Building a Modular Robot

User-Interface

Leonardo Lerchenfeld & Emanuel Buchholz

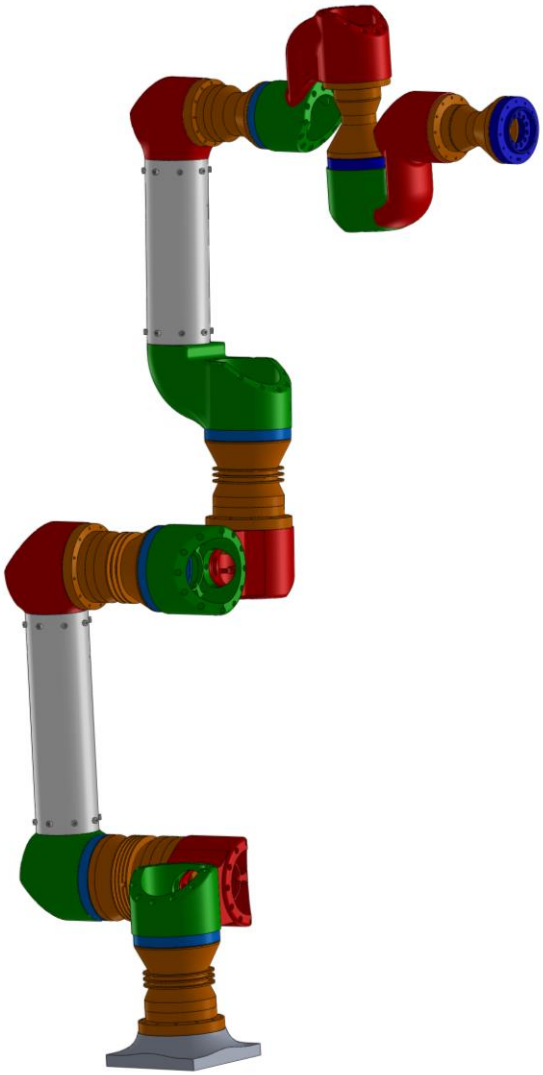
Motivation

Situation:

- Flexible productions
- Small companies
- Use without expert knowledge

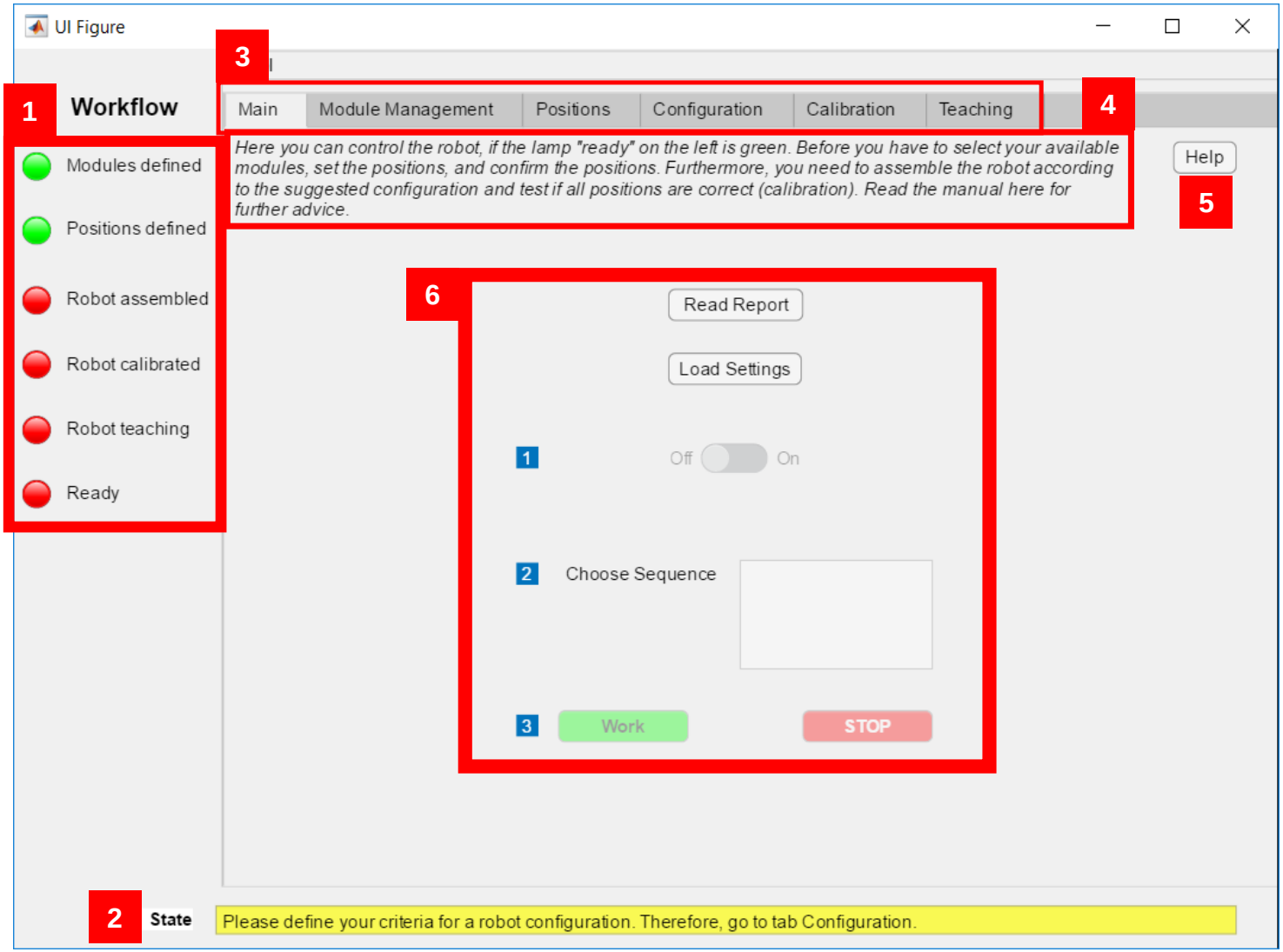
Interface:

