Press Release

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ROBOTS LEARN TO HANDLE FABRICS AND FILMS

As a matter of fact, a great deal of manual labour is still required in the textile industry. At TU Wien, methods and technologies are being developed in cooperation with the AIT Austrian Institute of Technology that enable robots to handle soft, malleable materials.

How do you glue a soft piece of plastic onto a shoe, so that it does not wrinkle and adapts to the shape of the shoe and bonds with it? How can you drape textiles tightly onto surfaces without wrinkles and then sew or glue them, for example? Everyone knows that this is easily feasible for humans with a lot of practice and dexterity. For robots, these tasks are still difficult to solve. Therefore, wherever soft, deformable materials (e.g. leather, fabrics, foils, technical textiles) are used in industry, a lot of manual work is still necessary. The TU Vienna and the AIT Austrian Institute of Technology are working together on these issues. The partners have achieved first successes with selected demonstrators.

Wrinkle-free draping or gluing

"The problem is known from different areas of industry," says Prof. Andreas Kugi, head of the Institute for Automation and Control at TU Wien and head of the Centre for Vision, Automation and Control at AIT. "In the shoe and textile industries, you have to deal with materials that deform due to gravity alone. This makes the processing extremely difficult. It also plays an important role in the automotive industry, for example in the production of leather or textile interiors, such as a dashboard."

The challenge from an automation point of view is to master the multitude of different tasks: Depending on the size and shape of the objects or components, the robot movements have to be constantly adjusted. The forces that have to be exerted at any given time depend on small, geometric details of the task. There is no simple basic principle with which a robot can master many different situations in a satisfactory way.

"We humans are tremendously flexible - we effortlessly coordinate our vision with our dexterity, we can adapt to different materials, shapes and structures. To teach something similar to a machine poses a great challenge," says Andreas Kugi.

This is made possible by sophisticated algorithms developed by the teams at the Vienna University of Technology and the AIT Austrian Institute of Technology: The work steps are precisely planned in advance - it is not only calculated at which points the contact between the robot and the workpiece should take place, but also in which direction and with what amount of force. At the same time, it is calculated in advance how the shape of the material used will change in the process.

"Our method is extremely flexible," says Dr Christian Hartl-Nesic from the Institute of Automation and Control Engineering. "We demonstrated the method we developed by automatically gluing long (curved) strips to a complex 3D object with different curvatures - a rabbit - in exactly predetermined places, without any wrinkles. But you could use the same algorithms and methods for completely different applications, such as letting the robot make precisely predetermined cuts on three-dimensional surfaces, or applying a sprayed layer of material to a curved 3D object that has exactly the right thickness at each location."

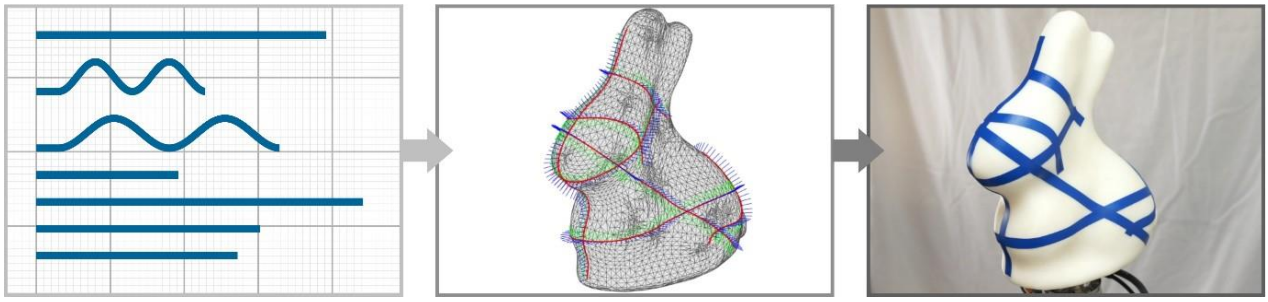

Figure 1: Automated application of adhesive strips on a 3D object. © Christian Hartl-Nesic

Machines cannot perform all tasks entirely on their own: The groups at the Vienna University of Technology and the AIT Austrian Institute of Technology also developed methods with which humans and machines can work together better. Humans can guide the machine in a targeted manner and the machine learns the correct behaviour. "In so doing, automation can also become useful for small series, where previously it would not have been worth adapting the machines specifically due to the large amount of programming required," says Dr Tobias Glück, head of the Complex Dynamical Systems research group at AIT. To achieve this, it is necessary to develop advanced methods of environment recognition, automated planning as well as gripping technologies and to combine them synergistically for the specific requirements.

Figure 2: Cooperation between man and machine when applying an adhesive strip. © Stefan Flixeder

The work is also very well received in the international scientific community, as confirmed by the Mechatronics Paper Prize Award 2020 for a paper in the journal Mechatronics in 2018 and the recent publication in the IEEE Transactions on Robotics. "Through the close cooperation between TU Wien and AIT, we try to bring the results of basic research to the market very quickly and to develop effective solutions for industrial practice. The work at TU Wien focuses very strongly on the area of basic research-oriented method development and at AIT we systematically try to increase the maturity of the technologies developed," explains Andreas Kugi. "Production technology and the use of flexible, adaptive and adaptive robotic systems will continue to develop over the next few years and in some cases change massively," he is convinced. "We should consider this as an opportunity and actively shape the development."

Further information and links Videos:
Cooperation between man and machine in the application of an adhesive strip:
https://www.acin.tuwien.ac.at/8a25/
The glued rabbit:
https://www.acin.tuwien.ac.at/52f5/

Journalbeiträge:
https://doi.org/10.1016/j.mechatronics.2016.10.003
https://doi.org/10.1109/TRO.2020.3033721

Mechatronics Paper Prize Award 2020:
https://www.ifac-control.org/awards/journal-awards

Research institutions:
AIT Center for Vision, Automation & Control:
https://www.ait.ac.at/ueber-das-ait/center/center-for-vision-automation-control/

Automation and Control Institute (ACIN) / TU Vienna:
https://www.acin.tuwien.ac.at/en/

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