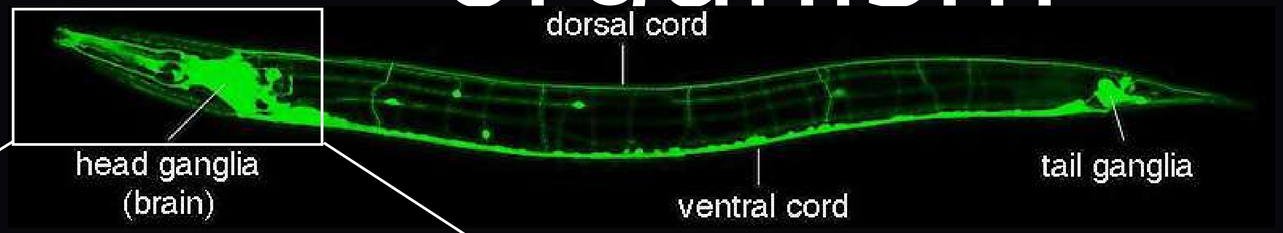
Project #1: worm tracking for reading minds

Alice & Mahsa

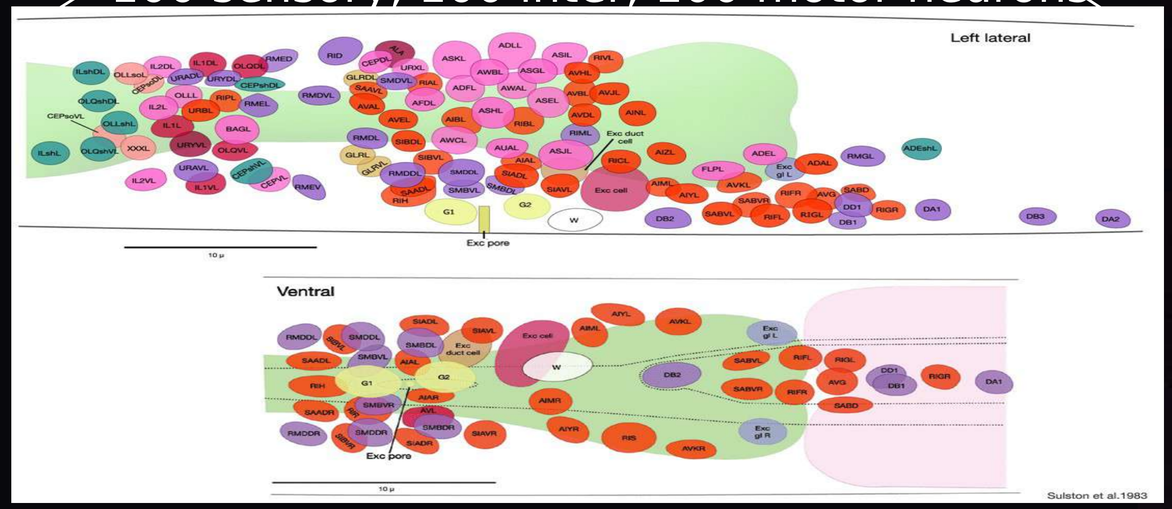
École polytechnique fédérale de Lausanne

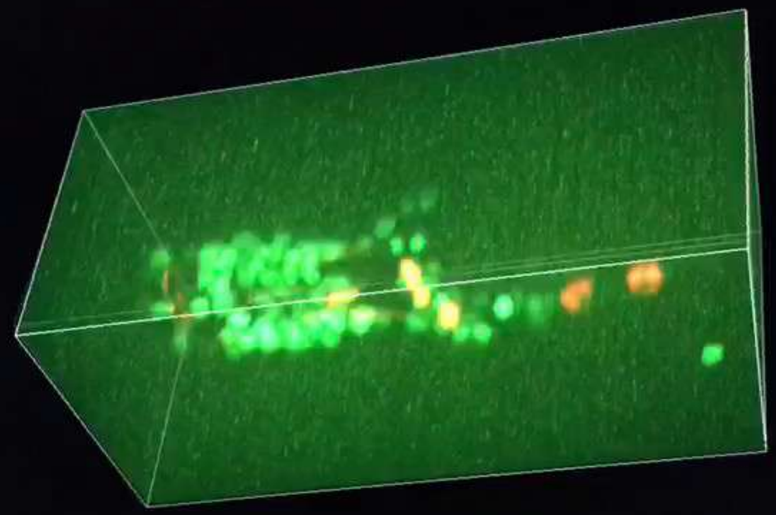
October 2022

C. elegans as a model organism



~ 100 sensory, 100 inter, 100 motor neurons





White et al., 1998

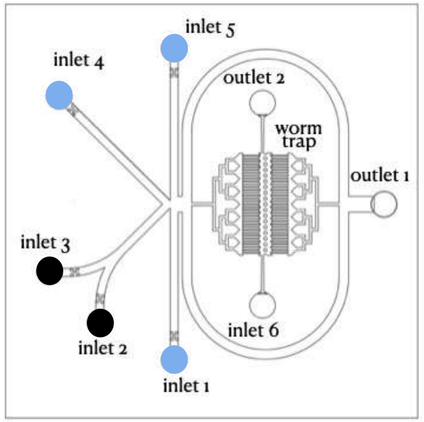
- motor behaviours can be easily tracked
- neuronal measurements with high temporal and spatial resolution
- tools for perturbing neuronal activity