- Structured
- Clear
- Intuitive

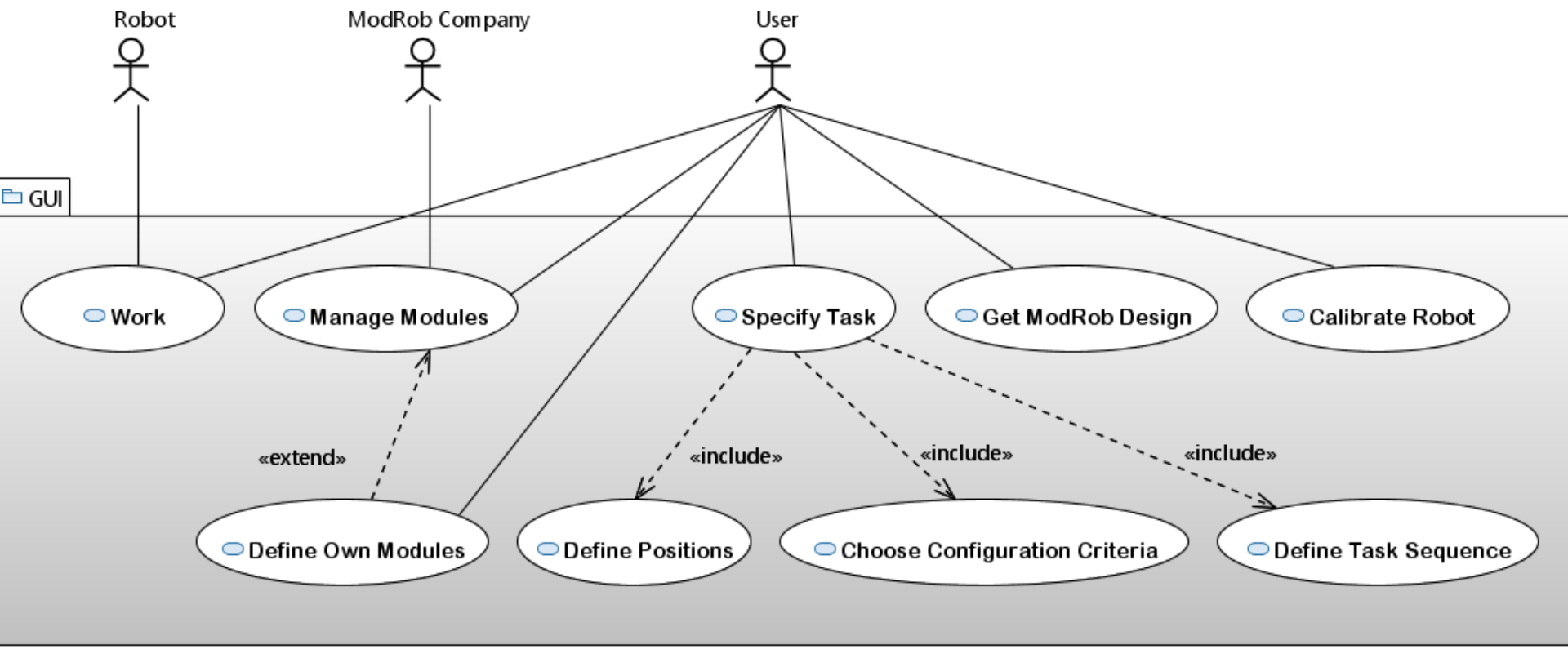


Contents

General Design

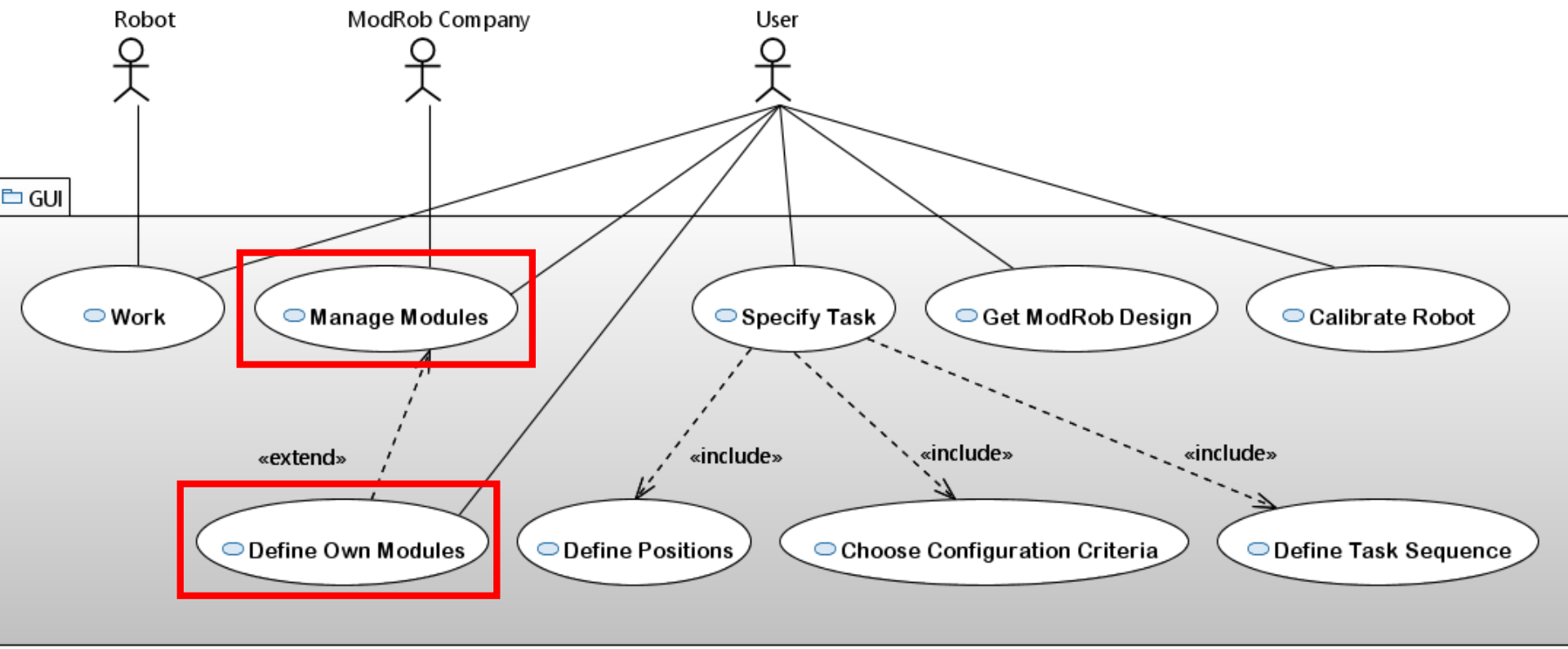


Use-Cases


Robot
ModRob Company
User
GUI
Work
Manage Modules
Specify Task
Get ModRob Design
Calibrate Robot
«extend»
«include»
«include»
«include»
Define Own Modules
Define Positions
Choose Configuration Criteria
Define Task Sequence

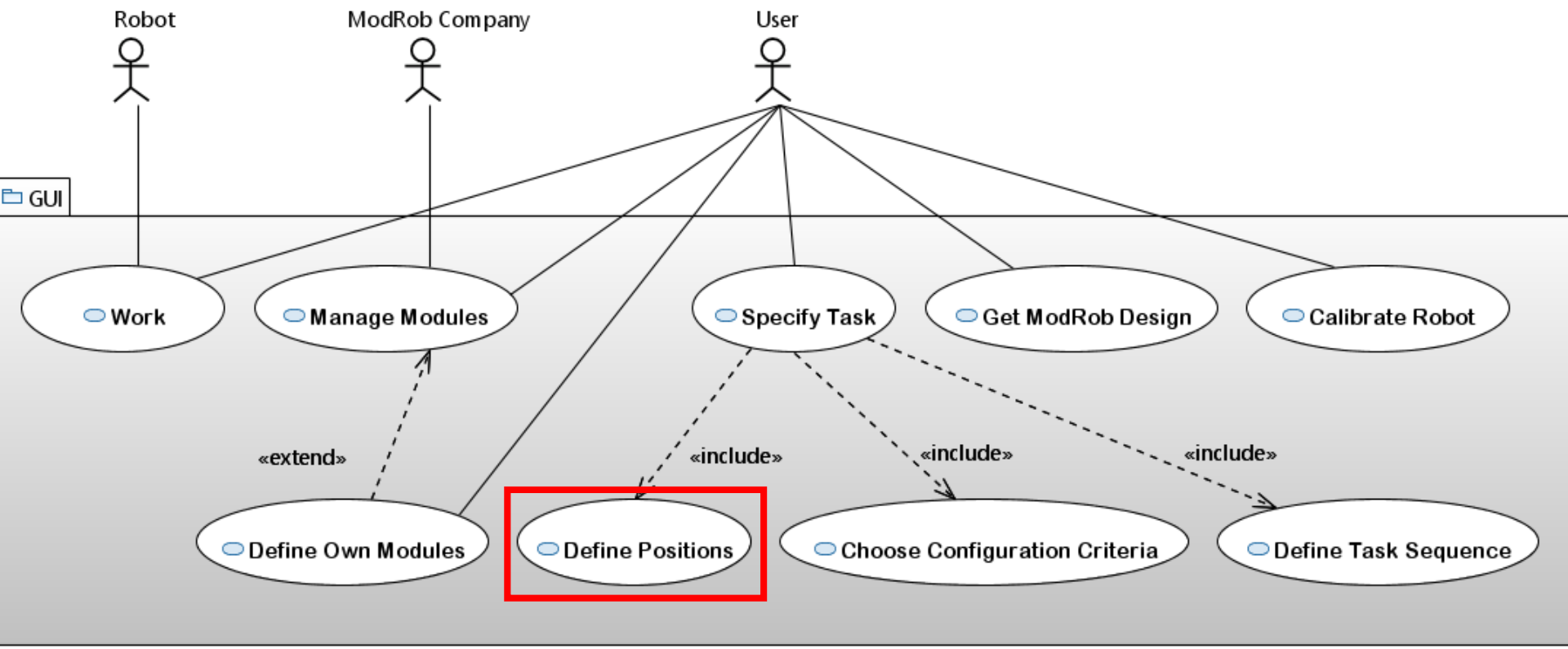
Use-Cases

Main	**Module Management**	Positions	Configuration	Calibration	Teaching



Use-Cases

Main	Module Management	**Positions**	Configuration	Calibration	Teaching



Use-Cases

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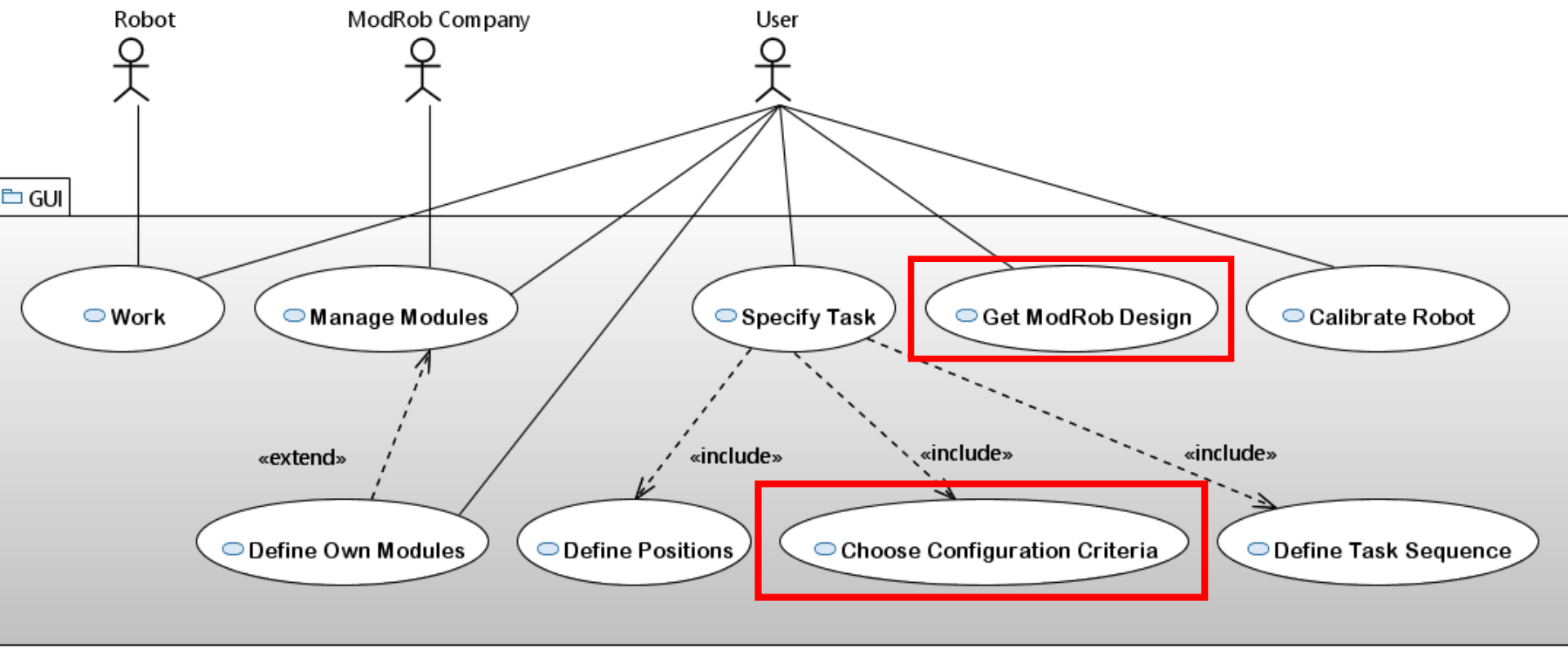

