Fraunhofer
IPA

FRAUNHOFER INSTITUTE FOR MANUFACTURING ENGINEERING AND AUTOMATION IPA


1 *Two-armed real and digital twin robot performing a bin picking task.*
2 *Visualization of sensor data and localized objects.*
3 *Picking chaotically stored U-bolts from a bin.*

# GRASP PLANNING –
## WE DEVELOP GRIPPING SOLUTIONS FOR ROBOTS

### Background

Handling workpieces is one of the most important tasks in industrial applications. However, the challenges are often underestimated and the almost infinite number of different workpieces usually calls for individual gripping solutions. Both design and programming are complex tasks when it comes to developing specific high-performance gripping solutions. Especially workpieces located in relatively chaotic positions cannot be grasped using static, pre-programmed gripping trajectories. Instead, object pose, gripping point and robot trajectories have to be determined and evaluated online on the basis of sensory data. The appropriate mechanical design of the gripper is fundamental to good gripping performance. For a given object, the suitability of the gripper design should first be evaluated by means of simulation, thus enabling it to be optimized before being built. Fraunhofer IPA offers a comprehensive and easy-to-use software solution that deals with all these challenges and requirements for a wide range of gripping tasks.

### Our approach

Fraunhofer IPA provides both model-based and model-free grasping solutions. The model-based grasping solution uses 3D sensor data to locate the workpieces based on a CAD model of the workpiece. As localization alone is not sufficient to grasp the object, the software also finds the optimal gripping point and a collision-free path for picking the object. The model-free solution directly estimates the optimal gripping point using 3D sensor data without localizing individual objects and calculates a collision-free trajectory online to grasp the object. Our efficient algorithms ensure that objects can be picked reliably without collision, even from difficult positions such

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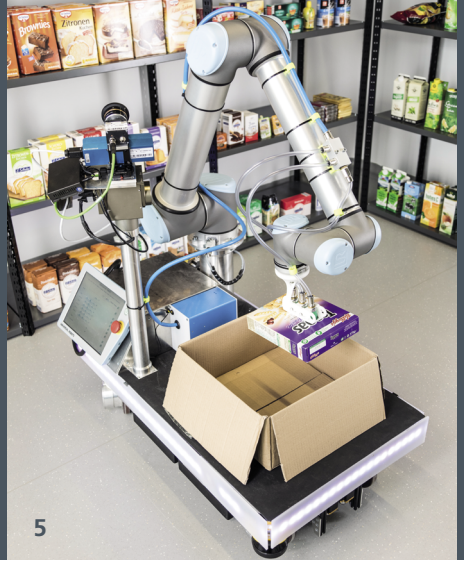
http://www.ipa.fraunhofer.de/en/intralogistics_materialflow



as the bottom of the bin, or close to the bin walls. Both solutions can be easily implemented for new parts and do not require particular expert knowledge on the side of the operator.

### Easy to use

Teaching the robot how to grasp new objects can be a time-consuming task because the user has to scan the object repeatedly and adapt object detection parameters. Our advanced machine learning algorithms make the teach-in process so efficient that the correct localization of objects is easily achieved with minimal user input. The user simply has to load a CAD model, which is then analyzed automatically to compute optimal parameters for detecting the position of the object.

### Automatic gripping point generation

For model-based grasping applications, suitable gripping points have to be predefined. These gripping points are usually defined manually via 3D visualization. Our software provides users with a comfortable and flexible solution, enabling them to generate gripping points automatically with just one click. Our efficient machine learning and computer vision algorithms generate and prioritize gripping points automatically using CAD models of the object and gripper. This additional feature makes this software easy to use by any user for all types of vacuum or mechanical grippers.

### Automatic gripper selection

In some applications, multiple different grippers or even different gripping principles are required. Instead of leaving the user to decide which gripper is best for a particular object, our software considers different object features, such as shape, weight, or surface smoothness. While generating gripping points for a workpiece, it also recommends the best gripper. It does this by analyzing the object's CAD model and different gripper models using advanced machine learning and computer vision algorithms.

### Digital twin simulation

Our software also provides an extra package in which the users have the option to simulate their robotic application and analyze any problems/shortcomings before the real system is realized. Together with our grasp planning software, the simulation also helps the user to compare different gripper designs and identify the best one for the handling application at hand.

### Our services

The software package we supply allows you to integrate the function of grasp planning into your systems easily and cost-effectively.

Furthermore, we help you with the design and initial start-up of your automated pick & place system with the following services:

- Feasibility studies for your objects in real robot cells at our test facility
- Feasibility studies for your objects via simulation
- Development of the layout of the robot cell
- Selection of suitable sensors and grippers
- Configuration and commissioning of the grasp planner
- Design and implementation of complete bin picking and handling solutions
- Training developers, commissioning staff and users
- Customer-specific modifications and extension of the grasp planning software

Fraunhofer IPA has several test set-ups of industrial robots and service robots at its disposal, as well as various state-of-the-art 3D sensors and grippers for conducting feasibility studies. This makes it possible to study both model-based and model-free grasping systems.

### Your advantages

Using our grasp planning software, your system becomes more compact and more efficient. Our grasp planning software, which has been tried and tested in industry, enables you to realize a wide range of tasks such as bin picking, kitting applications, or pick & place systems for warehouses.

4 *Picking sheet metal parts with a flexible gripper.*
5 *Order picking retail objects with a mobile platform.*
6 *Automatic generation of the gripping point for a flexible gripper.*