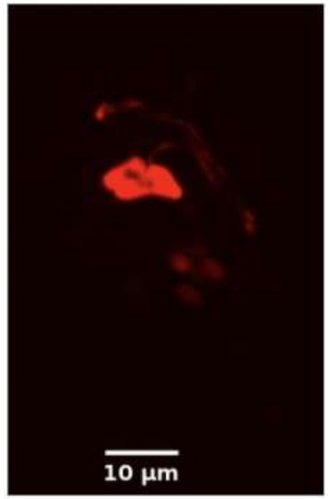
Components of research

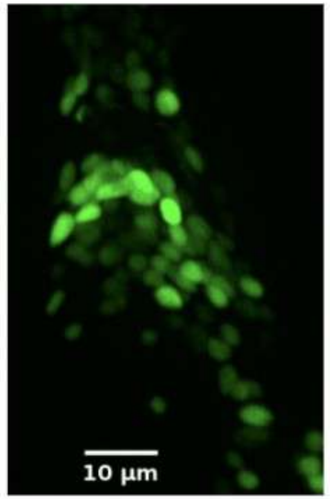
- Preparation of a library of mutants using genetic manipulations
- Fabrication of microfluidic chips
- Recording of neuronal dynamics and behaviour of freely moving animals in real time
- Tracking of neurons and neurites using the CNN, extracting features of movements from behaviour data
- Extraction of the quantitive laws

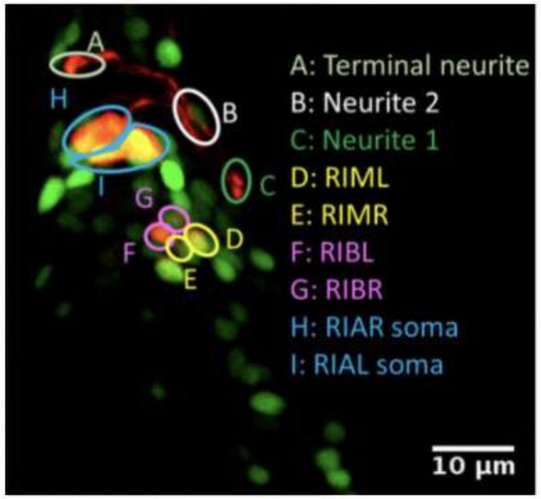
Whole-brain imaging

- Microfluidic chips (soft lithography + silicone elastomer attached to a glass coverslip)
- confocal microscopy 35 Z @ 1-3 volumes/s, ~ 50 mins recordings
- nuclear-localised or cytosolic GCaMP6, mCherry, mNeptune
- 20 s stimuli of repulsive or attractive odours separated by 40 s inter-trial intervals