Use-Cases

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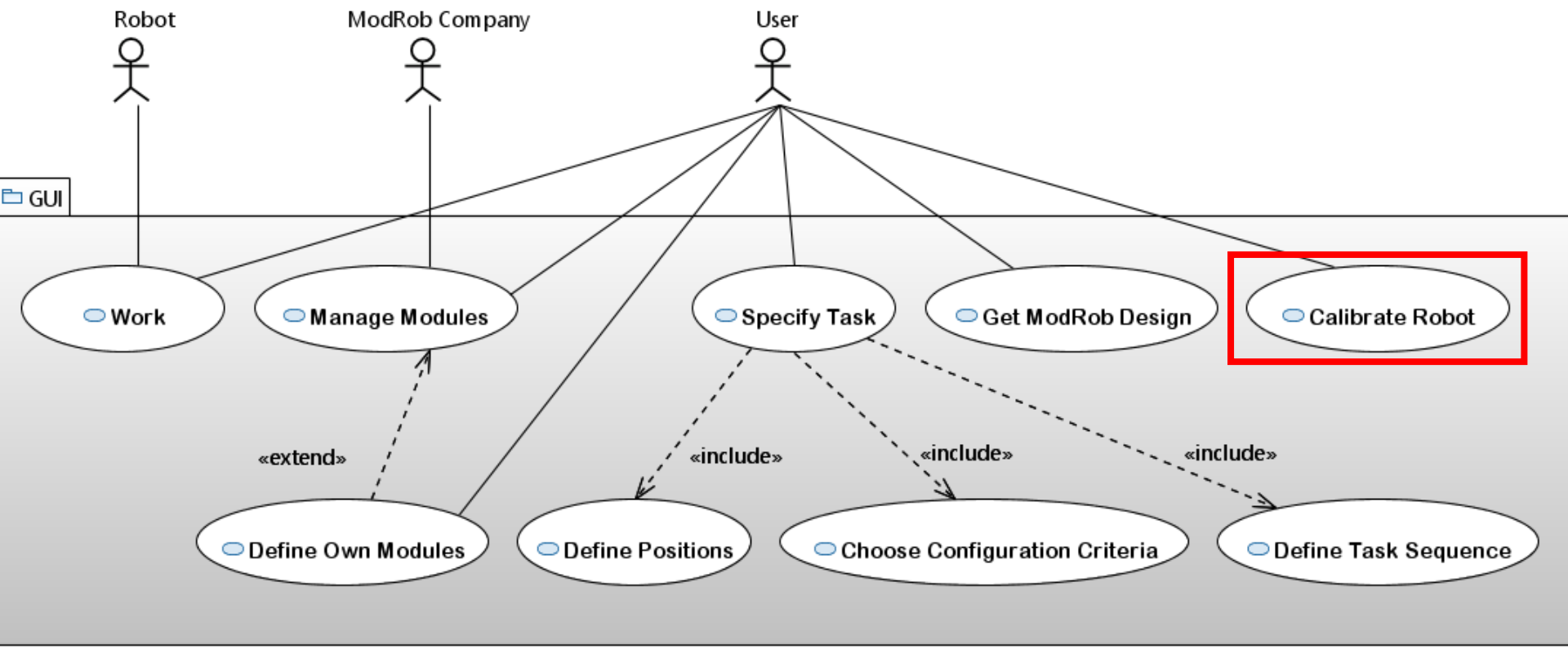
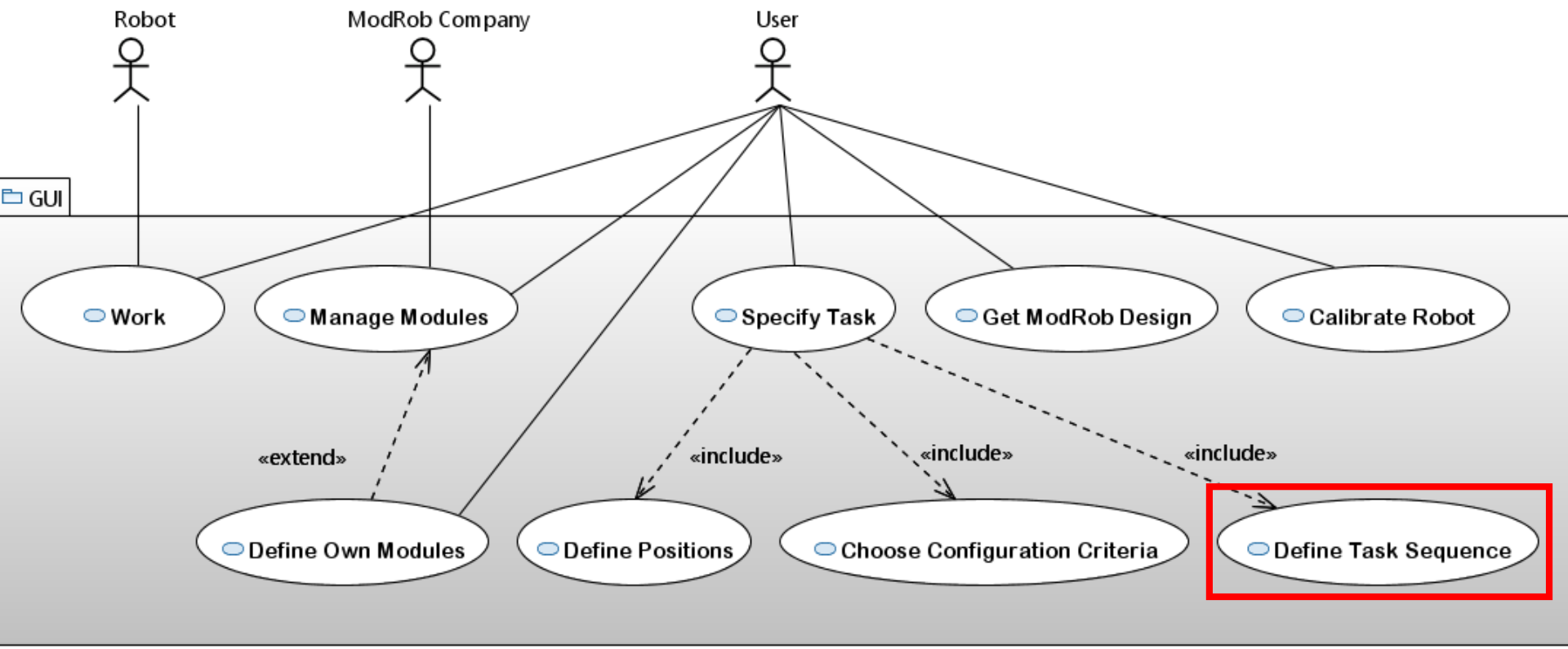


Use-Cases

Main	Module Management	Positions	Configuration	Calibration	**Teaching**



Use-Cases

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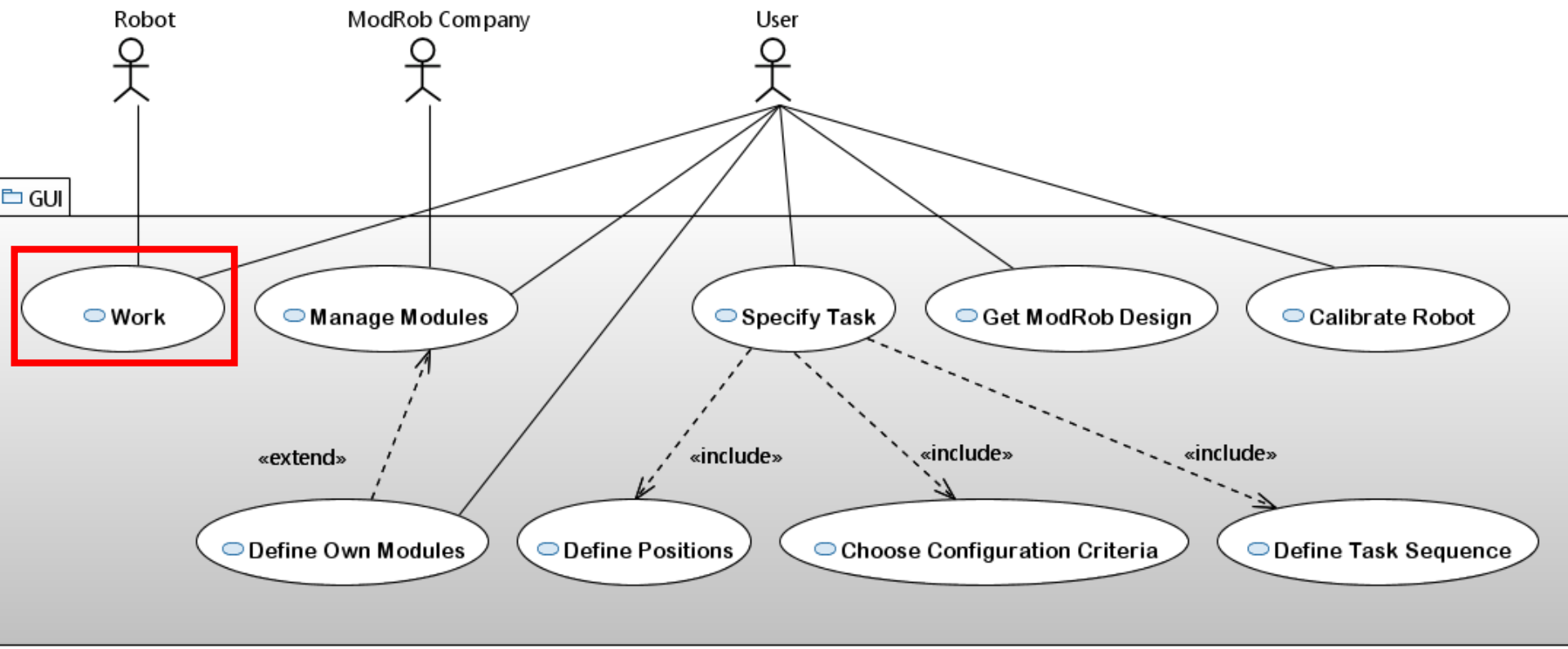
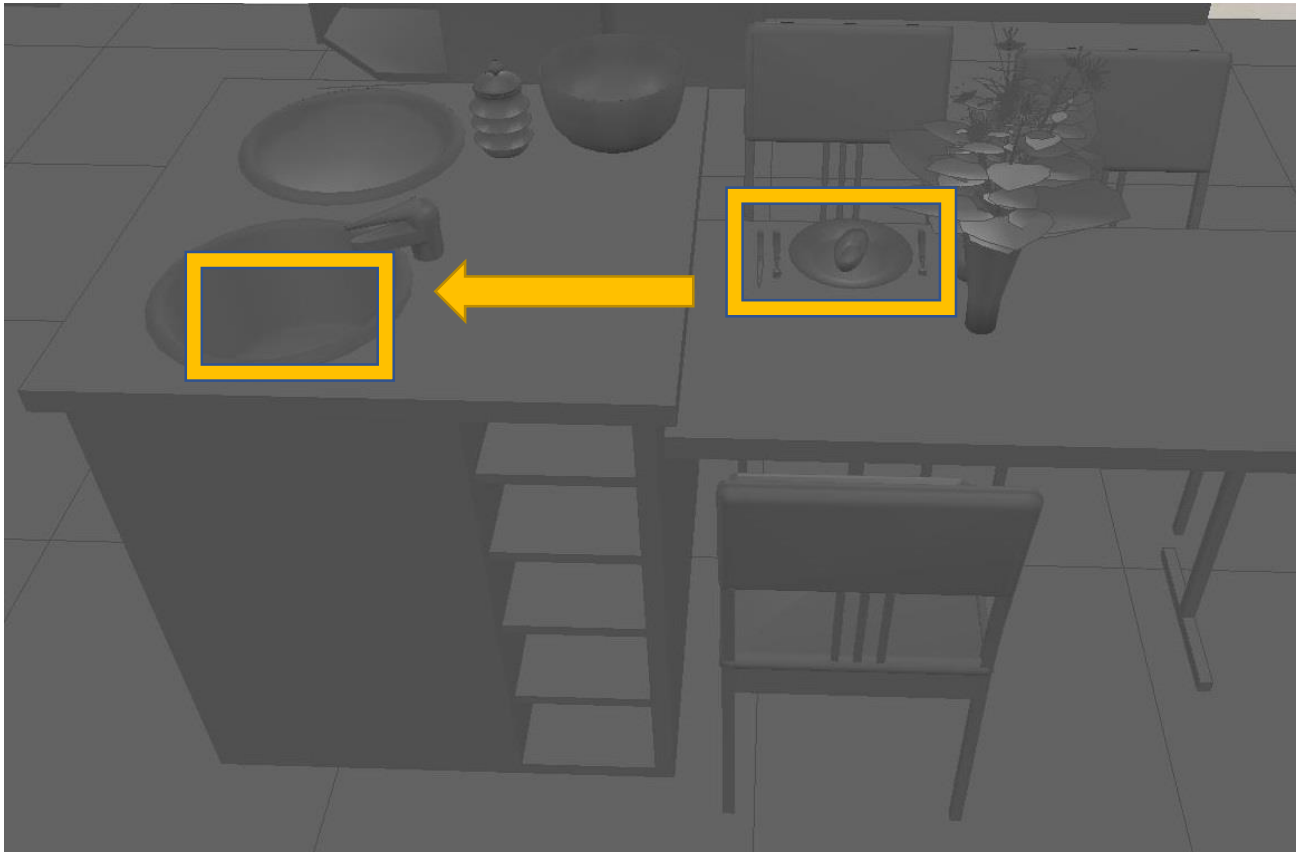


