

Media Information

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BMW Group expands use of 3D-printed, customised robot grippers

+++ Fast, economical, versatile and sustainable with additive manufacturing +++ New bionic gripper at BMW Group Plant Landshut saves further weight +++ Innovative bionic gripper for entire floor assemblies at BMW Group Plant Munich +++

Munich. With more than 30 years of experience, the BMW Group is a pioneer in the field of additive manufacturing, better known as 3D printing. 3D printers have been used from as early as 1991 to produce individual vehicle parts and components, initially for concept cars, prototypes and race cars, then later for production models. The BMW Group now also manufactures many work aids and tools for its own production system in various 3D printing processes. From tailor-made orthoses for employees, and teaching and production aids, to large, weight-optimised robot grippers, used for such things as CFRP roofs and entire floor assemblies. At the "Additive Manufacturing Campus" in Oberschleißheim, the BMW Group's central hub for production, research and training in 3D printing, more than 300,000 parts were "printed" in 2023. Furthermore, over 100,000 printed parts were produced per year across all the plants that form the global production network, from Spartanburg and the German plants to sites in Asia.

"The increasing use of additive manufacturing in the BMW Group production system has many benefits. For example, we are able to quickly, economically, flexibly and sustainably produce our own production aids and handling robots, which we can individually adapt to specific requirements at any time, as well as being able to optimise their weight. Less weight allows higher speeds on the production line, shorter cycle times and reduced costs. Plus, smaller robots can be used in the medium term, which also cuts CO₂ emissions and costs," says Jens Ertel, Head of BMW Additive Manufacturing.

"As well as the direct additive manufacturing procedure, the BMW Group has also been using sand-based 3D printing to create moulds for many years at its site in Landshut. This technology is typically used to manufacture prototype casts, as well as for the large-scale production of components for high-performance motors. Another very attractive field of application is now that of large production aids," says Klaus Sammer, Head of Product and Process Planning for Light Metal Casting.

Printed moulds for aluminium cylinder heads in large-scale production

Additive manufacturing processes have been used on a daily basis for a long time at BMW Group Plant Landshut. For many years, these have included moulds for the manufacturing of aluminium cylinder heads, which are printed three-dimensionally using the sand casting process. Here, sand is repeatedly applied in thin layers and stuck together using binders. This makes it possible to create moulds for the manufacturing of very complex structures, which are then filled with liquefied aluminium.

Using 3D printing to manufacture large robot grippers for CFRP roofs

For a number of years, the BMW Group's Lightweight Construction and Technology Centre in Landshut has been using a particularly large gripper element, which was made using the 3D printing process. Weighing around 120 kilograms, the gripper for a robot can be manufactured in just 22 hours and is then used on a press in the production of all CFRP roofs for BMW M GmbH models. The press is first loaded with the CFRP raw material. The gripper is simply rotated 180 degrees to remove the finished roofs. Compared to conventional grippers, the version manufactured using 3D printing was roughly 20 percent lighter, which in turn extended the operating life of the robots and also reduced wear and tear on the system, as well as cutting maintenance intervals. The combined use for two steps also reduced the cycle time. A unique feature of the robot gripper is the ideal combination of two different 3D printing processes. While the vacuum grippers and the clamps for the needle gripper to lift the CFRP raw material are made using selective laser sintering (SLS), the large roof shell and bearing structure are manufactured using large scale printing (LSP). LSP can be used to produce large components economically and sustainably. The process uses injection moulding granules and recycled plastics, while CFRP residual material can also be used and recycled. Compared to the use of primary raw materials, CO₂ emissions when manufacturing the gripper are roughly 60 percent lower.

