

# Software Lab Computational Engineering Science

Group 12, Pusher Mechanism

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Informatik 12: Software and Tools for Computational Engineering (STCE)  
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## Visualization

## User Requirements

## System Requirements

## Prototype

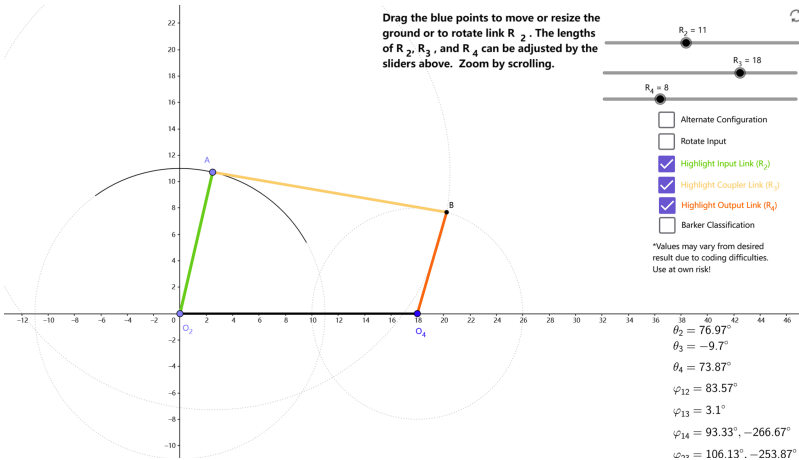
## Project Management

## For this Presentation

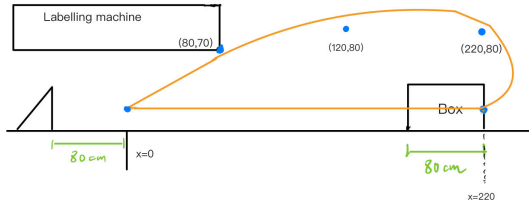
## For the Project

## Summary and Conclusion

► Online Demo: <https://www.geogebra.org/m/BueCG9ch>



- ▶ Simulate the motion of the pusher mechanism.
- ▶ Implement all motion types for the four-bar linkage with one bar fixed (8 cases according to [https://en.wikipedia.org/wiki/Four-bar\\_linkage](https://en.wikipedia.org/wiki/Four-bar_linkage)).
- ▶ Implement GUI with motion animation and the ability to choose geometrical parameters.
- ▶ Solve an optimization problem.



- ▶ Find suitable parameters for the pusher mechanism to meet requirements:
  - ▶ Push box with size  $80 \times 60$  from  $x = 220$  to  $x = 0$
  - ▶ Do not cross the area of the labelling machine (Area with  $x < 80$  and  $y > 70$ ).
  - ▶ Pass above points  $(120, 80)$  and  $(220, 80)$
- ▶ Provide the following data for the designed four-bar mechanism:
  - ▶ Position of the two fixed pivot positions
  - ▶ Lengths of the three moving links and of the fourth base link
  - ▶ The position of the couple offset point relative to the coupler

\*all coordinates and length are in cm

### ► **Four-bar linkage model:**

- System simulates the motion of the four-bar linkage.
- System distinguishes between all different motion cases.
- System does not crash with any input of geometrical configuration.
- System provides asserts or/and exception mechanisms to validate input data.

### ► **Tests:**

- Implement test cases to cover all motion cases.
- Provide reference data to compare results with.
- Implement test cases with bad input to test system stability.

### ► **Graphical User Interface:**

- GUI provides the four-bar linkage visualization.
- User can input geometrical data by moving a point on a slide bar or/and using a keyboard.
- GUI reacts to new input data by changing the four-bar linkage visualization accordingly.
- GUI provides animation of the four-bar linkage motion.
- User can choose parameters of this motion, e.g. restrict rotation angles.
- User can move linkage by pulling an input bar using a computer mouse.
- GUI is coupled with the four-bar linkage model to use implemented motion cases for animation.

### ► **Optimization problem:**

- It should be possible to find a solution (manually) for the optimization problem using the four-bar linkage model.
- GUI visualizes the solution.

### ► **Performance:**

- The four-bar linkage model is fast enough to provide smooth GUI animations.
- GUI animations are not slower than 30 frames per second.

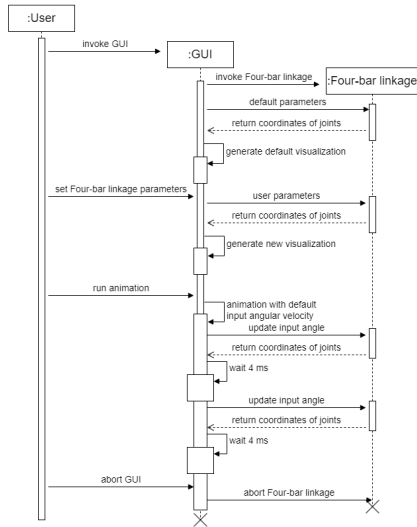
### ► **Usability:**

- Every essential part of the four-bar linkage model is well documented.
- GUI is easy to operate.
- GUI functionalities are well documented.
- All changeable parameters are explained.
- GUI animation displays trajectories of bar connection points.

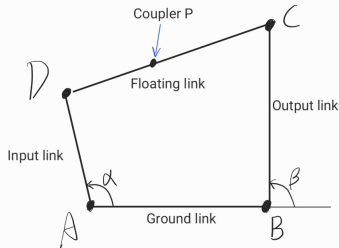
### ► **Locality:**

- GUI and the four-bar linkage model both can run on a local machine.
- Additionally: Local GUI should be able to connect to a remote four-bar linkage model.
- Additionally: It should be possible to provide a web GUI.





## Animation



## Parameter

Ground link length  
Input link length  
Output link length  
Floating link length  
Coupler position  
Ground link angle  
...

## Function

- ☐ Animation
- ☐ Reset
- ☐ Trace trajectory
- ☐ Show Labels, pivots...

- ▶ **Aaron Floerke:**
  - ▶ User Requirements.
- ▶ **Arseniy Kholod::**
  - ▶ System Requirements.
- ▶ **Xinyang Song::**
  - ▶ Visualization and Prototype.
- ▶ **Yanliang Zhu::**
  - ▶ Project Management.

- ▶ **Biweekly in-person or online group meetings.:**
- ▶ **Use Gantt Chart for time management and more detailed task assignment.:**
- ▶ **Tasks to be assigned::**
  - ▶ Design classes, interfaces, functions.
  - ▶ Design detailed use-cases.
  - ▶ Choose languages and environment to implement Four-bar linkage model and GUI.
  - ▶ Implementation and documentation.
  - ▶ Implement tests and use-cases.
  - ▶ Solve the optimization problem.

- ▶ **User requirements**
- ▶ **Optimization problem**
- ▶ **System requirements**
- ▶ **Prototype:**
  - ▶ Sequence diagram for communication between user, GUI, and Four-bar linkage model.
  - ▶ Graphical user interface visualization.
- ▶ **Project Management**