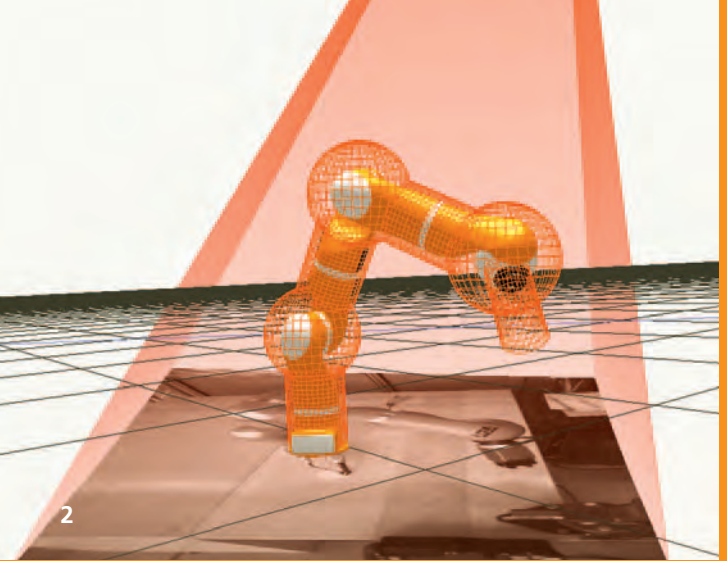

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FRAUNHOFER INSTITUTE FOR FACTORY
OPERATION AND AUTOMATION IFF, MAGDEBURG

SAFETY FOR COLLABORATION BETWEEN HUMANS AND ROBOTS

The vision of humans and machines collaborating in shared workplaces will be reality in the near future.

Shared workplaces where barriers still separate humans and, for example, robots from one another will soon be monitored by sensor systems combined with planning tools. Whenever humans enter danger zones, the systems will protect them, for instance by reducing a robot's operating speed or bringing it to a full stop.

Outside the industrial sector, optical workplace monitoring systems will certainly be needed in a wide variety of other domains in the future and provide the basis for new robot applications. Not only the active safety functions but also other aspects such as ergonomic interaction with humans (soft safety) will be important because they indicate critical restricted areas simply by transmitting signals.