Further weight savings, courtesy of new generation of bionic grippers

In the summer of 2023, a new, even lighter generation of gripper was introduced. To achieve this, the previous gripper concept was analysed and optimised topologically – the birth of the bionic robot gripper. This combines the roof shell from the LSP printer with SLS vacuums and a bionically optimised bearing structure. For this, a mould with printed cores is used in the sand casting. This mould is then cast with the intricate aluminium structure. The new gripper is a further 25 percent lighter than its predecessor, meaning

the entire process of manufacturing a CFRP roof of the BMW M3 can be performed with just one robot, rather than three as was previously the case. Nowadays, double grippers manufactured individually within the BMW Group, courtesy of 3D printing, are used for all CFRP roofs at BMW Group Plant Landshut.

New 3D-printed gripper also used in chassis construction

The BMW Group also employs grippers produced using the 3D printing process in chassis construction – for example, grippers printed with the LSP process for dealing with doors at BMW Group Plant Regensburg. "With an optimised bearing structure produced using 3D printing, we were able to increase the rigidity of the gripper when handling door elements at the plant in Regensburg, while at the same time reducing weight. In subsequent projects, it is then possible to use robots with a low bearing capacity, which helps to cut costs," says Florian Riebel, Head of Door and Flap Production in Regensburg.

However, the company is now taking it one step further at BMW Group Plant Munich. As of recently, the first examples of a bionic robot gripper have been used at the parent plant. This gripper can hold and move the entire floor assembly of a BMW i4. For the floor assembly gripper, 3D printing is used to create a sand casting mould, which is filled with liquid aluminium. The bearer is optimised in terms of weight and maximum load capacity, and weighs with all additional add-on elements a mere 110 kilograms. That makes it roughly 30 percent lighter than the previous, conventional model. Manufacturing using sand casting and aluminium makes it possible to represent intricate load-optimised structures. This results in maximum weight reduction and thus makes it possible in the medium term to use smaller and lighter heavy-duty lifting robots, which require less energy and thus reduce CO₂ emissions. Markus Lehmann, Head of Plant Engineering and Robotics at BMW Group Plant Munich: "At the Munich plant, we are continuously expanding the use of production aids created through additive manufacturing. When it comes to the field of gripper and handling systems, we use 3D printing to equip our established grippers with individual, printed attachments and are already replacing complete gripper systems with highly-integrated and weight-optimised bearing structures. When handling the full BMW i4 floor assembly, this allowed us to reduce the weight of the complete gripper by 30 percent – 50 kg – and thus to extend the service life of our facilities."

Use of innovative software solutions in additive manufacturing

Intricate and bionic structures are designed and calculated using special generic software tools, such as Synera. BMW iVentures had strategically invested in this software, previously known as Elise. Synera allows fast and efficient optimisation and is now used in many development areas within the BMW Group. It is particularly worth using the software in 3D printing, as topologically optimised, bionic structures can virtually be printed one to one, thanks to the high degree of flexibility of the 3D printing process. This makes it possible to exploit the full potential for lightweight construction. The BMW Group's Additive Manufacturing Campus is home to a team of design and construction specialists, who compare a diverse range of software solutions and use them to design components. The knowledge is then passed on throughout the company via the Additive Manufacturing Campus. In the case of gripper design, special workflows have been developed and implemented, which allow the calculation and construction of the bearing structure to be largely automated, and thus fast and efficient.

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The BMW Group

With its four brands BMW, MINI, Rolls-Royce and BMW Motorrad, the BMW Group is the world's leading premium manufacturer of automobiles and motorcycles and also provides premium financial and mobility services. The BMW Group production network comprises over 30 production sites worldwide; the company has a global sales network in more than 140 countries.

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Datum

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Thema

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Seite

5

In 2023, the BMW Group sold over 2.55 million passenger vehicles and more than 209,000 motorcycles worldwide. The profit before tax in the financial year 2023 was € 17.1 billion on revenues amounting to € 155.5 billion. As of 31 December 2023, the BMW Group had a workforce of 154,950 employees.

The success of the BMW Group has always been based on long-term thinking and responsible action. The company set the course for the future at an early stage and consistently makes sustainability and efficient resource management central to its strategic direction, from the supply chain through production to the end of the use phase of all products.

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