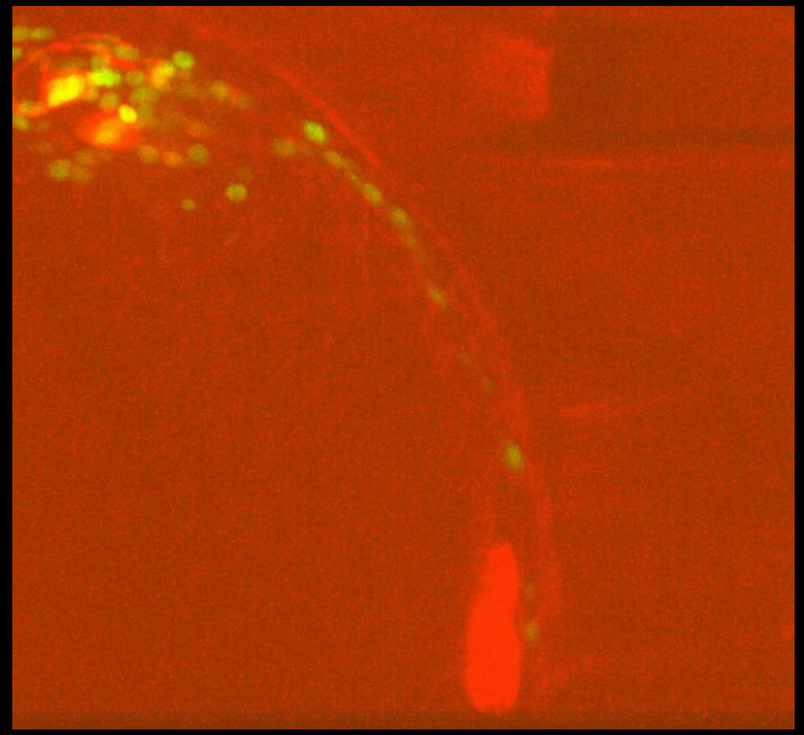








Record neuronal activity and behaviour



Confocal microscope

Infrared camera

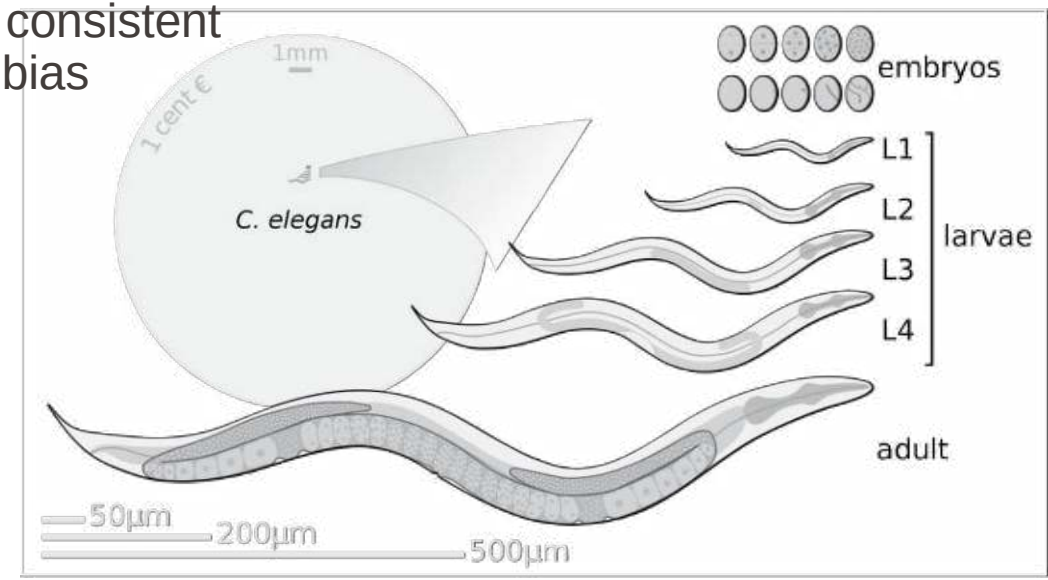
Project #2: worm tracking for personality detection

Matthieu Schmidt
(Laboratory of the Physics of Biological Systems)

Introduction

Matthieu Schmidt

Personality : Long-term & consistent behavioral differences or bias between individuals

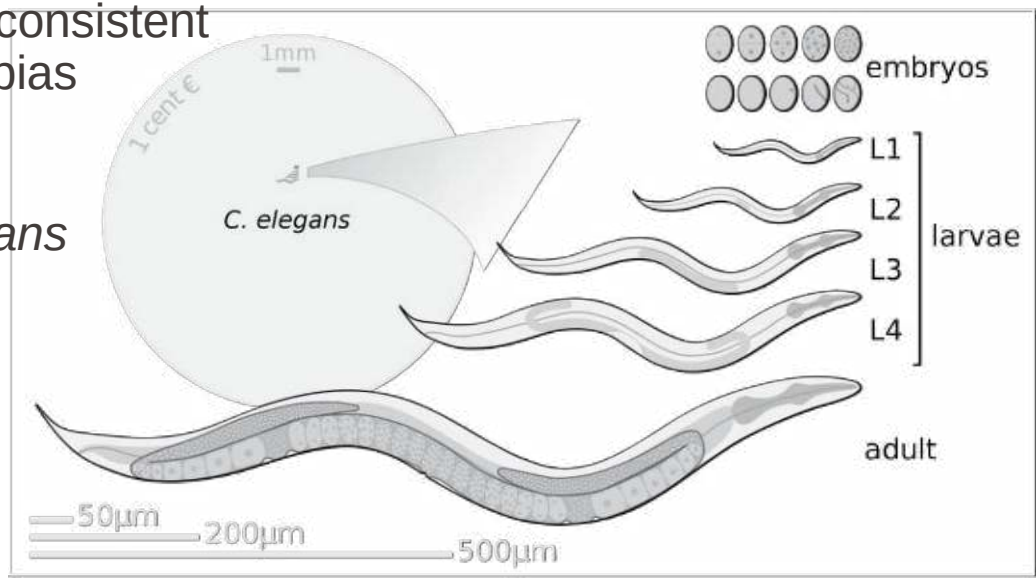


Introduction

Matthieu Schmidt

Personality : Long-term & consistent behavioral differences or bias between individuals

Compare isogenic *C. elegans* from embryo to adulthood (~60h) in standardized environnement



