**Universität Stuttgart**
Institut für Baubetriebslehre
Prof. Dr.-Ing. Hans Christian Jünger

Master Thesis

# AI-Based Optimal Grasp Planning for Robotic Handling of Large Façade Panels

**Situation:**
In façade construction, the installation of large prefabricated panels is a critical task. These panels are heavy, wide, and sensitive to misalignment. Traditionally, panel handling is performed manually with cranes, which often leads to inefficiencies, safety risks, and misplacements. The AMALTEA project, a European research initiative, addresses these challenges by advancing the design, robotized manufacturing, and installation of curtain wall panels. In this context, the integration of Automation, Robotics, and Digitalization is becoming crucial to improve both performance and safety during façade installation.

**Objectives:**
This thesis aims to develop an AI-based method for optimal grasp planning of large façade panels using robotic manipulators with vacuum grippers. The research will explore:

- Development of algorithms to compute optimal grasping positions on wide panels.
- Incorporation of grasp quality metrics (e.g., stability, reachability, torque balance, and robustness).
- Robust simulation of vacuum gripper connection, including suction physics, surface contact, and force/torque distribution, which will form a core part of the thesis.
- Evaluation of grasping strategies under realistic construction constraints using NVIDIA IsaacSim.
- Improvement of vacuum gripper specifications based on simulation results and grasp evaluation.
- Master Thesis will be conducted and written in English.

**Proccedure:**

- Conduct a state-of-the-art analysis of grasp strategies relevant or closely related to large-panel manipulation and multi-suction grasping.
- Develop AI-driven algorithms to propose candidate grasp points on large panels.
- Model the vacuum gripper system in simulation, including suction physics, contact mechanics, and force distribution.
- Implement and evaluate the proposed grasping strategies in a digital environment (Isaac Sim) using the modeled vacuum system.
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**Requirements:**

- Currently enrolled in a Master's program in Mechanical Engineering, Computer Science, Robotics, Electrical Engineering, or a related technical field
- Strong programming skills in Python and preferably C++
- Experience with ROS/ROS2 and familiarity with NVIDIA IsaacSim
- Familiarity with Git for version control and Docker
- Hands-on experience with modern AI frameworks (e.g., PyTorch, TensorFlow)
- Solid understanding of robot kinematics, dynamics, and sensors
- Experience with CAD software (e.g. Inventor, SolidWorks)
- Fluent in English

**Preferred**:

- Experience with vacuum systems

**Processing time:** 6 months
**Planned start:** by arrangement
**Supervisor: Jun.-Prof. Dr.-Ing. Kepa Iturralde**
**Application deadline: Oct. 20, 2025**

If you are interested, please contact the supervisor for more information. You can find the contact details on the institute's homepage. Please submit your application using the application form available on our homepage under the heading "Thesis" section. There you will also find further information on the application process.

Prof. Dr.-Ing. Hans Christian Jünger
Institutsleiter