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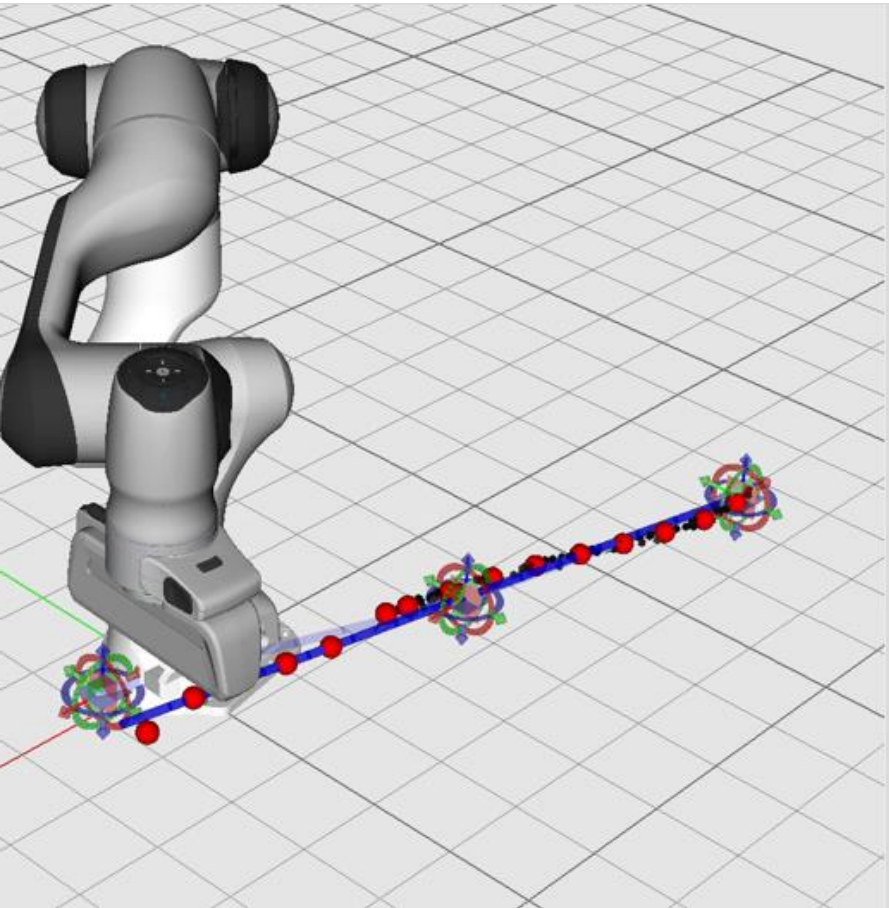


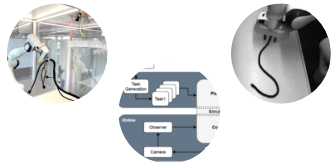
RoSE: Software Architecture for DLO Manipulation: A Shape Manipulation Case Study

Soft Tissue Robotics

Manuel Zürn

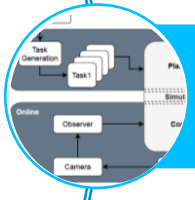
Structure of this presentation

Mini structure in the corner



Motivation

- Why focusing on **research concerning deformable objects**?
- Why presenting a **software architecture**?



Approach

- **Problem formulation** of shape manipulation
- **Components** and **design** of the software architecture

Evaluation

- Videos
- Conclusion

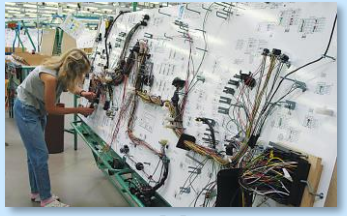
Potential for automation

Examples of intended use for DLOs

Electrical Sector

[1]

[2]



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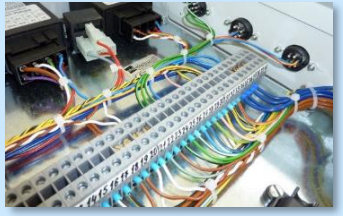
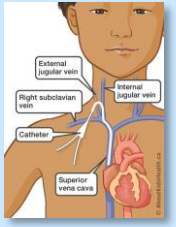


[4]

Automotive | Aviation | Switch Cabinet

Medical Sector

[5]



[6]

