Enabling robots to become co-workers that collaborate with humans efficiently and in safely is a major goal of current robotics research. At Bielefeld Universities CoR-Lab, researchers use learning and interaction technology for control of compliant robots such as the KUKA Lightweight Robot (LWR) to realize such human–robot interaction. Research results are continuously integrated in the showcase robotic system “FlexIRob” providing a testbed for flexible robotic co-worker and advanced human–robot collaboration scenarios.

In its current setup, FlexIRob allows to teach a redundant robot various Nullspace constraints in different areas of the workspace. Users with no particular robotics knowledge can perform this task in physical interaction with the compliant robot, for example to reconfigure of a working cell environment. After a short training phase, the learned adaptive mapping solves the inverse kinematics problem of the robot. It is embedded in the motion controller of the system, hence allowing for execution of arbitrary motions in task space, respecting the learned Nullspace constraints. This is a large step towards our vision of a flexible robotic co-worker system, because it avoids the complex manual programming that standard methods for this task have previously required.

For the FlexIRob scenario, we developed a system architecture for the control of compliant robots, in particular for the KUKA LWR, that provides a set of coherent tools for high-level simulation, programming of individual and re-use of complete learning or interaction components. Learning in this system is realized by means of the Backpropagation–Decorrelation learning method [1] developed at the CoR–Lab at Bielefeld University.

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