



# Working on your Visions

DLR

## New Compliant Manufacturing Assistant



### Motivation

Today's industrial robots are position-controlled handling devices that can precisely follow a defined trajectory in space. Therefore, many production processes that rely on robots for automation require a high level of accuracy in the feeding and positioning of objects. A few applications, such as fitting assembling bolts, can hardly be attained without use of external sensors if a position-controlled robot is used.

### Controllable compliance

In contrast to today's industrial robots, the human can manipulate objects through the direct control of both the compliance (stiffness) and the position of his arm. In this way he can perform dexterous manipulation tasks. The underlying design principles and concepts from nature were taken as stimulation for the design of light-weight robot arms in the German Aerospace Center (DLR), Institute for Robotics and Mechatronics, headed by Prof. Dr.-Ing. Gerd Hirzinger. Due to a holistic mechatronic approach all control, power, and signal electronics and all cabling were successfully integrated into the arm. The motors, gears, and structure elements were optimized to the edge of today's technical reaches with respect to their weight and performance characteristics. Each of the robot's joints is equipped with a motor position sensor and sensors for joint position and torque. Thus, the robot can be position-, velocity- or torque-controlled, and it operates vibration-free and highly dynamic. The compliance can be arbitrarily defined, i.e., a combination of position (orientation) and force (torque) can be given for every section of the trajectory.

### Compliant Manufacturing Assistant

Through the combination of this new robot generation and the industry-proven PC-based KUKA robot controller KR C, a new type of robot emerges: a manufacturing assistant (**RoboAssistant**). It has been conceived to allow people and robots to share

the same work environment. In particular, the robot reacts sensitively with a definable compliance (or impedance) on any kind of external touch-features. A new intuitive form of robotic programming naturally emerges: Programming by Demonstration (PbD). This operation mode enables even novice users to program robots. For the experienced industrial user nothing changes. He may operate and program the manufacturing assistant through the



matured and well-known KUKA control panel. In addition, he gets access to new technologies, such as compliance, impedance control, torque control, kinematic redundancy, and light-weight construction. These features paired with new intuitive programming methods open new applications and markets.

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#### Contact Persons:

Dr. Gerhard Grunwald  
Deutsches Zentrum für Luft- und Raumfahrt  
Institut für Robotik und Mechatronik  
82234 Weßling - Oberpfaffenhofen  
Phone: +49 (0)8153 28 - 2406  
E-Mail: Gerhard.Grunwald@dlr.de

Rainer Bischoff  
KUKA Controls GmbH  
Blücherstraße 144  
86165 Augsburg  
Phone: +49 (0)821 797 - 3244  
E-Mail: RainerBischoff@kuka-controls.de

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