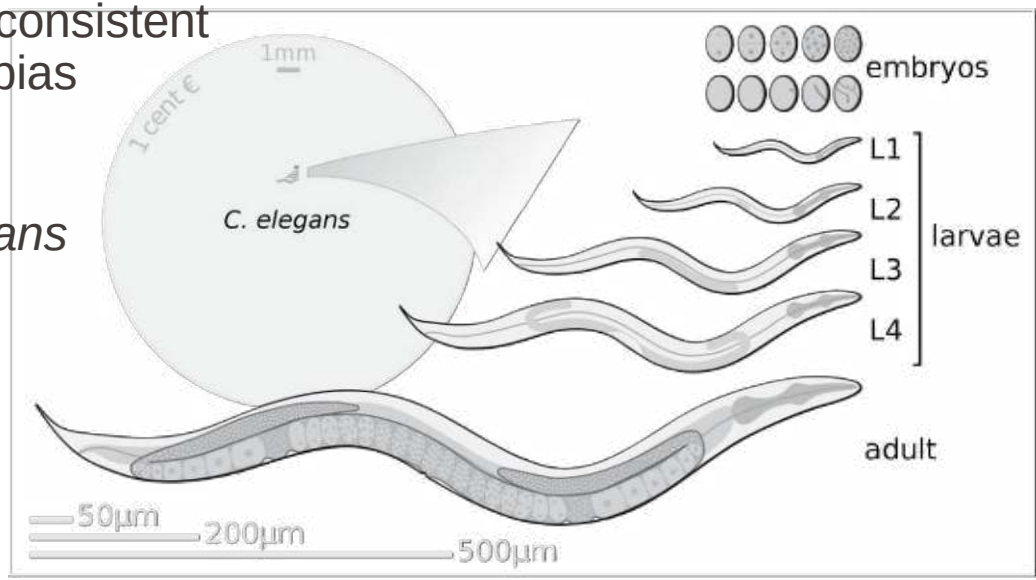
Introduction

Matthieu Schmidt

Personality : Long-term & consistent behavioral differences or bias between individuals

Compare isogenic *C. elegans* from embryo to adulthood (~60h) in standardized environnement

Study behavior variability



Introduction

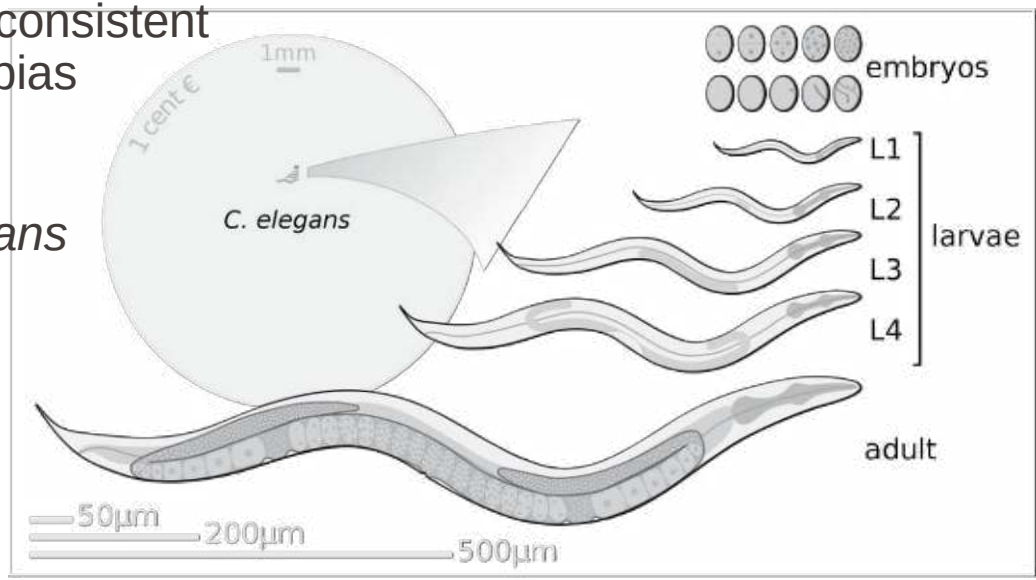
Matthieu Schmidt

Personality : Long-term & consistent behavioral differences or bias between individuals

Compare isogenic *C. elegans* from embryo to adulthood (~60h) in standardized environnement

Study behavior variability

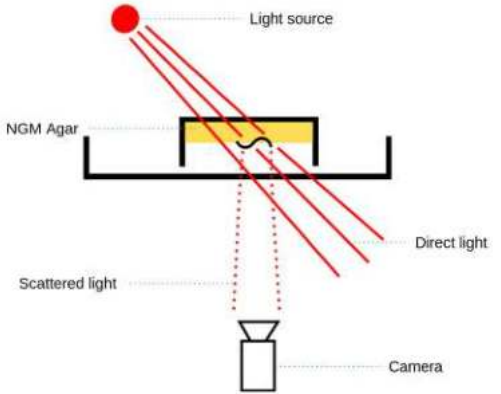
Eventually correlate personality and neuronal activity

