

EXPERTISE

The Fraunhofer IFF offers a wide range of services related to safe manipulators for human-robot interaction. In addition to developing contracted safe manipulators, we also provide you consulting or deliver comprehensive risk assessments of your robots or your specific robot application scenario, factoring in the relevant standards.

Contract Development

We are your partner for the development of new and safe manipulators. You profit from our long-standing expertise in development and wide-ranging technical know-how about requirements of and solutions for safe human-robot interaction.

Risk Assessment

We have extensive and unique equipment that measures and analyzes collisions. Among other things, it enables us to measure and document collision forces and velocities and pressure distributions for a wide variety of situations and machine constellations. Keeping the use scenario in mind, we prepare a risk assessment of your manipulator or mobile platforms in compliance with guidelines from standards.

Consulting

We will provide you support when you are engineering safe manipulators. Take advantage of our experience and expertise.

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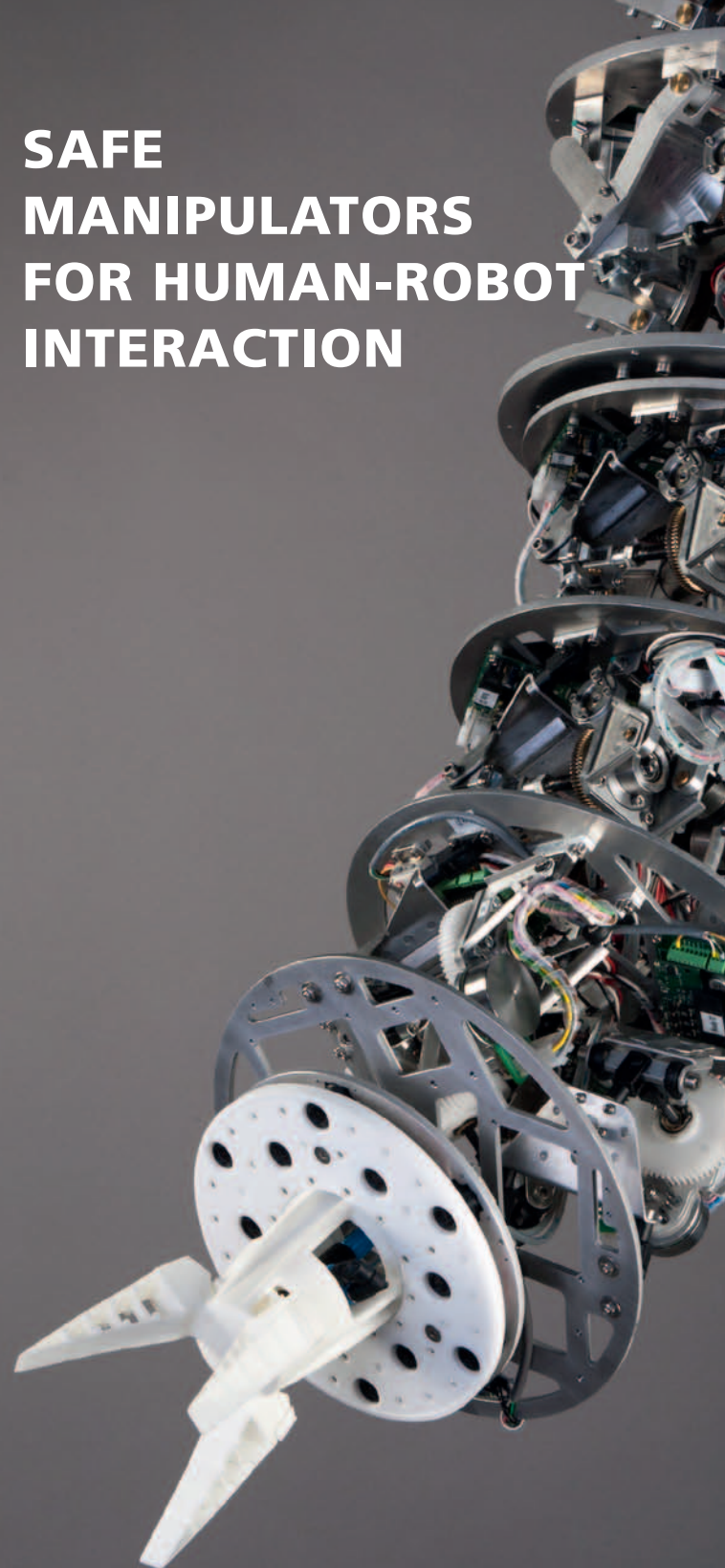
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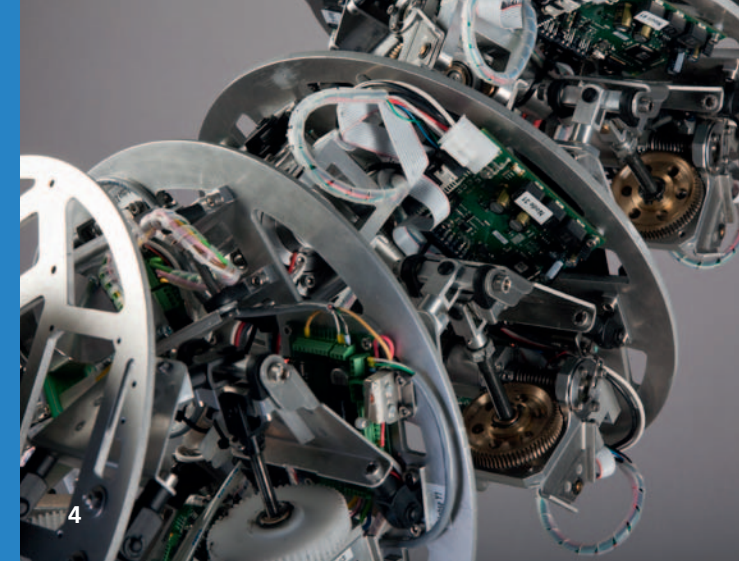
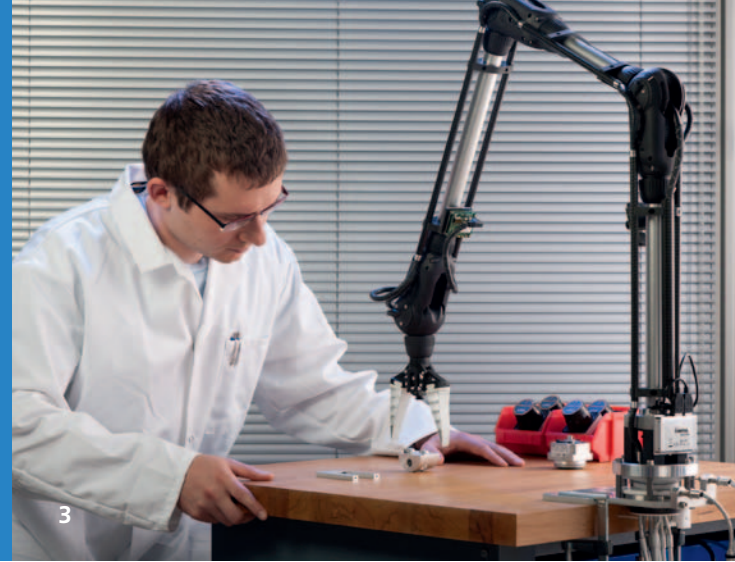
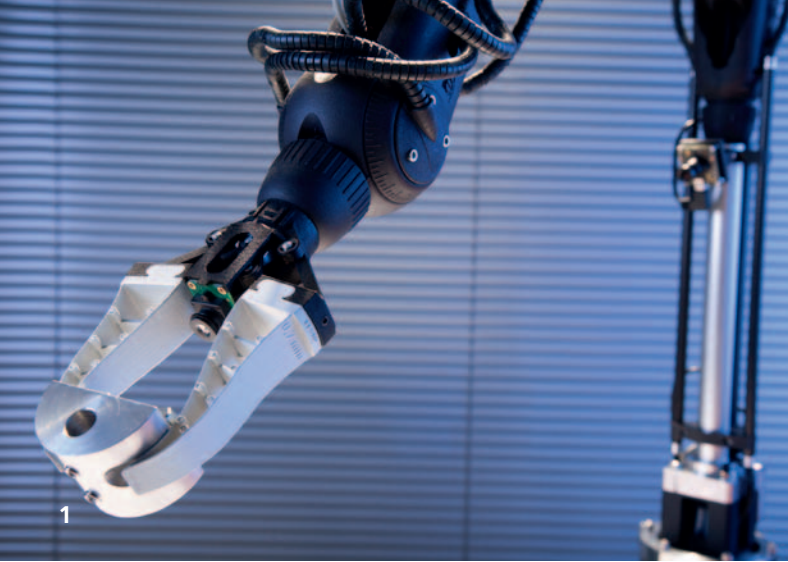
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SAFE MANIPULATORS FOR HUMAN-ROBOT INTERACTION





