Technical Data:	
Arms:	KUKA LBR 7 iiwa R800 - Nominal payload: 7 kg - Total weight: 23.9 kg - Maximum reach: 800mm - Repeatability +/- 0,1mm
Grippers:	Schunk WSG 50 with customized finger tips
Tools:	Brushless screwdriver
Degrees of freedom:	2 x (7+1) +1 = 17
Software:	Distributed architecture with components implemented in Java, C/C++ , Python
Middleware:	DLR Links and nodes (LN)

DLR at a glance

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency.

DLR has approximately 8000 employees at 20 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Bremerhaven, Dresden, Goettingen, Hamburg, Jena, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Oldenburg, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

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German Aerospace Center

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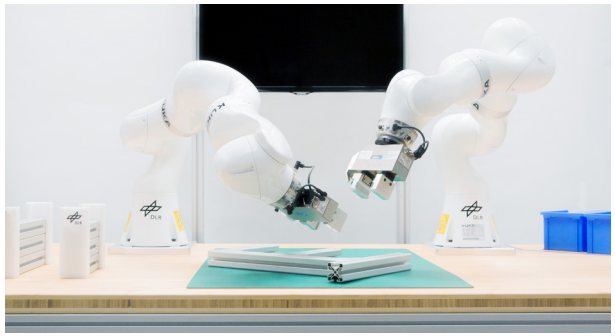
FlexibleAssemblySystem_GB_10/2018

Flexible Assembly System

DLR

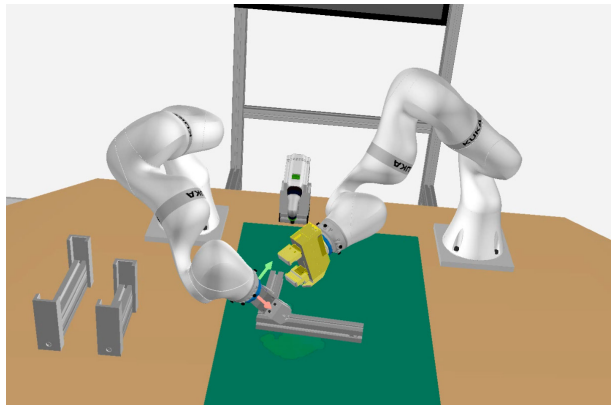
Flexible Assembly System

Mass customization of complex products and the permanent demand for a reduction of the time-to-market are recent trends that will significantly change the way how products will be manufactured in the future. Conventional automation technology, with its highly specialized and engineered solutions, is far too inert to deal with these challenges and is only affordable for large lot sizes. Autonomous and cognitive robotic systems will play a key role to achieve the required flexibility. Such systems enable the automation of the assembly of single-unit products, as well as natural interactions with the human co-worker in shared workspaces.



Bildunterschrift?

The vision demonstrated by the DLR is a robotic assembly system which can be used with less expert knowledge and engineering in order to assemble complex products and product variants. The implementation effort for the user shall be reduced significantly.



Bildunterschrift

The system relieves the user by solving planning tasks independently. In the strongest form only the desired end-product is given as an input, e.g. specified by a customer through an intuitive product configuration interface (Tablet picture). Advanced algorithms for planning and reasoning find then automatically a sequence of robotic actions to perform the entire assembly.

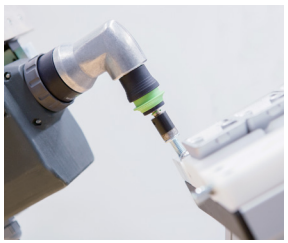
The DLR system is based on multiple planning units to solve the task planning. The flexibility and the grade of autonomy of the platform are continuously increased by contribution of various research projects. An assembly planning algorithm is used for finding appropriate assembly sequences that can be executed by our robotic system.

The integration of grasp planning and workspace analysis methods as well as a collision-free motion planner give the system a high flexibility with respect to product variants. Of major importance for future assembly systems is their adaptability to novel tasks.

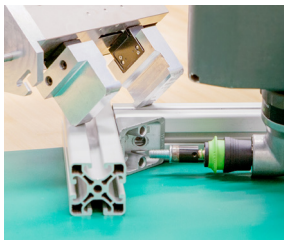
The concept of robotic skills which encapsulate capabilities of a robotic system in a reusable and parameterizable form is applied throughout the system from planning to execution.

Bildunterschrift

The features of the two KUKA LBR iiwa robots are used for a reliable execution that is robust against uncertainties in the setup. The impedance control allows adapting the stiffness of the arm and enables sensitive assembly. The measurements of the torque sensors in the joints give furthermore the possibility to track and react on the current execution state. As a consequence the requirements on the absolute accuracy in the setup can be reduced.



Bildunterschriften



Bildunterschriften

The capabilities of the assembly system are presented for a use case where aluminum profiles from a modular construction kit are combined to complex spatial structures. A major design goal of the two armed system is to reduce the number of specialized fixture and support a large product families in this way. The system can deal with combinatorial and continuous variations of products. In this particular use case the system needs to solve the subtasks of profile and bracket placement, slot nut insertion and joining connections with screws. The two robot arms collaborate in order to solve these tasks without fixtures.