Scenario Analysis



Scenario Analysis

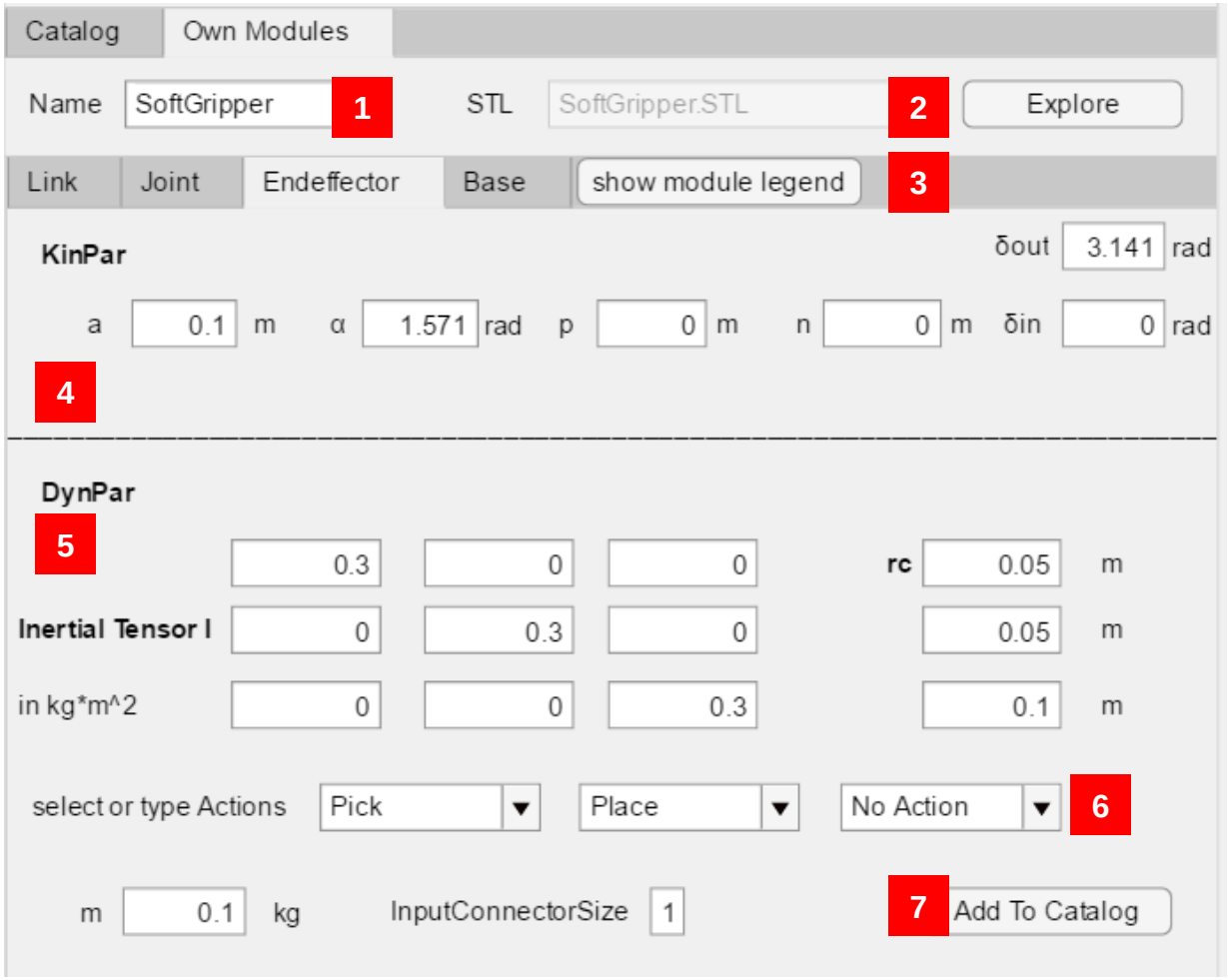
Task: move the dishes from the table to the sink

Description:

- Available joints: XL, L (3), S, XS (2)
- Available links: L_90_compact_LL (2), L_360_400_LL, L_90L_400_LS, L_wrist3, L_wrist2
- Own module: endeffector (suitable for dishes)
- Positions: table and sink
- Criteria for robot: Payload: 0.5kg, Monetary: very economic, Task Time: very fast, Assembly: rather keep configuration

Module Management

Main | **Module Management** | Positions | Configuration | Calibration | Teaching



Module Management

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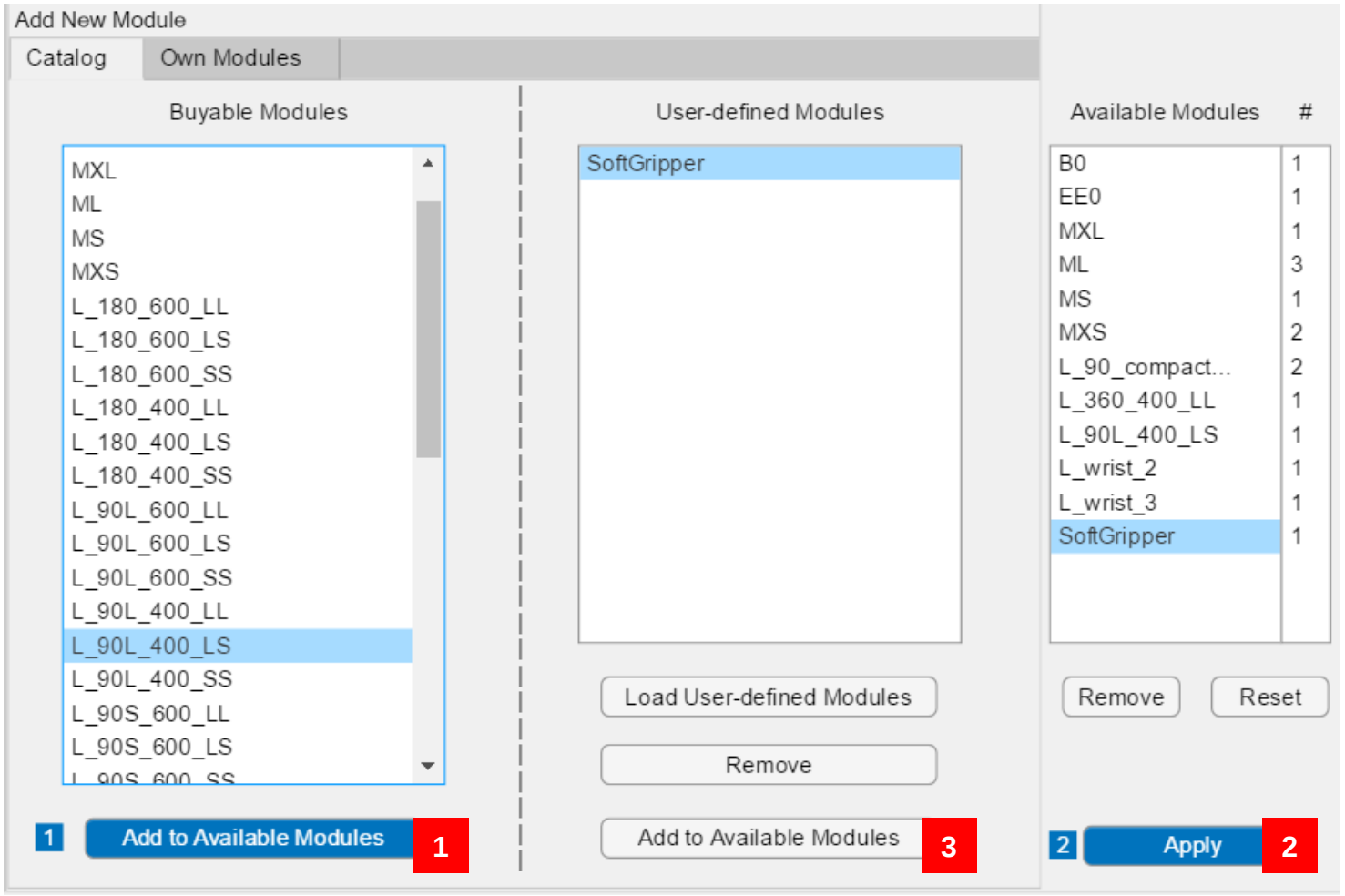
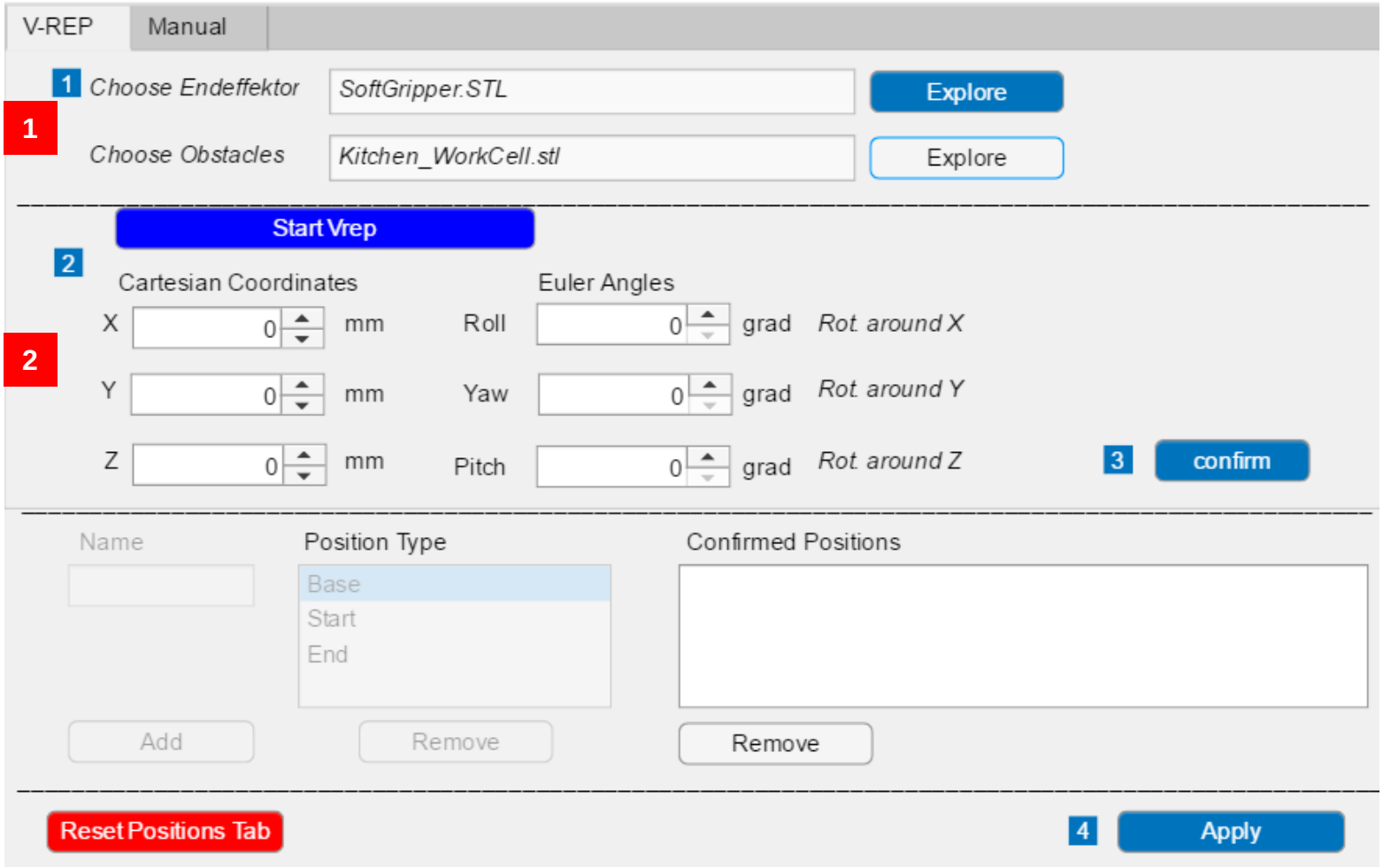