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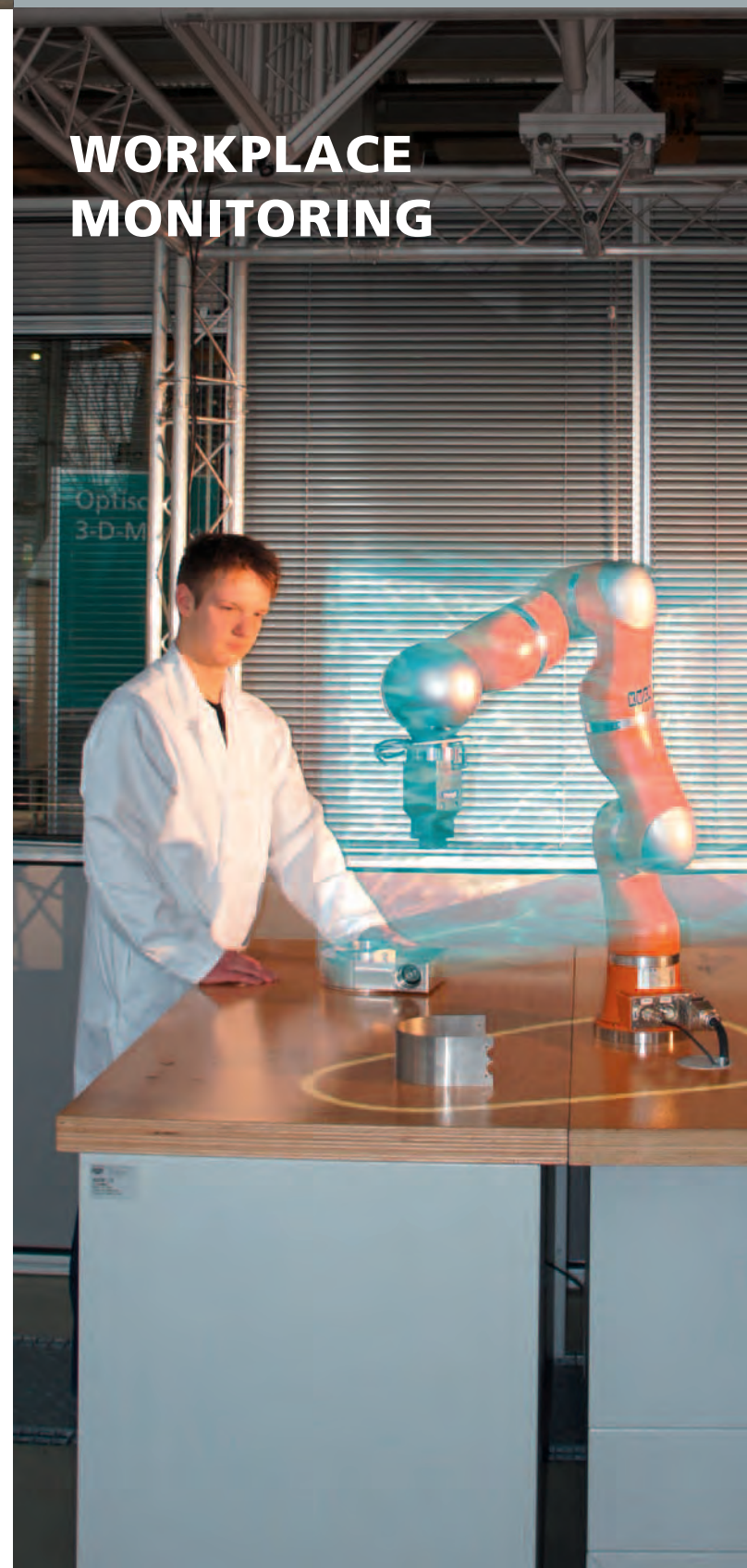
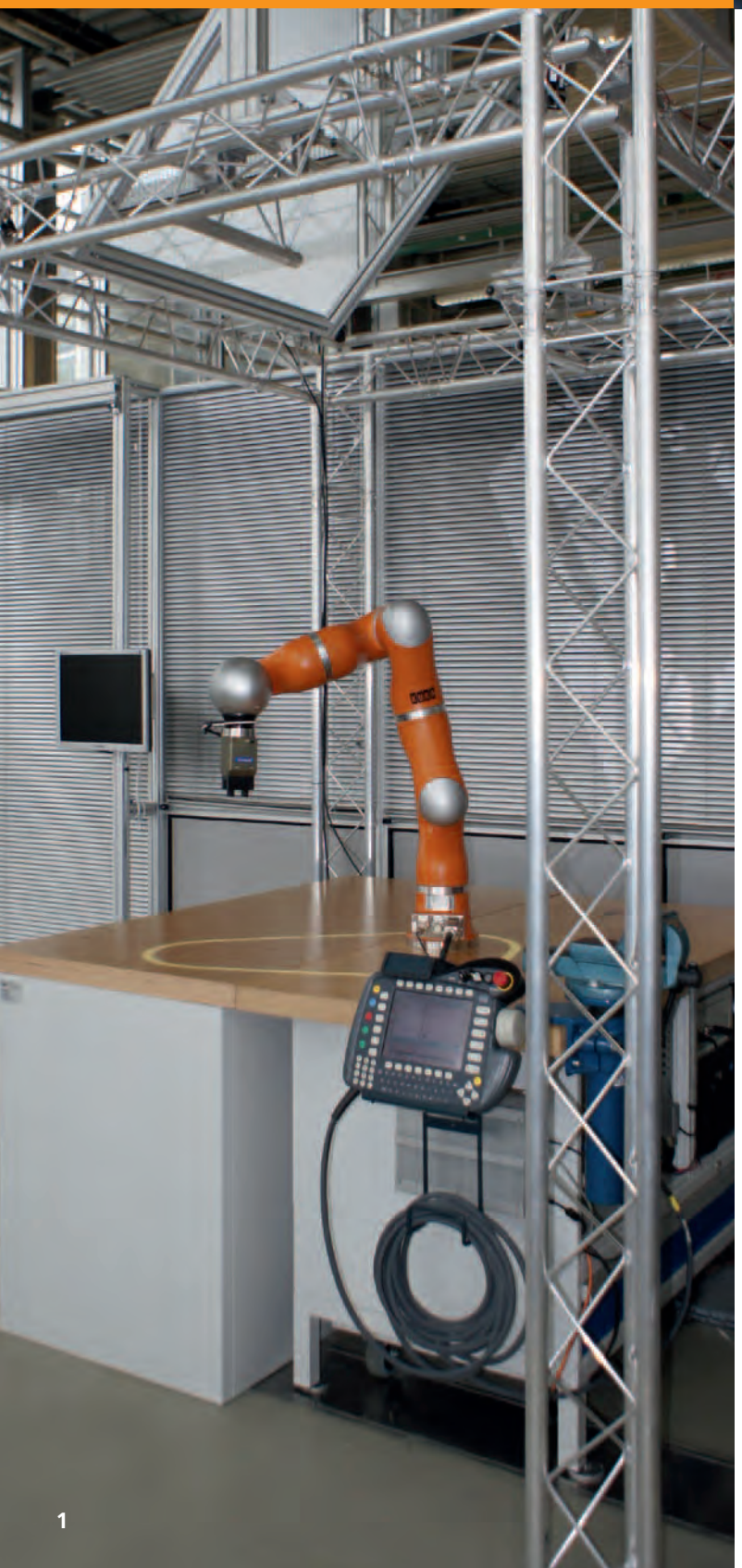
Photos: Fraunhofer IFF; 5 Viktoria Kühne