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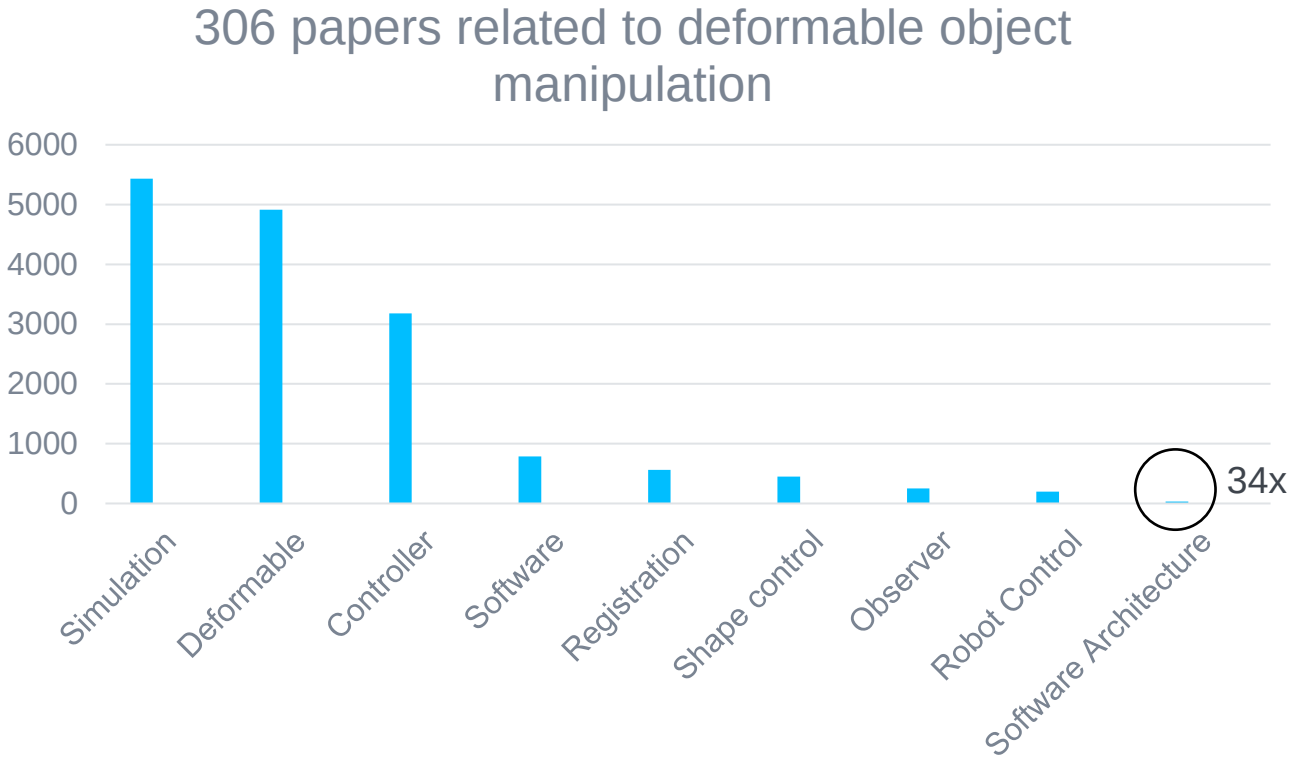
[8]

Catheter insertion | Stitching | Surgery

Reason to present a software architecture

Paper evaluation by search term

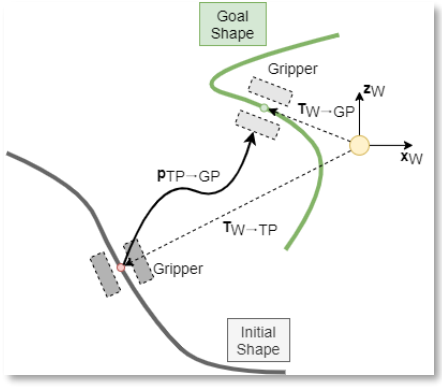


Research mostly focuses on components → **software architecture** can help in **modularization** and **comparison**