Positions

Main | Module Management | **Positions** | Configuration | Calibration | Teaching

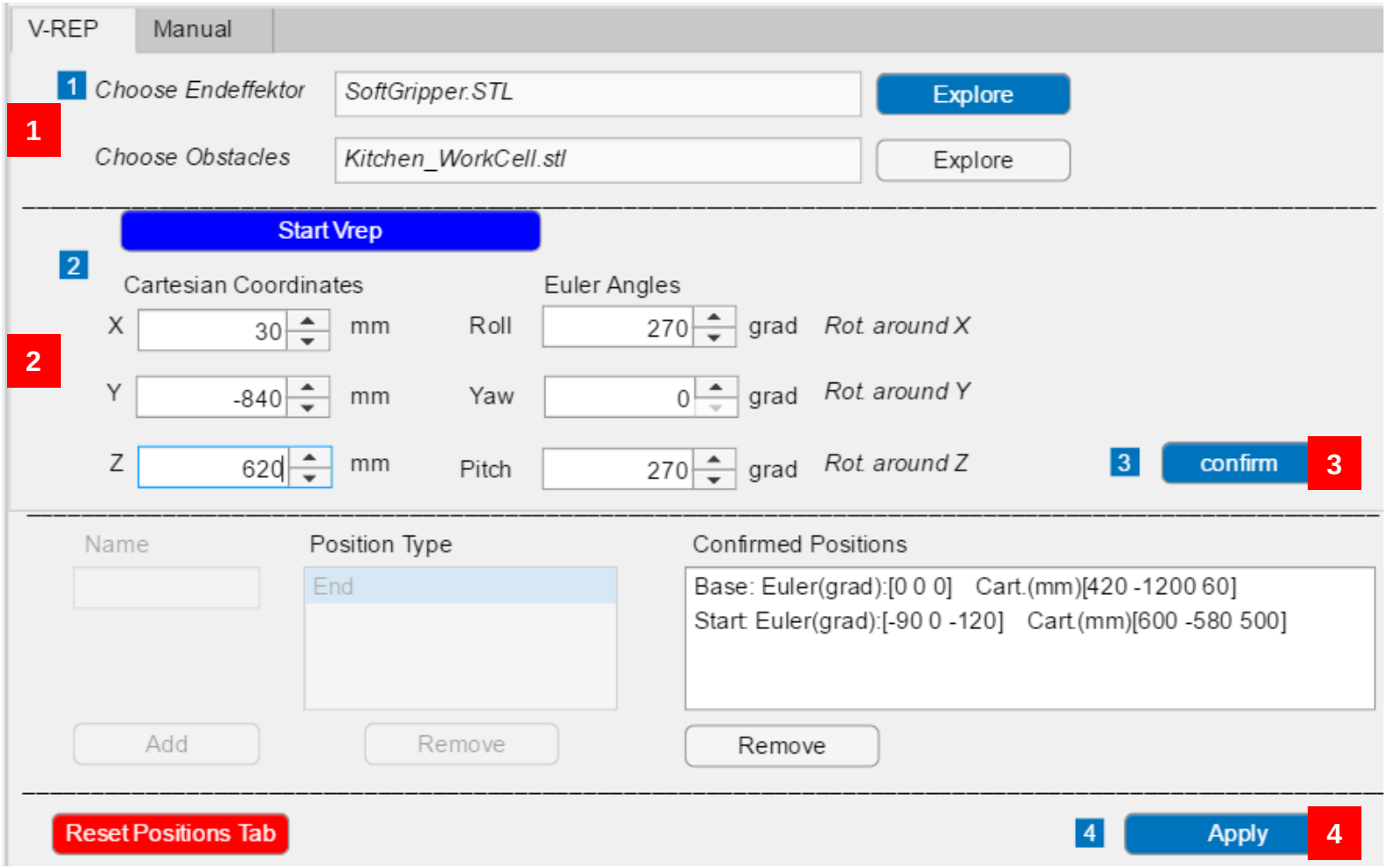


Positions @ V-REP

Main	Module Management	**Positions**	Configuration	Calibration	Teaching

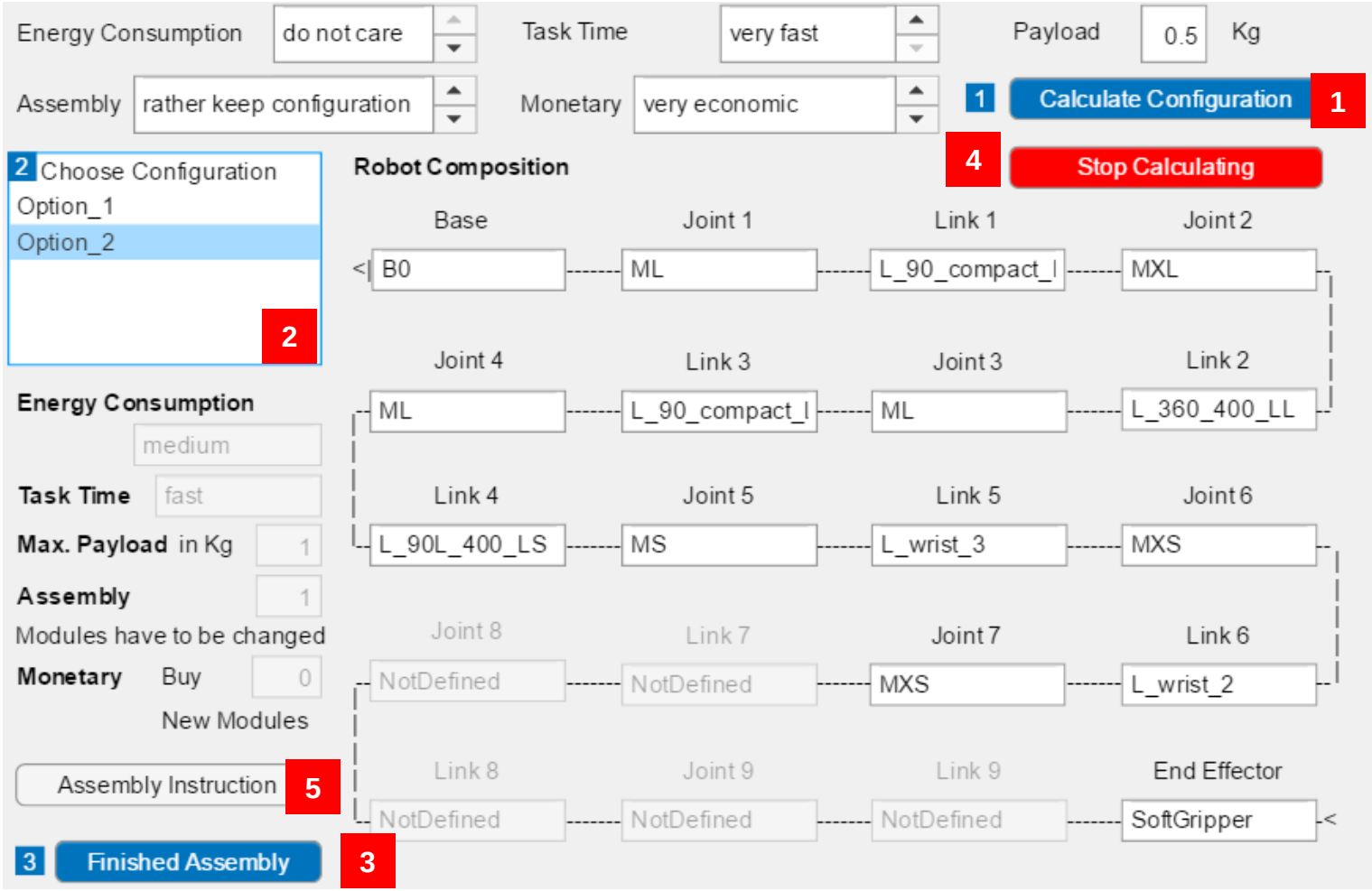
Positions

Main | Module Management | **Positions** | Configuration | Calibration | Teaching