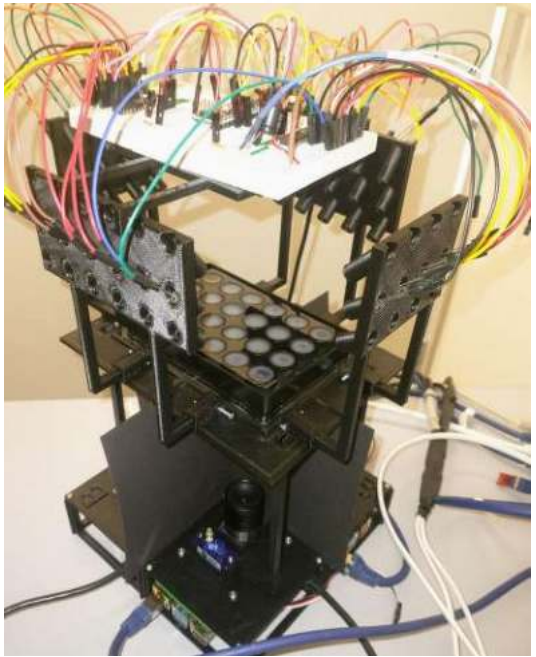


Matthieu Schmidt

The Wormstation

Home-made setup for high-throughput experiments



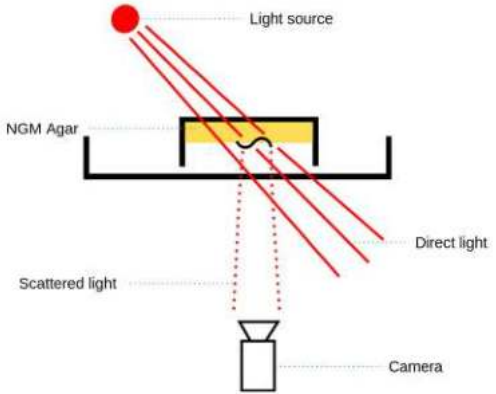


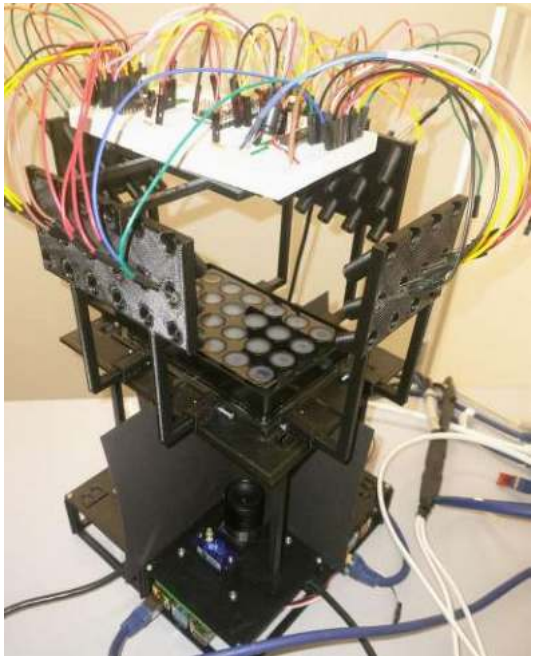
The Wormstation

Home-made setup for high-throughput experiments

3D printed + Raspberry Pi

(-> easily duplicable)





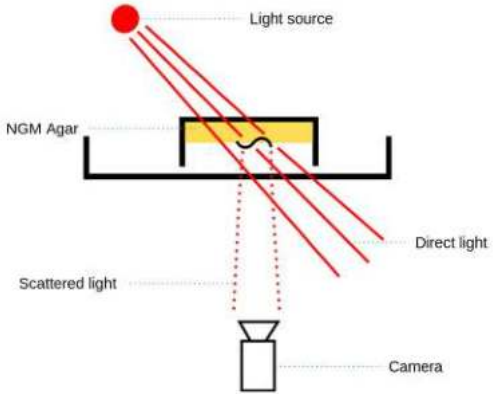
The Wormstation

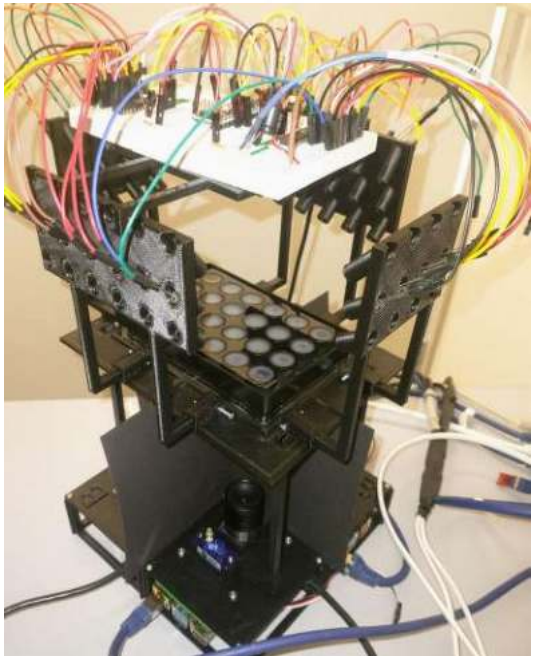
Home-made setup for high-throughput experiments

3D printed + Raspberry Pi

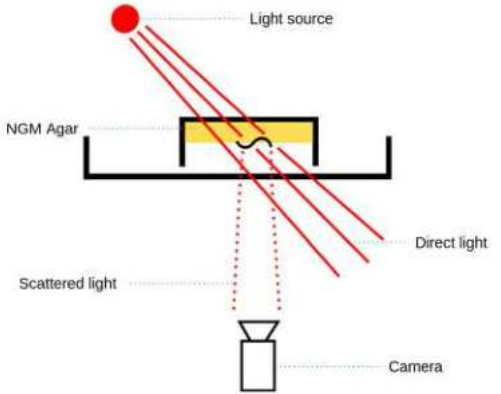
(-> easily duplicable)

