

# Making dirty PCR clean

Since the early days of the current COVID-19 pandemic, the term „PCR test“ is on everybody’s lips. However, PCR (Polymerase Chain Reaction) is a technique that has been **in use in biochemistry laboratories for more than 30 years**. It serves as a method to amplify and finally measure the amount of DNA in a sample. As of today, many published results are **not reproducible**, which is often due to the many manual process steps involved and the lack of standardisation in both hardware and software tasks [1, 2].

In our group, we are working on the **next generation of biolaboratory automation**. At the intersection of electrical engineering and computer science we are tackling both the **hardware and software challenges** of this endeavour. Quantitative PCR (qPCR) is one of the methods that we apply to analyse the outcomes of our experiments. We offer opportunities for projects with different focus areas and modules:



## Project 1: Let my robot handle all these dirty liquids ...

**Enabling a robot to prepare a PCR test**

**Main target groups and modules: (mechanical & electrical) engineering -  
Ingenieurspraxis / Bachelor’s thesis / Forschungspraxis / similar modules**

This project deals with the preparation of a PCR analysis with a robot, in particular focusing on liquid handling tasks:

- Workflow conceptualization from biological sample to PCR result
- Identification of engineering challenges
- Stable and aligned grasping and transport of liquid containers
- Design and refinement of suitable gripping equipment
- Interaction of robot with lab equipment, e.g. thermocycler, centrifuge, ice bucket, ...



As visible from this description, this project deals with conceptual, hardware and software aspects of robotic lab automation. It puts itself especially forward for engineering students of different fields. Others are welcome to apply as well of course.

## Project 2: ... and let my computer manage all the dirty data

### Automated qPCR Software Automation & Data Analysis

**Main target groups and modules: computer science & bioinformatics -  
Praktische Arbeit / Bachelorpraktikum / Bachelor's thesis / similar modules**

This project deals with software treatment of the qPCR thermocycler used in the lab and the resulting data. It encompasses the following tasks:

- Device control via API without control software and GUI
- Sustainable data: Integration of MIQE and FAIR data guidelines
- Automated qPCR result analysis
- Workflow integration into Laboratory Information Management System (LIMS)
- Optional: integration with hardware automation; containerization with docker, ...



This project puts itself especially forward for computer science and bioinformatics students. Of course it is also open to students of other study programs.

## The Details

In order to perform successfully on these projects, the topics lead to the following requirements:

- Interest in working in a state-of-the-art research field at the intersection of the life sciences, computer science and robotics
- Creativity in problem solving
- Very basic knowledge of biological processes and DNA (or willingness to learn)
- Hard skills depending on the project:
  - Solid programming skills, e.g. Python, C++, C#, Java
  - Basic knowledge in CAD, 3D printing, robotics
  - Software development

In case you're interested or you have any questions, feel free to reach out to Henning Zwirnmann:

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## References

[1] Sean C. Taylor *et al.* The Ultimate qPCR Experiment: Producing Publication Quality, Reproducible Data the First Time. *Trends in Biotechnology* 37(7), July 2019, <https://doi.org/10.1016/j.tibtech.2018.12.002>

[2] M. Baker. 1,500 scientists lift the lid on reproducibility. *Nature* 533, 452–454, May 2016. <https://doi.org/10.1038/533452a>

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