Configuration

Main | Module Management | Positions | **Configuration** | Calibration | Teaching



Connect a Joint to a Link

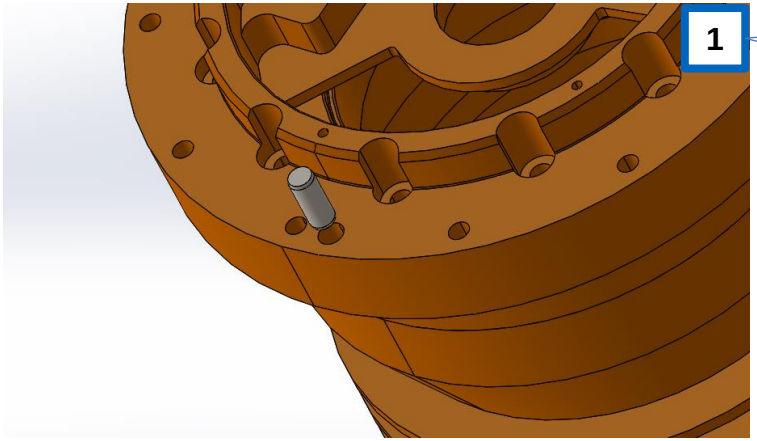
Main	Module Management	Positions	**Configuration**	Calibration	Teaching

Required Tools:

- Cross-tip screwdriver

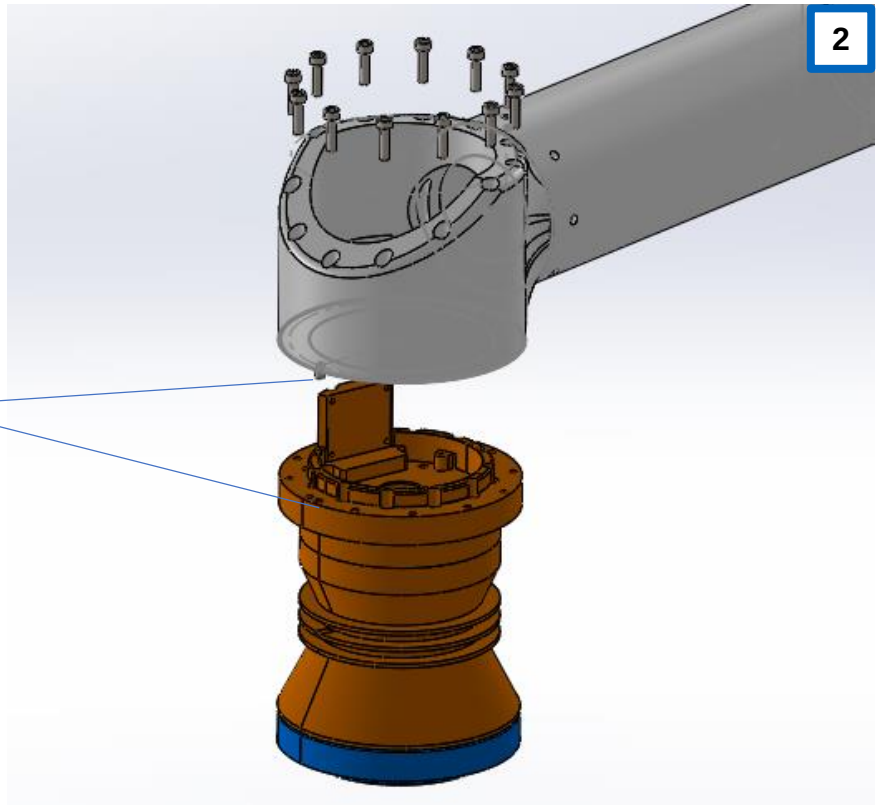
Step 1:

Orient motor to link such that the adjust pin fits into both parts



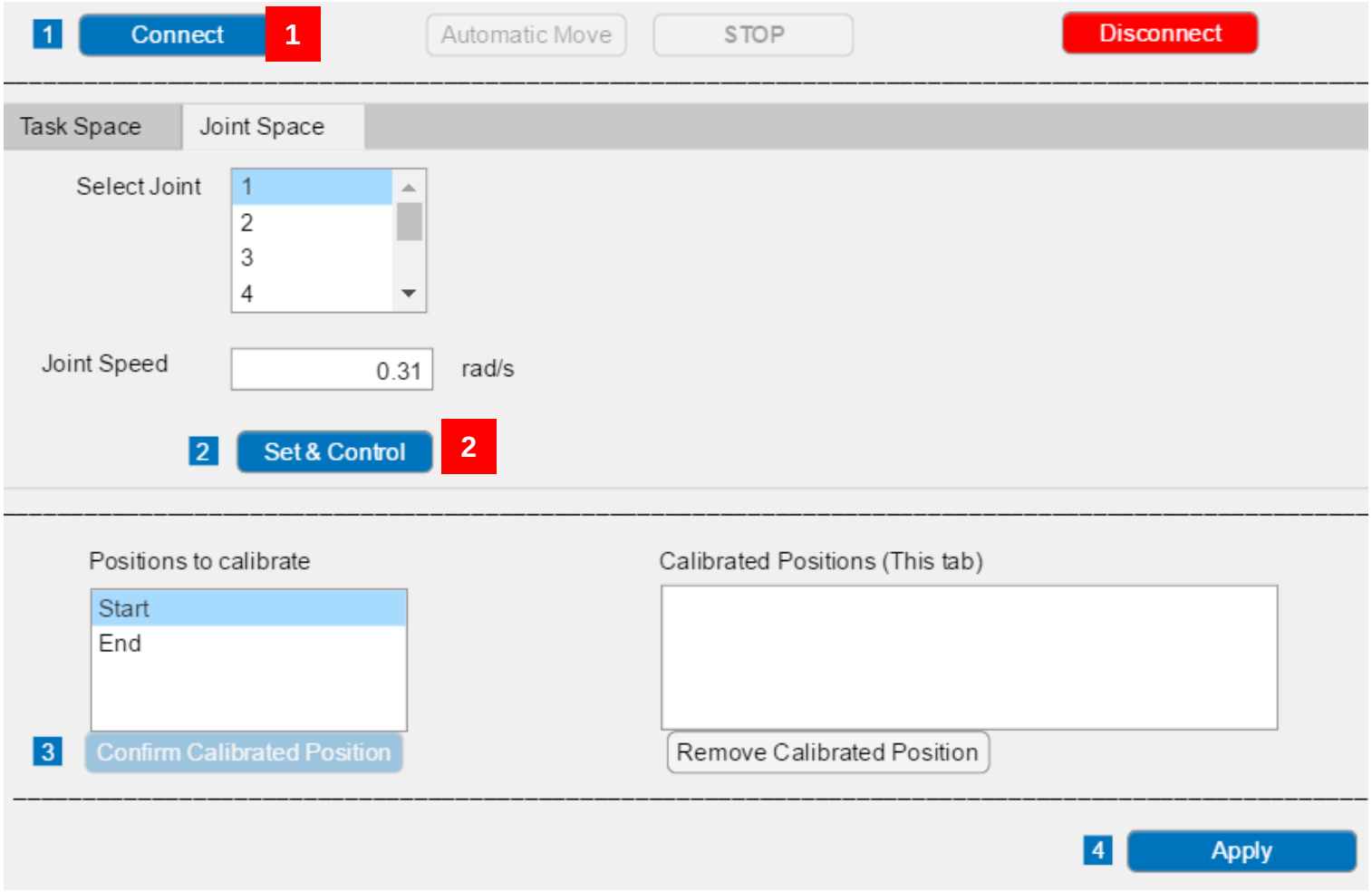
Step 2:

Insert the 12 screws



Calibration

Main | Module Management | Positions | Configuration | **Calibration** | Teaching



