

Implementation of an Optical Particle Tracking Controller



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Bachelor Thesis Proposal

At the Institute for Physics of Condensed Matter of the TU Darmstadt (Department of Physics), among others, self propelled matter is investigated using theoretical and experimental approaches. As an experimental technique the Soft Matter at Interfaces group of Regine v. Klitzing employs dark field microscopy to visualize self propelled- μm large spherical particles, where the particles under observations are captured by a camera (see Fig. 1).

To optimize the experiments the moving particle should be kept within the microscope's field of view as long as possible. Therefore the sample holder is mounted on a piezo-driven 2D table that can be controlled by software.

To make use of this setup we, the Soft Matter at Interfaces Group and the Control and Cyber-Physical Systems Laboratory, want to employ the concept depicted in Fig. 2 where we use image processing to determine the position of the particle and thus close the control loop.

There exists some preliminary work like a prove of concept of the camera readout and an analysis of different particle tracking algorithms. The focus of this Bachelor thesis lies on designing and implementing a modular C++ program that implements all functionality needed to apply the concept to the actual experiment.

In detail it comprises the following tasks:

- Analysis of the requirements of the different components of the control loop and defining the interfaces of the program's components.
- Implementation of the communication between camera and computer.
- Implementation of the communication between computer and piezo table,
- Determine and implement an algorithm for particle finding and tracking (Sobel, Scharr, Canny, ...).
- Design a suitable controller for particle tracking and evaluate the closed control loop.

We offer a well defined, interdisciplinary and directly applicable project in a sophisticated laboratory at the interface between control systems engineering, real time automated image analysis and application in basic science. The experimental work will take place in the laboratories of the AG von Klitzing (S2|04).

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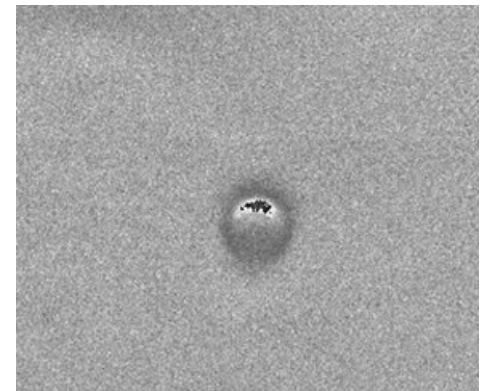


Figure 1: Particle captured by the camera

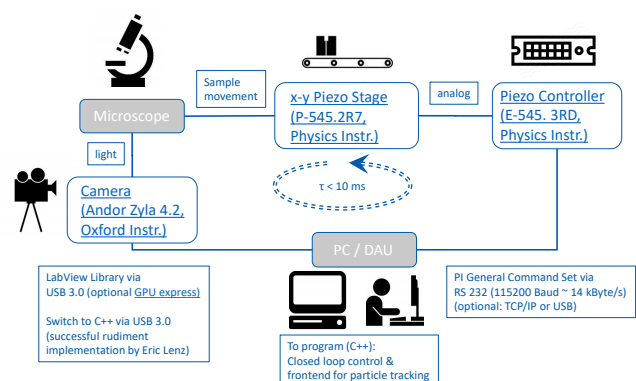


Figure 2: Control concept for particle tracking