



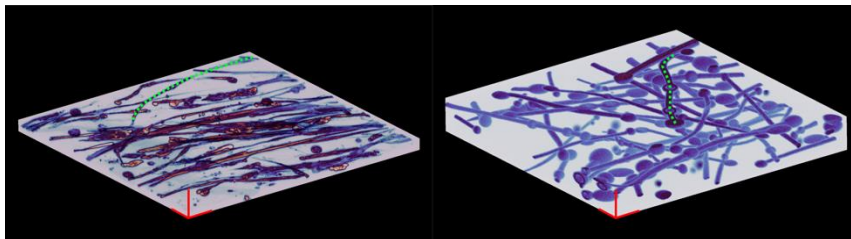
**Master's Thesis**

# Scribble-Guided Interactive 3D Myotube Instance Segmentation

Accurate instance segmentation of 3D microscopy data is a key challenge in biomedical image analysis. In particular, myotubes are elongated, highly interconnected structures whose correct separation is essential for studying muscle development, disease progression, and drug response. While recent deep learning approaches have improved segmentation quality, they still struggle with ambiguous boundaries, complex 3D morphology, and overlapping structures.

In previous work, a baseline model was developed based on a U-Net architecture. This approach struggles to predict coherent boundaries for individual instances at intersection points.

Interactive segmentation methods, such as scribble- or prompt-based approaches, have shown strong performance in 2D natural images by incorporating minimal user input to refine predictions. However, these methods are not directly applicable to dense 3D biomedical data and typically do not leverage prior model predictions. This creates the opportunity to develop new methods that combine automated segmentation with efficient user guidance tailored to 3D myotube data.



This thesis aims to develop a scribble-guided segmentation method inspired by prompt-based models. The approach will use an initial prediction from the existing model and refine it based on sparse user-provided scribbles. Different strategies will be explored, such as fixing the foreground prediction or jointly predicting instances, as well as suitable ways to encode scribble information. The method will be trained on synthetic data with simulated annotations and evaluated on its ability to improve instance segmentation quality with minimal user interaction.

**Does this sound exciting? Then get in touch with us!**

We are happy to answer any questions you might have. If you are interested, please send us an email including your current transcript of records and academic CV.

**Advisor:**

M. Sc. David Exler  
Prof. Dr.-Ing. Markus Reischl

**Requirements:**

- Basic knowledge of deep learning methods / AI
- Experience or interest in segmentation
- Basic programming skills, preferably in Python or another language with deep learning libraries

**Language(s):**

German or English

**Starting data:**

As soon as possible

**For more information, please contact:**

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