Calibration

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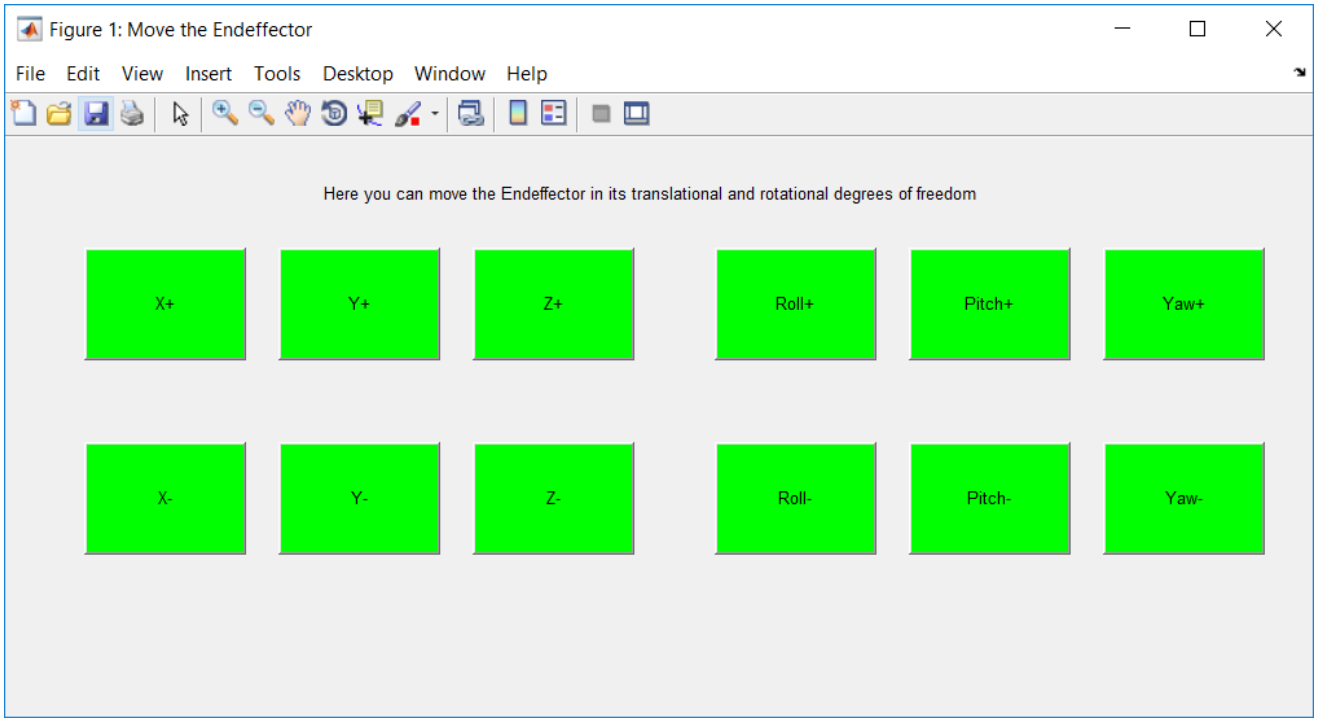
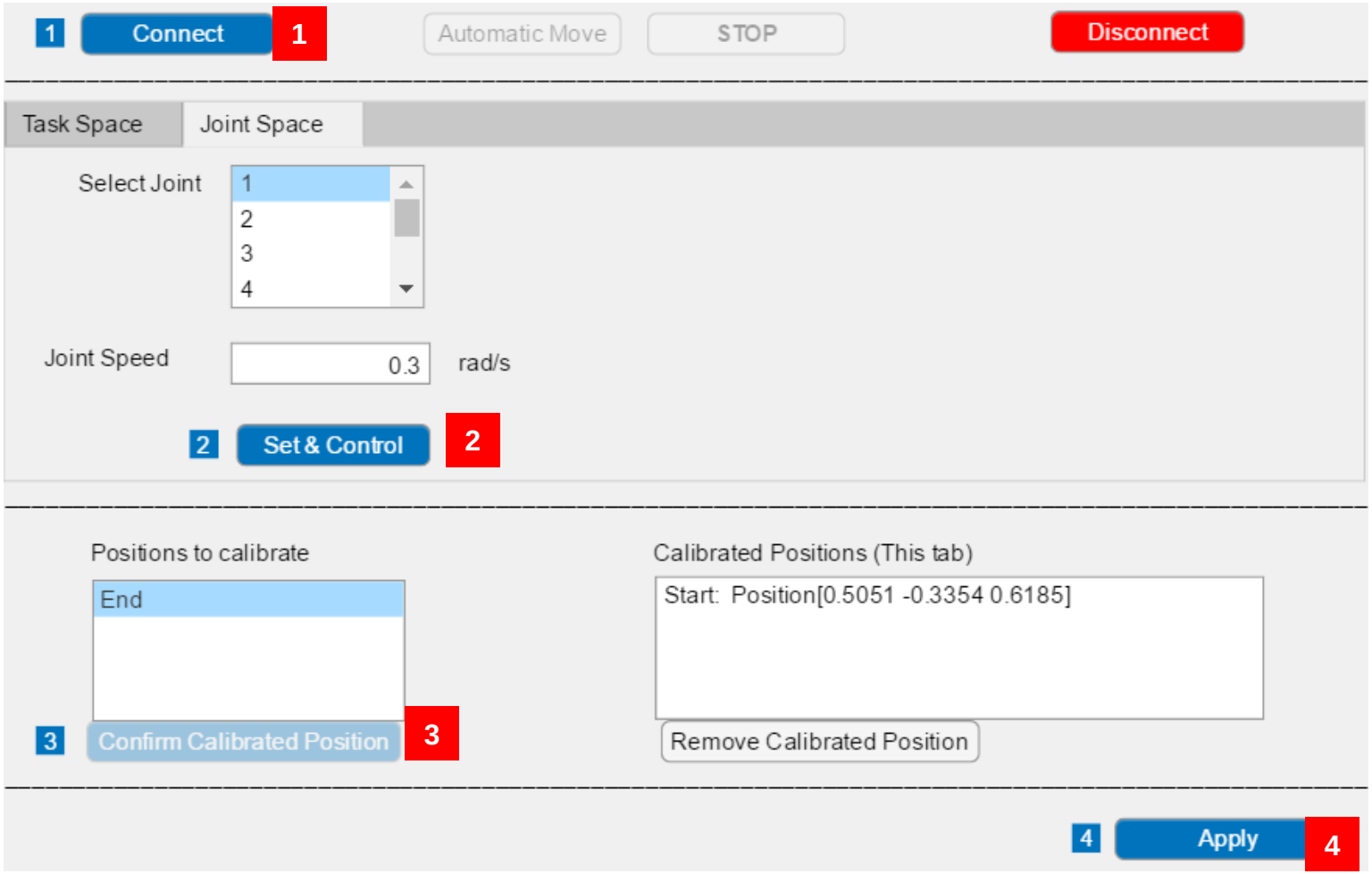


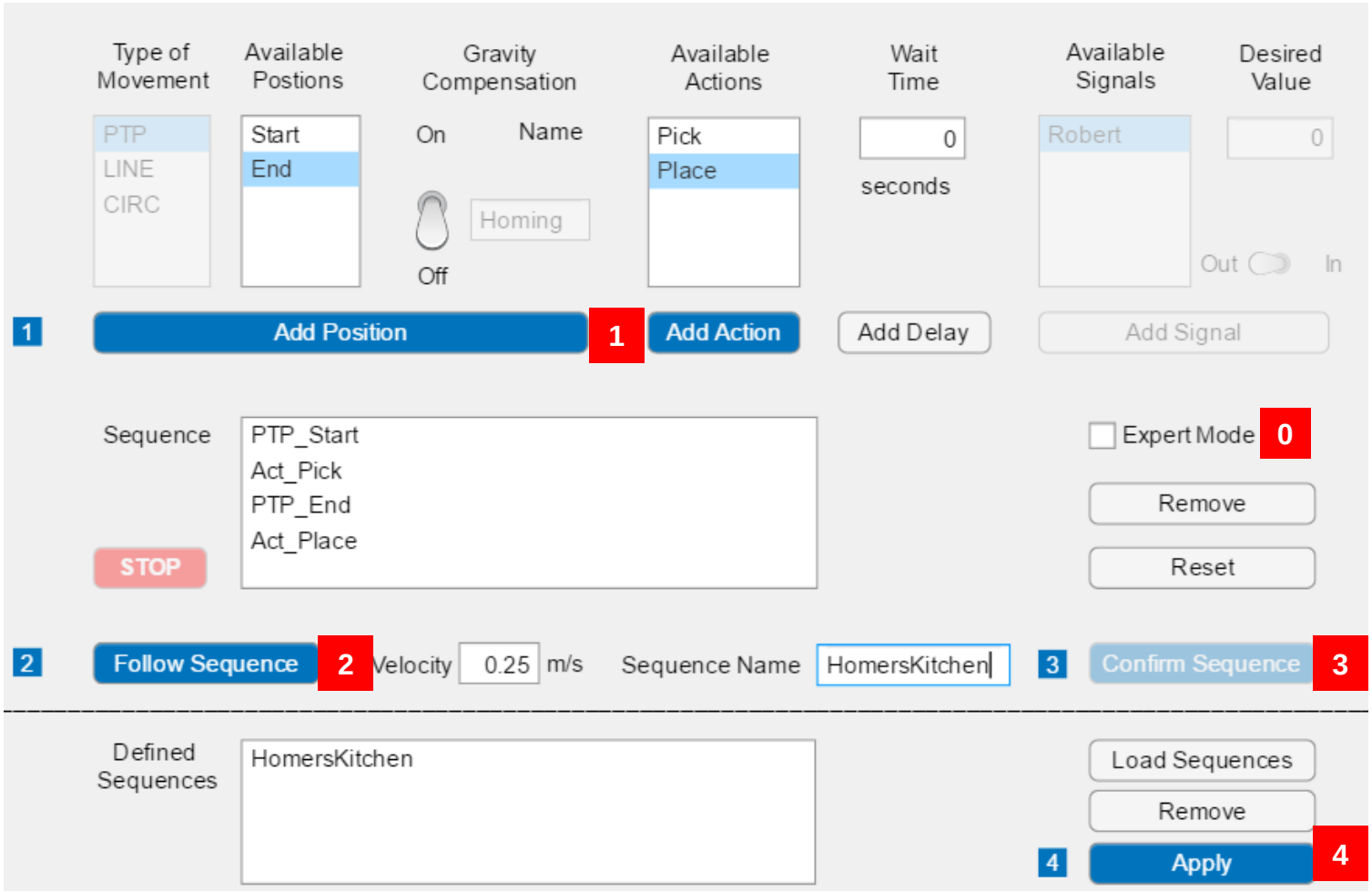
Calibration

Main | Module Management | Positions | Configuration | **Calibration** | Teaching

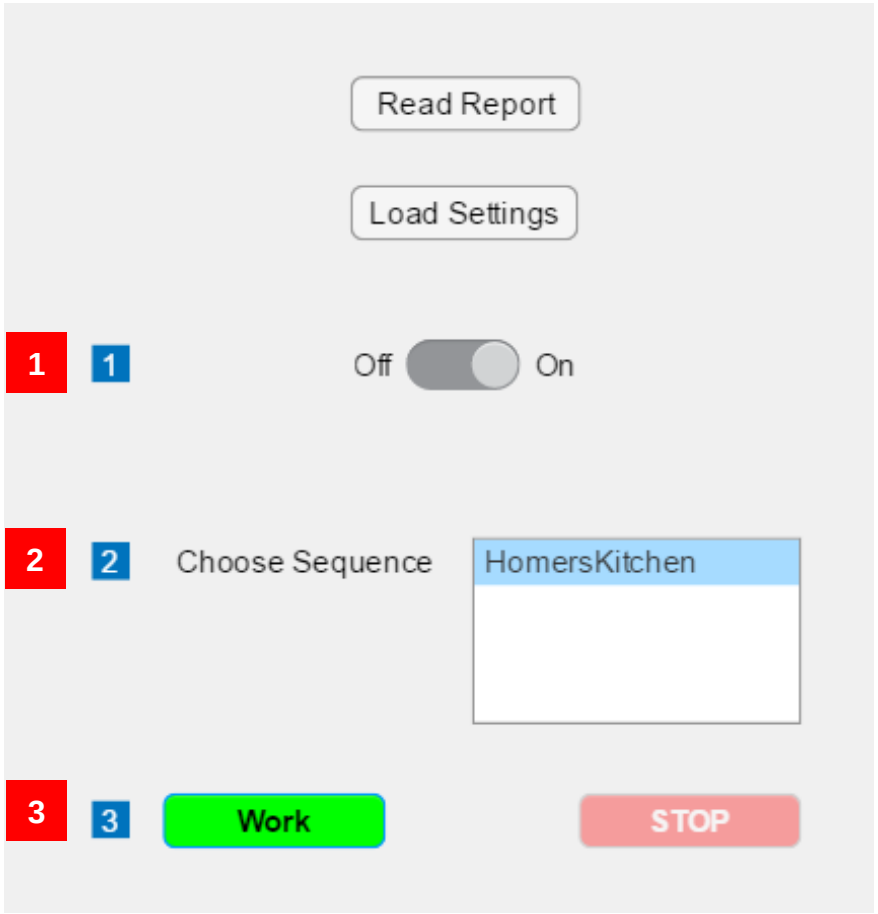


Teaching

Main | Module Management | Positions | Configuration | Calibration | **Teaching**

