The RoboShield Demonstrator
Techniques for Safe and Efficient Human-robot Collaboration

The cooperation between humans and robots, also referred to as Human-Robot Collaboration (HRC), will significantly shape automation technology in the future. Human intelligence and flexibility will remain irreplaceable, but robots can effectively support humans when work requires great power and precision or is ergonomically stressful. Besides, HRC workplaces are more versatile than classical fully automated production lines. They are therefore particularly attractive for the production of small lot sizes and individualized products. An essential challenge is to ensure human safety without overly restricting robot movement. At our demonstration plant, we show a series of measures that make collaboration more flexible and efficient without safety losses. They contribute to realizing the full potential of HRC for companies.

Stepless Speed Scaling

In practice, safety is often ensured through static protection zones: If the sensors detect that a predefined zone has been entered, the robot speed is reduced stepwise or the robot stops. Static zones are no longer used in our system. Instead, the human position is continuously monitored and...
Complementary Software Tools

Besides the demonstrated techniques, we also develop complementary software tools, which support the design of safe HRC applications. Specifically, our research comprises an automated placement of safety sensors and the identification of possible hazardous situations with the help of machine learning.

Intelligent Process Planning

As long as humans and robots share a workspace without the need for physical contact, the robot plans its steps in such a way that it prefers working in areas that are averted from the current position of the human. Continuous velocity scaling enables the robot to move faster; it works more efficiently, and the throughput of the system hence is increased on the whole.

Inspection Mode

If desired, the robot switches to an operating mode that allows physical contact. The human can then guide the robot by hand, for example to position the workpiece for inspection purposes. To prevent unauthorized intervention, the inspection mode is authorized by facial recognition.

Posture Recognition

Safety laser scanners, which are typically used for the detection of people, work safely and reliably, but are limited to two-dimensional localization. To overcome this restriction, our arrangement is supplemented by a camera-based solution to allow for three-dimensional localization. By utilizing such a setup, we are able to detect upper body and arm movements that are imperceptible for the laser scanner. Since camera-based approaches suffer from problems like occlusion, our system estimates the confidence in each detection of a body part, allowing to decide how much the detected pose can be trusted.

Skeleton model of posture recognition.

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