Infrared dark-field illumination





The Wormstation



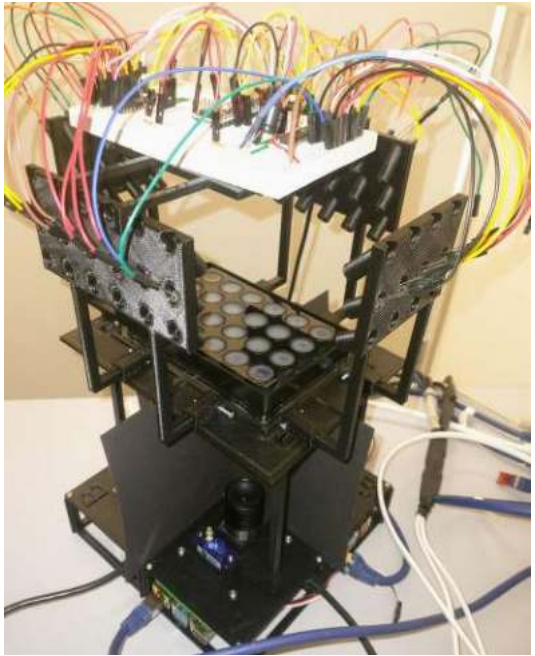
Home-made setup for high-throughput experiments