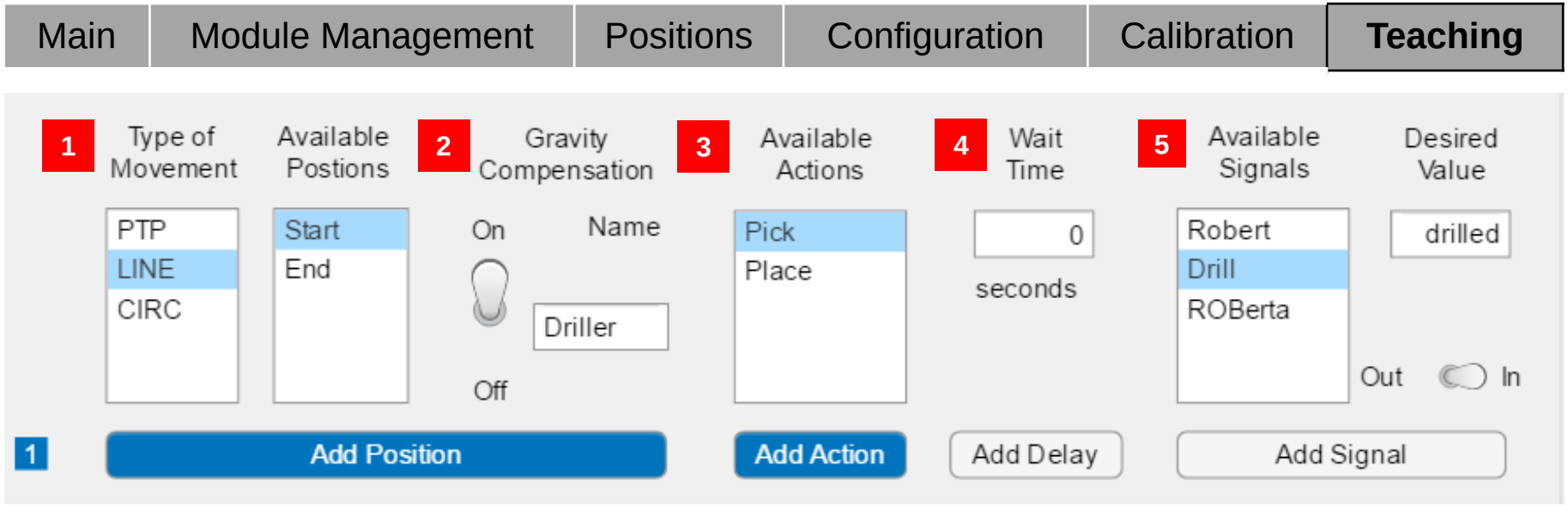


Main



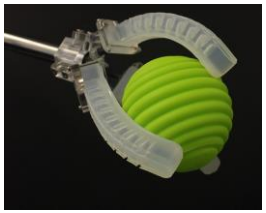
Homer does not need to move and the table will be cleaned

Expert Teaching



1

2



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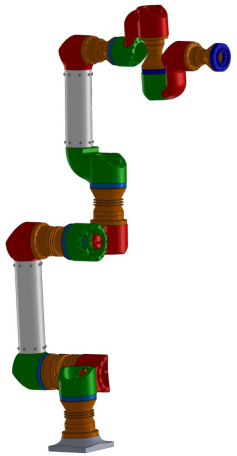
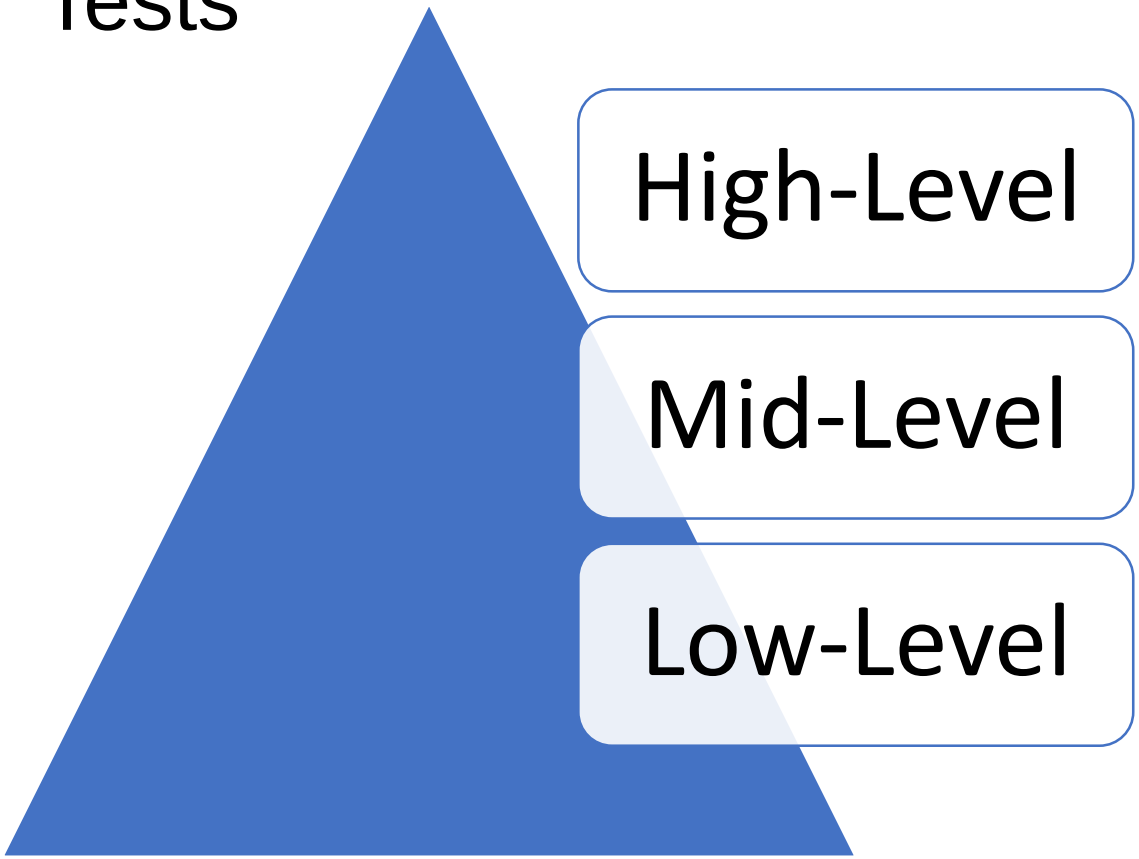
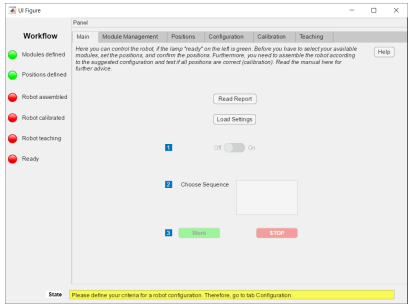


Evaluation

Tests





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Tab

Button

Evaluation

Define first task

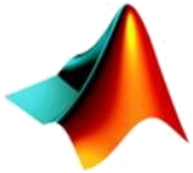
Define another task

Connection to Robot and Algorithm 

Requirements are fulfilled

User-friendliness tested by DLR employee 

Programming Language



MATLAB

+	-
Academic license	Expensive commercial license
Modular Robot Toolbox in MATLAB	
Simulink Real-Time	Requires Windows
V-REP API for MATLAB	
Appdesigner for graphical user-interface	Recommended for small apps Only basic graphical support

Programming Language

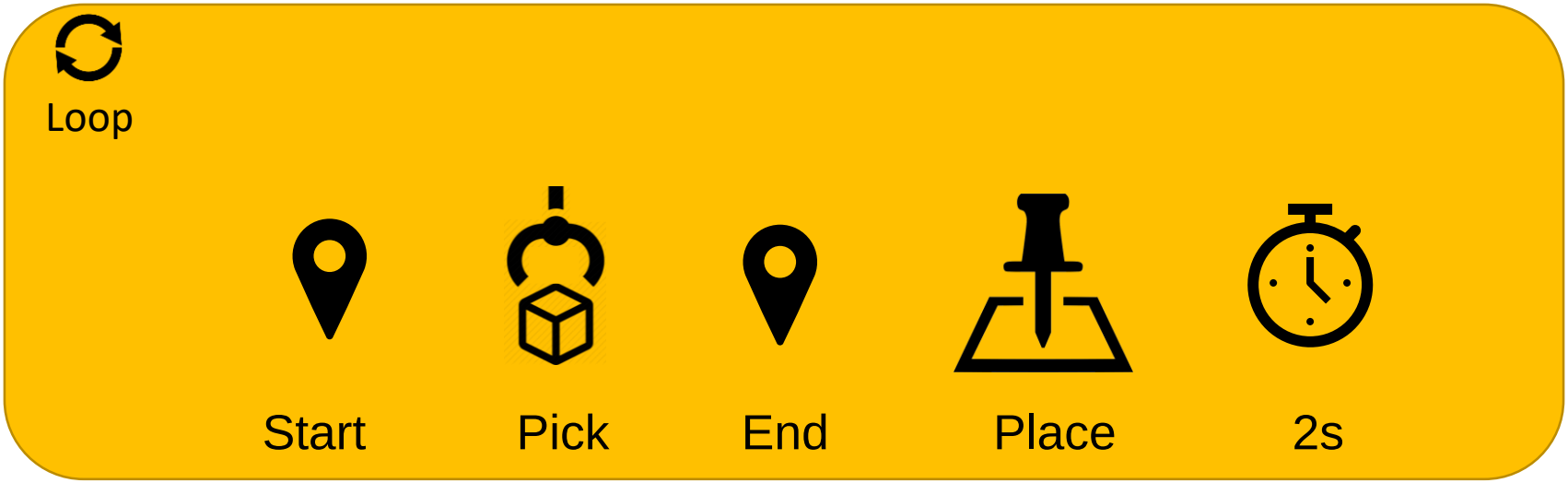
WEB-BASED

+	-
No licenses required	
Runs on **every platform** & device	
Advanced **graphical** support	
	Migrating Modular Robot Toolbox to other programming language is complicated
	Requires API to Simulink Real-time
	Requires API to V-REP

Further Improvements

Main	Module Management	Positions	Configuration	Calibration	**Teaching**

- Highlight current tab
- Teaching: Icons and Drag & Drop



Conclusion

Requirements:

+ fulfilled all use-cases
+ intuitive guidance through entire menu
+ detailed instructions
+ handles errors
+ provide additional functionalities for expert users

Outlook: Web-based GUI

- Can be used by every platform and every device
- Supports much more graphics

Thank you for your attention!

DEMO!

Leonardo Lerchenfeld & Emanuel Buchholz

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- 25: Soft Gripper - robohub.org
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- 30: Pick - iconfinder.com
- 30: Place - onlinewebfonts.com