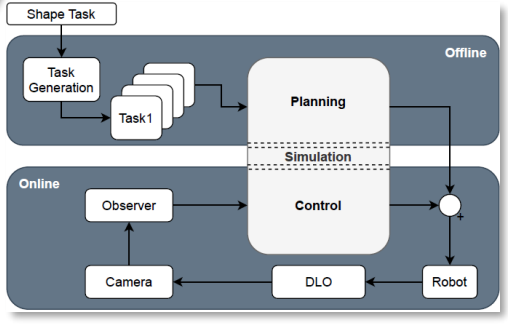
Shape manipulation

From problem formulation to a program flow chart

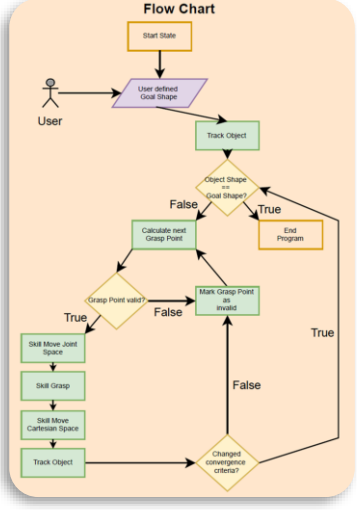
Problem Formulation



Block Diagram



Program Flow Chart



Software Architecture used for DLO manipulation

Three layer approach

Decision Layer

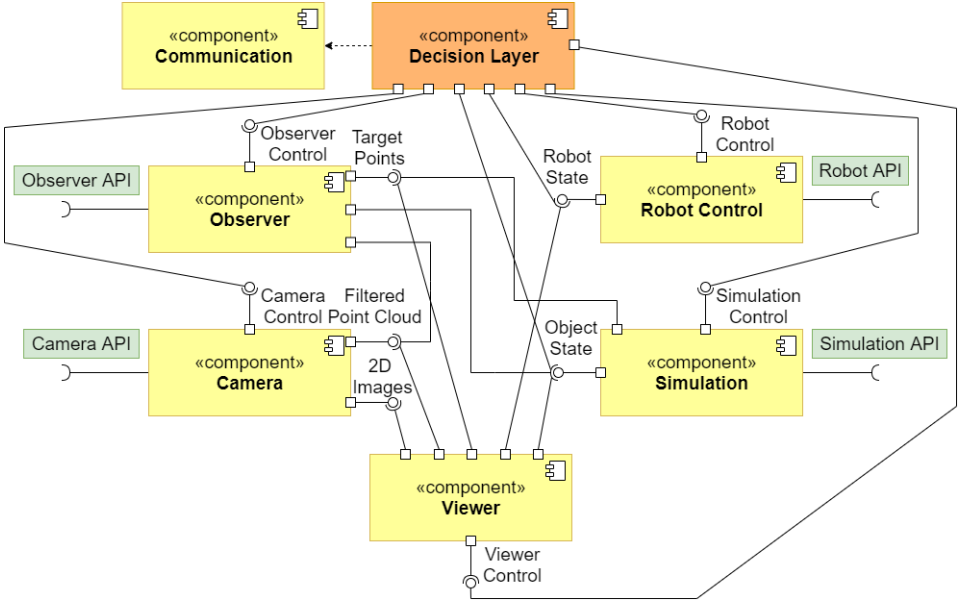
- Used for skill planning

Skill Layer

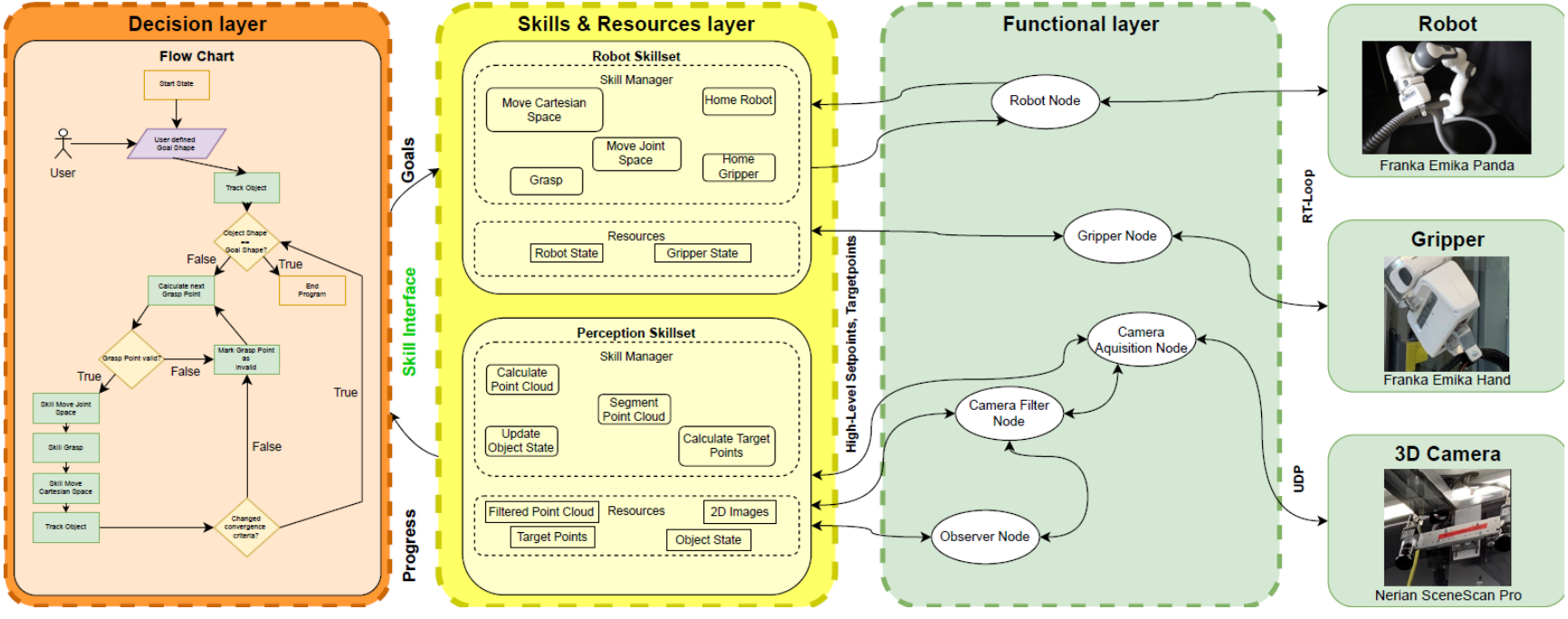
- Modularizing different skills

Functional Layer

- Hardware/Library abstraction

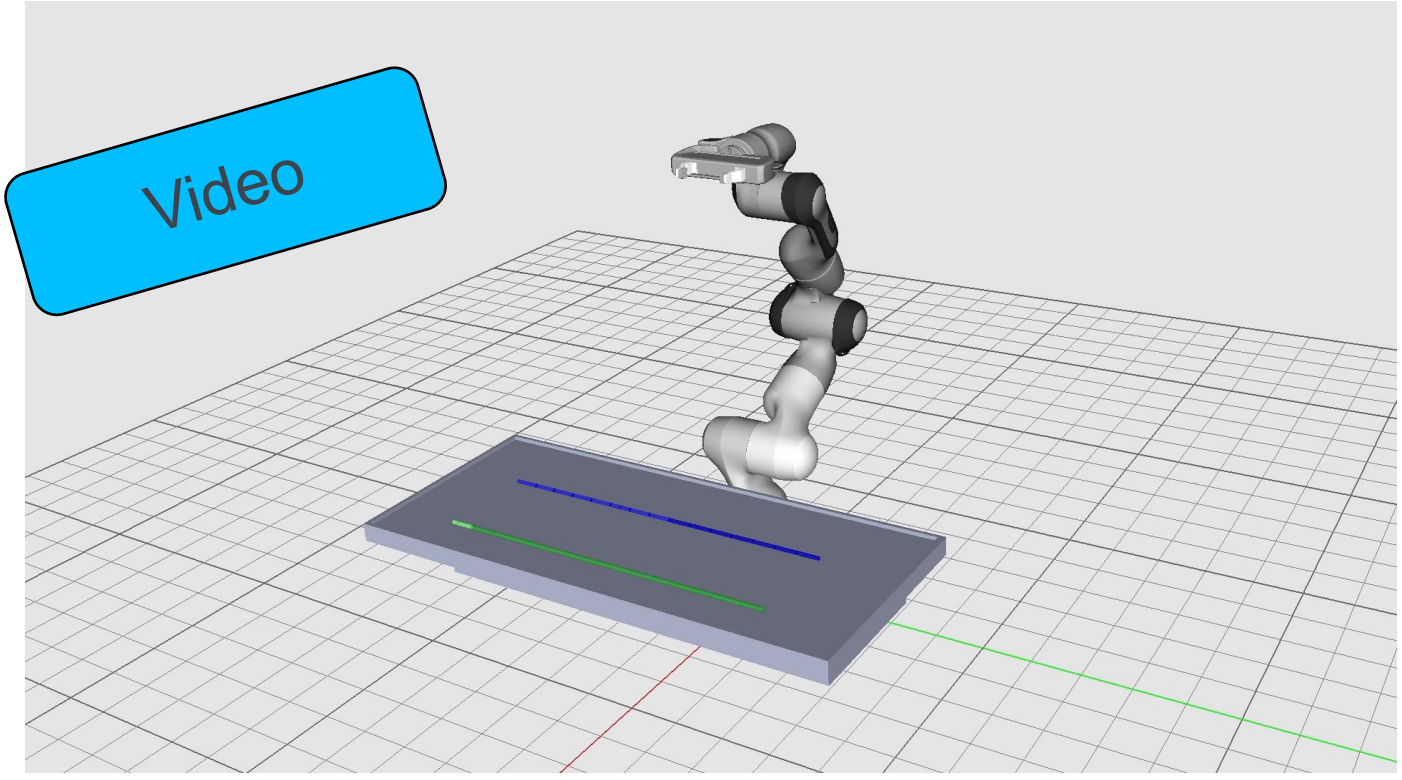