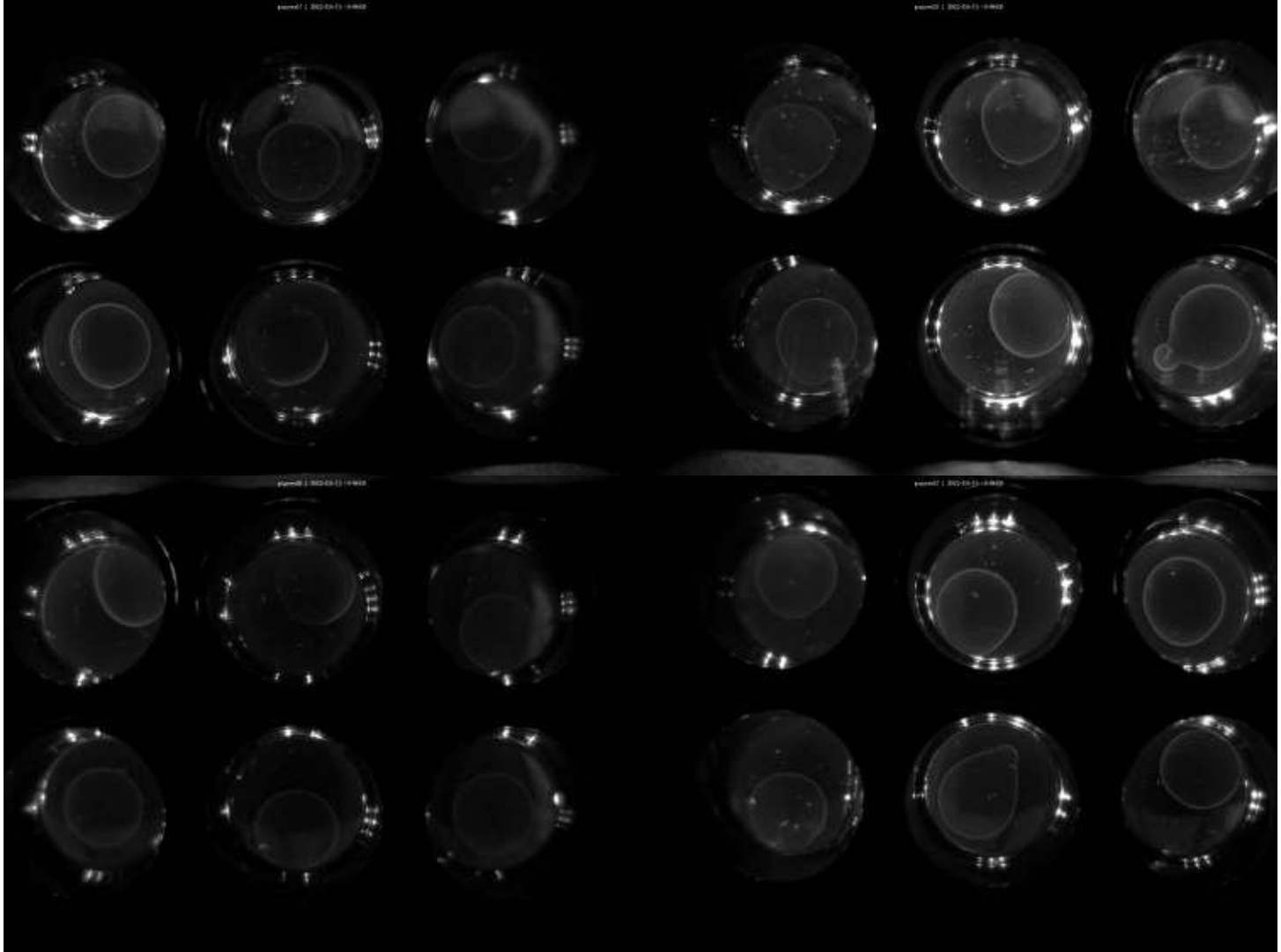
3D printed + Raspberry Pi

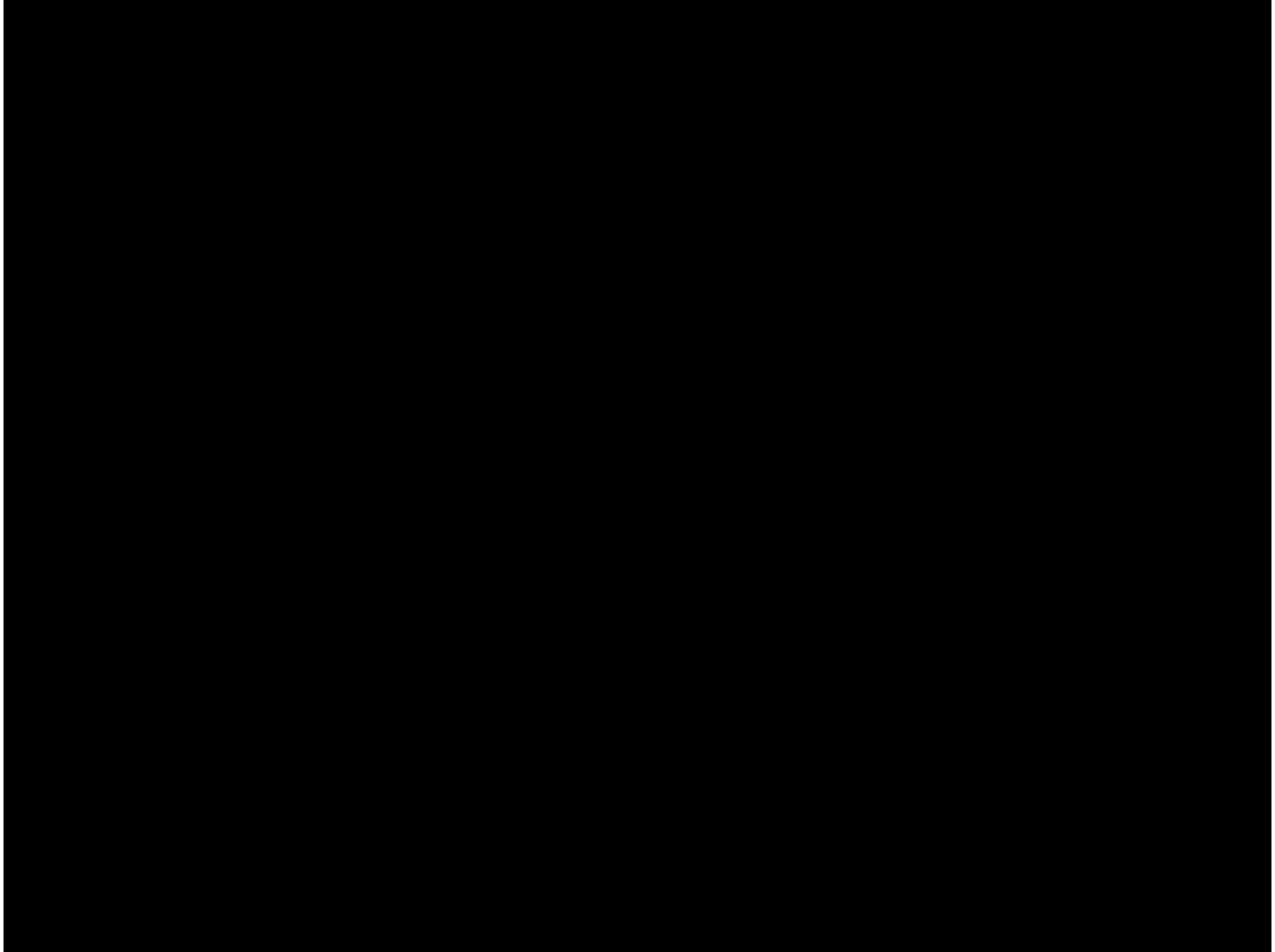
(-> easily duplicable)

