## Project Proposals for Doctoral Researcher Positions 2025

### ID01: Robust knowledge discovery of cell interactions in multichannel imaging flow cytometry and live cell imaging (Ralf Mikut, Daniel Hübschmann)

*Karlsruhe, KIT, Automated Image and Data Analysis*

The analysis of cellular interactions is important for understanding organismal development, tissue homeostasis and immunity. This includes in particular the understanding of disease and therapeutic effects in comparison to healthy organisms. Quantifying and understanding these interactions can contribute to a deeper understanding of basic mechanisms, earlier diagnosis of diseases, personalized selection of the most appropriate therapy options, and improved monitoring of therapy progress.

However, current single-cell genomic technologies for the analysis of physically interacting cells suffer from low cellular throughput, long processing times, high costs, and are typically limited to predefined cell types. In addition, they do not provide full insight into the morphology of involved cells, attached antibodies and dynamics of cellular interactions. Multichannel imaging flow cytometry combines flow cytometry and imaging to analyze cells. It is a high-throughput method for counting and characterizing cells. Traditionally, flow cytometry has focused on characterization of single cells. However, flow cytometry and in particular multi-channel imaging flow cytometry can be leveraged to count and characterize physical interactions between cells in great detail. Artificial Intelligence (AI) has successfully been applied for event detection and classification in the context of imaging flow cytometry. The potential of applying AI to study cellular interactions, however, has not been fully exploited.

The goal of the proposed project is to study, characterize and analyze the distributions, kinetics, and alterations under pathological conditions of cellular interactions by developing and applying an AI-based generic and standardized pipeline capable of handling data from different modalities.

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### Requirements:

- master's degree in computer science, bioinformatics, engineering or related fields
- very good programming skills in Python
- initial experience with deep learning frameworks (such as PyTorch) are an advantage

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