Three layer software architecture



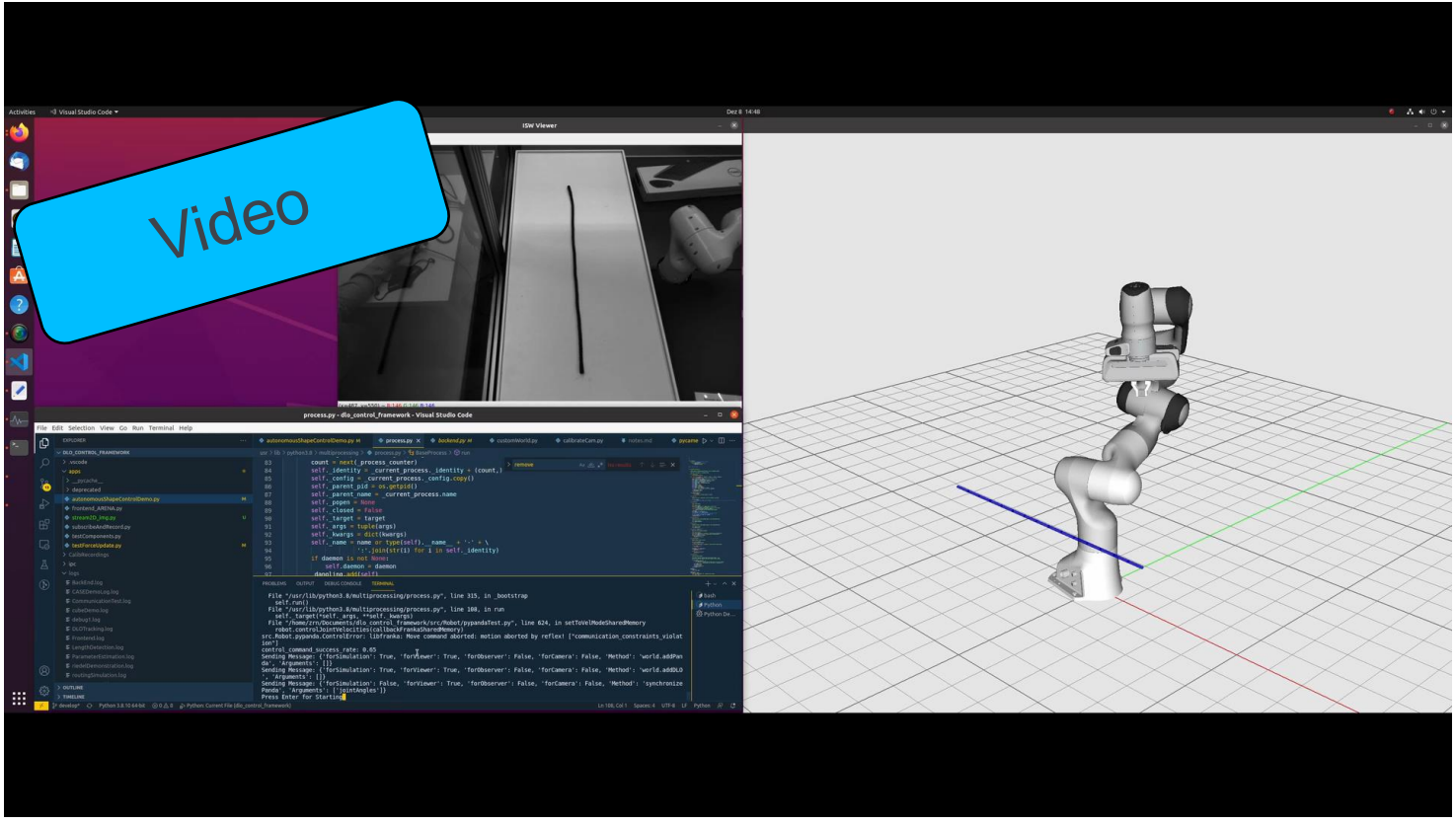
Evaluation

Skill verification and validation



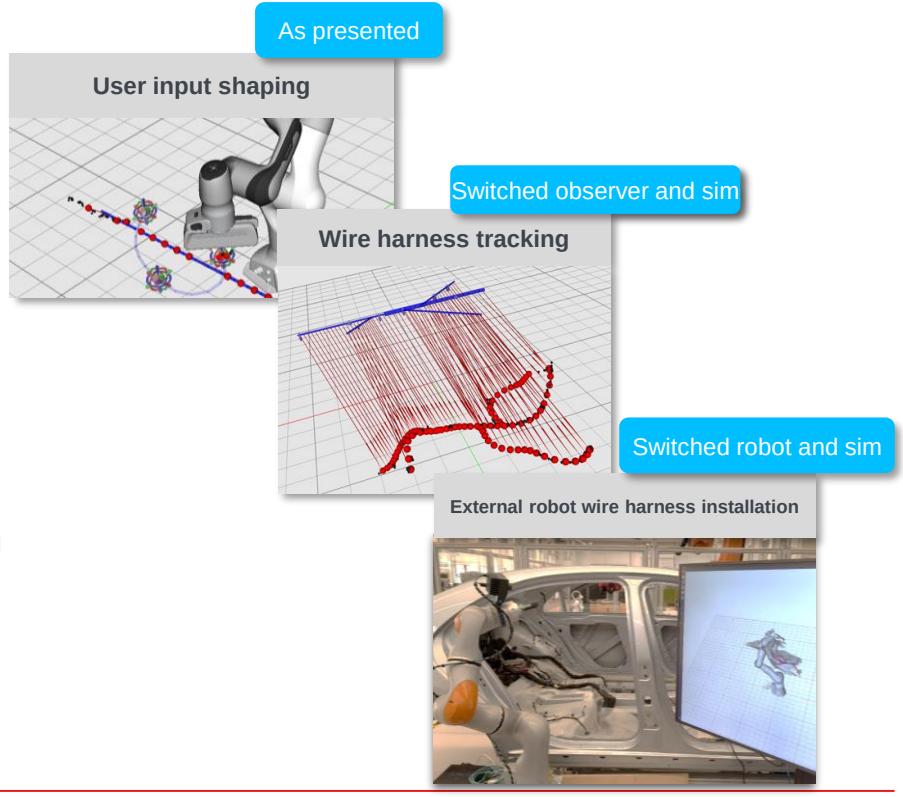
Evaluation

User defined shape validation



Conclusion and outlook

- **Conclusion**
  - Modularized layered approach allows for
    - Switching decision layers for **different application** scenarios
    - Switching specific algorithms for **comparison**
    - **Interchangeable components**, e.g. different simulation software
- **Outlook**
  - **Comparison** of different non-rigid-registration **algorithms**
  - Implement **further skills,** e.g. advanced task planning using **predicted states** of the deformable objects



Sources

[1] https://www.assemblymag.com/articles/95406-monitoring-activity-during-wire-harness-assembly?

[2] Yili Qin et al. Cable Installation by a Humanoid Integrating Dual-Arm Manipulation and Walking 2019

[3] https://www.assemblymag.com/articles/93476-handling-high-mix-harness-assembly

[4] https://www.ehb-electronics.de/en/products/switch-cabinet-construction

[5] BorisGuiu et al. Feasibility, safety and accuracy of a CT-guided robotic assistance for percutaneous needle placement in a swine liver model.

[6] https://www.aboutkidshealth.ca/cvl

[7] Chandan Kundavaram et al. Advances in Robotic Vena Cava Tumor Thrombectomy: Intracaval Balloon Occlusion, Patch Grafting, and Vena Cavoscopy.

[8] https://www.standard.co.uk/tech/robot-surgeons-watched-videos-to-learn-stitches-a4471776.html

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Thank you!

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