ADVANCING SAFE HUMAN-ROBOT INTERACTION

Industrial robots normally consist of high-performance joints joined by rigid coupling elements into a complete manipulator. In principle, such structures harbor a high risk of injury for humans, the moment they are in a robot's area of movement. Typical hazards are:

- pinch and shear points,
- opposing movements and
- large masses moving at high relative velocities.

In its "Safe Human-Robot Interaction" research field, the Fraunhofer IFF is developing, among other things, safe manipulators that entail a low or permissible risk of injury at the most. The following methods and design paradigms are referenced and pursued selectively during development:

- lightweight designs,
- controlled force actuators and
- new manipulator concepts.

The Fraunhofer IFF additionally has extensive and unique equipment that measures safety variables such as collision forces. We use it especially to test and evaluate manipulators or workplaces with human-robot interaction for potential hazards.

LIGHTWEIGHT DESIGNS

We use lightweight manipulators mainly on designs made of lightweight material such as plastics. The low weights and inertias of moving robot parts not only improve the energy footprint but also reduce potential hazards.

ALEXA: An Extremely Light Robotic Arm

In the ALEXA experiment, the Fraunhofer IFF developed a novel and extremely light robot for flexible pick-and-place tasks together with igus®. Stable and extremely light plastic robolink joints developed by igus® were used to lessen the robotic arm's weight. robolink joints are actuated by antagonistic pairs of draw-wires. The actual motors are mounted in a separate drive module rather than the robotic arm. This additionally minimizes a robot's weight.

The ALEXA robot's extremely low weight and input corresponding to its operating points constitute a new concept for a safe manipulator usable for applications with direct human-robot interaction. The ALEXA experiment is being supported as part of the ECHORD project.

CONTROLLED FORCE ACTUATORS

Robot joints' power reserves significantly influence the severity of any injury a human sustains from a robot. The Fraunhofer IFF has therefore designed a wire joint actuator with an adjustable force limiter. The technology developed is based on simple laws of friction. It is purely mechanical and allows fully adjustable limiting of momentum and torque.

NEW MANIPULATOR AND KINEMATICS CONCEPTS

The most frequently used robots have up to seven joints connected by rigid coupling elements in a kinematic chain. In principle, this classic structure is extremely hazardous for humans. Pinch and shear points around a joint, opposing movements or strong reaction forces in singular configurations are among the greatest hazards.

BROMMI: Bionic Arm Kinematics for Safe Robotic Applications in Human-Machine Interaction

In the BROMMI project, a robotic arm was developed, which is modeled after an elephant's trunk. A novel manipulator is being produced, which is extremely flexible and safe because of the concept. In keeping with its biological model, it does not have any pinch or shear points like articulated arm robots. Furthermore, its trunk-like movements are safer. Instead of opposing movements at high relative speeds, direct and plausible movements are dominant in a trunk. Its construction enables the BROMMI robotic arm to handle objects with pinpoint accuracy. Its modular design is modifiable for different loads and workplaces.

- 1 *A camera in the ALEXA gripper for good positioning accuracy*
- 2 *The ALEXA manipulator in operation*
- 3 *Safe interaction through lightweight design*
- 4 *BROMMI manipulator drives*