WORKPLACE MONITORING





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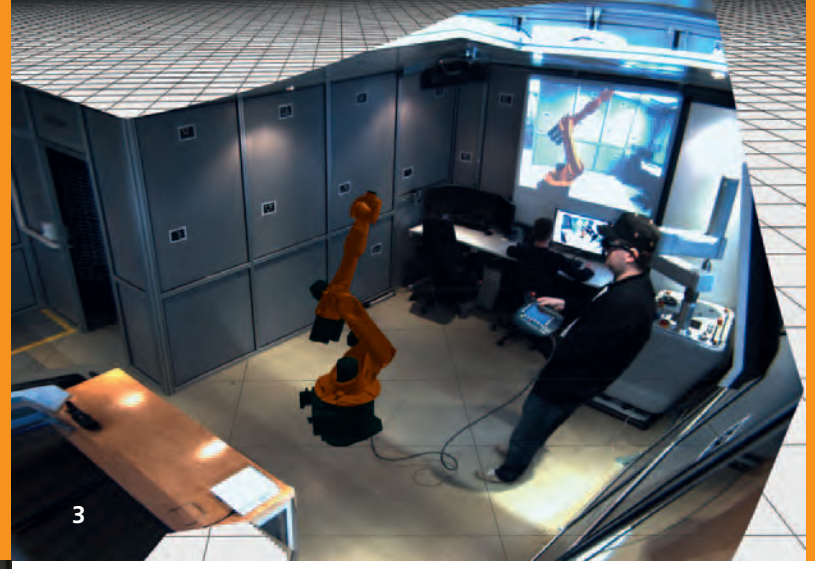

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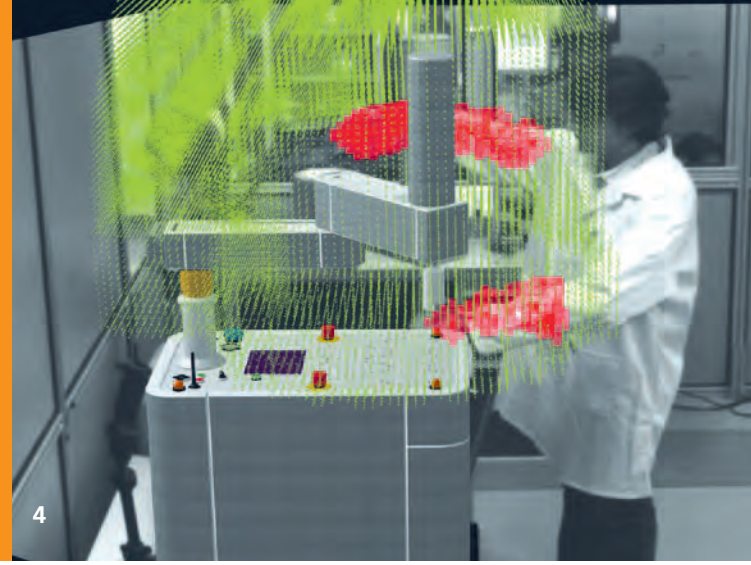

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PROJECTION AND CAMERA-BASED OPTICAL WORKPLACE MONITORING SYSTEMS

Improving the compatibility of humans and machines or robots is being worked on intensively in order to boost efficiency in manufacturing. Flexible and dynamic production and work environments in which they work directly with one another are an important advance in this direction. The Fraunhofer IFF has developed a novel and innovative sensor system for workplace monitoring that relies on state-of-the-art projector and camera equipment. The system is extremely safe and flexible, inexpensive and independent of external light. Unlike previous optical systems it renders danger and safe zones visible to humans, thus significantly boosting transparency for users. The Fraunhofer IFF has a patent pending on the system.

Technology

The novel workplace monitoring system operates with visible light. Monitored danger zones are projected directly on the environment, e.g. the floor, thus generating an optical danger and/or safe zone. The surrounding cameras reliably detect any intrusion in the safe zone because the projection beams are disrupted. Users thus recognize both active safe zones and violations all the time. At the same time, other information, e.g. on robot condition or procedural instructions, can be blended in for users to see. Rapid deterministic evaluation algorithms that detect violations of safe zones allow response times that downright predestine this technology for time-critical applications in combination with robots or other machines.

PLANNING AND ANALYZING HUMAN-ROBOT WORKPLACES

Safety in human-robot workplaces by new (sensor) technologies necessitates suitable simulation and analysis tools for the planning stage. The development of special tools for designing and verifying workplaces is another one of the Fraunhofer IFF's research specializations. Virtual and augmented reality are used to adjust workplace situations easily by combining real and computer generated objects. This makes concrete safe movement and safe zones visible and analyzable.

OPTIMIZED, DYNAMICALLY PLANNED SAFE ZONES

In addition to researching new methods and technologies that detect objects, e.g. people in a robot's workplace, strategies are needed, which facilitate optimal planning of safety-critical zones as a function of current or impending robot motions. Unlike firmly specified restricted areas, only such dynamic safe zones allow efficient use of existing workplaces and optimized process engineering.

The automatic planning procedures developed for safe and danger zones depend not only on a robot's location and its next concrete operation but also on the capabilities and constraints of the sensor systems used for safety and potential foreground clutter.