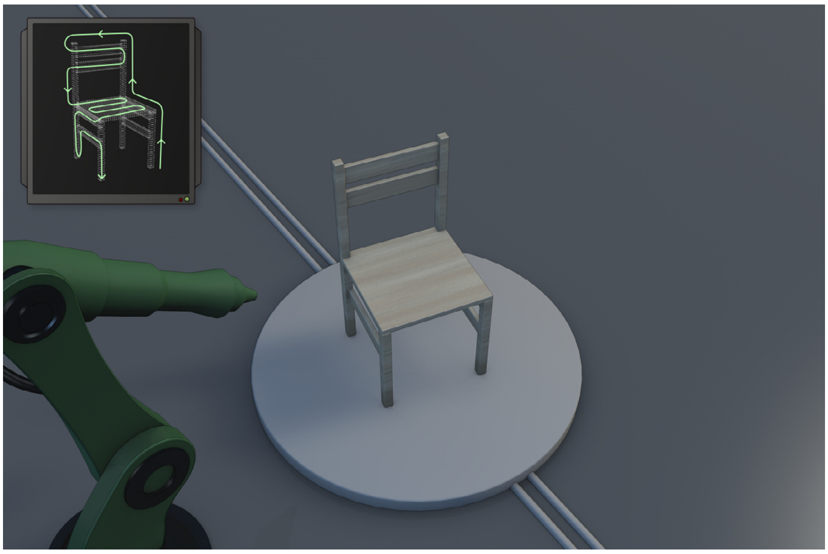

Schematic representation of the calculation process, in this example for a chair.
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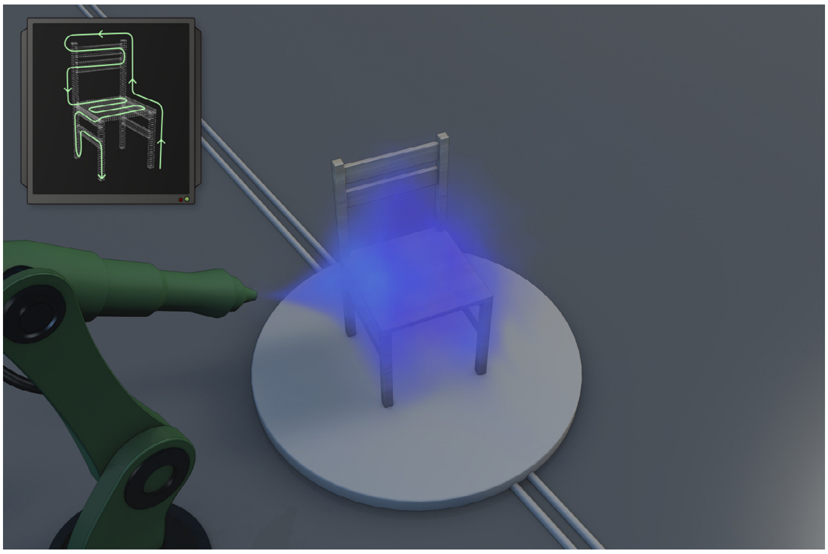

Schematic representation of the painting process, in this example for a chair.
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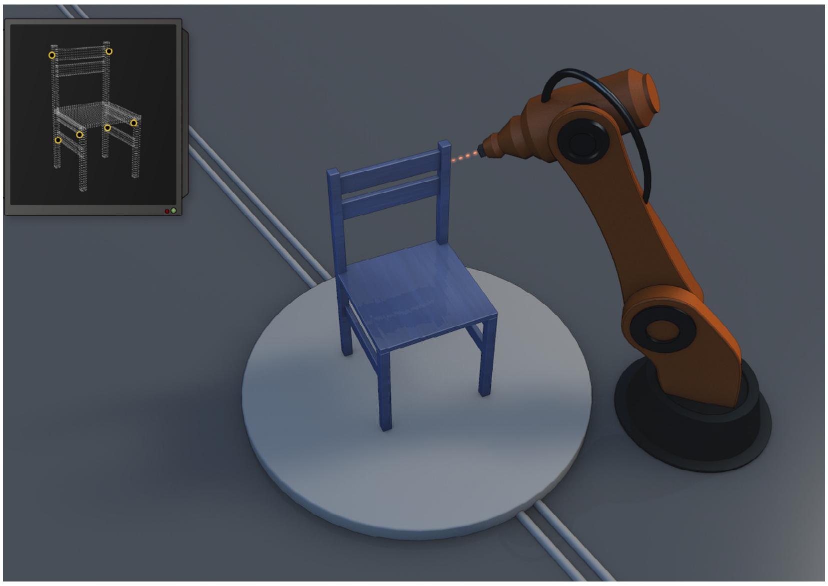

Schematic representation of the measurement process, in this example for a chair.
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