Infrared dark-field illumination

24 individuals per device



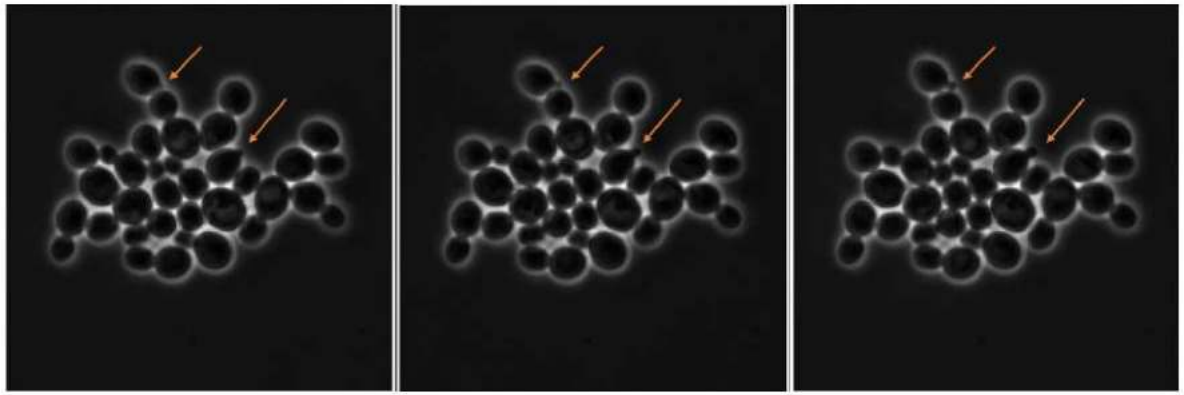


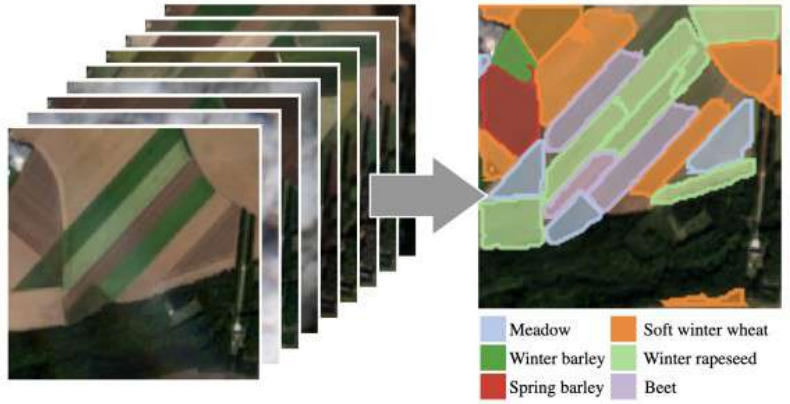


Link to video

Project #3: Attention-based temporal segmentation of budding yeast microscopy

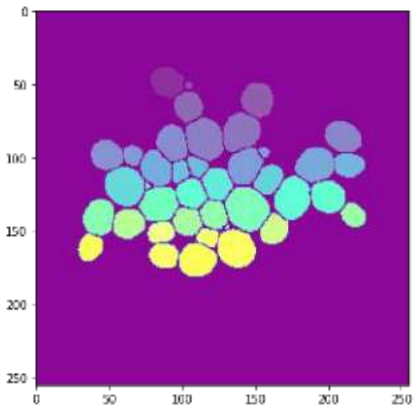
Use temporal information for the identification of small growing cells



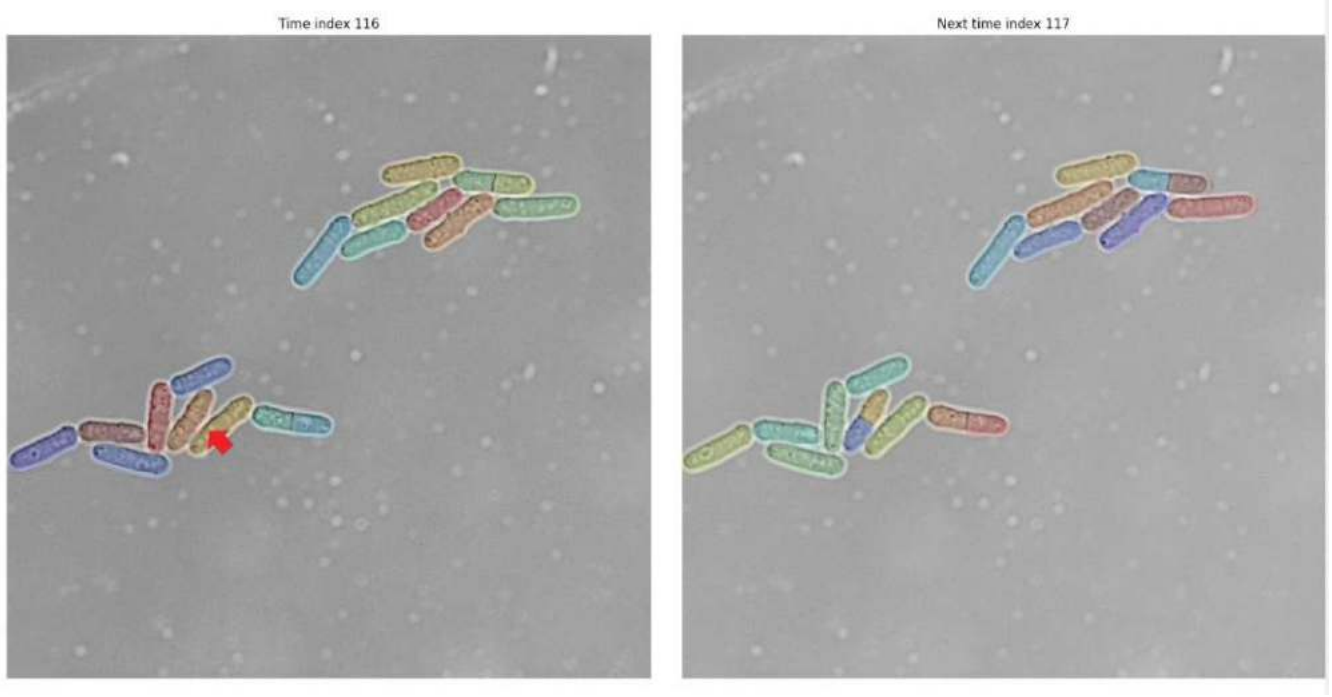


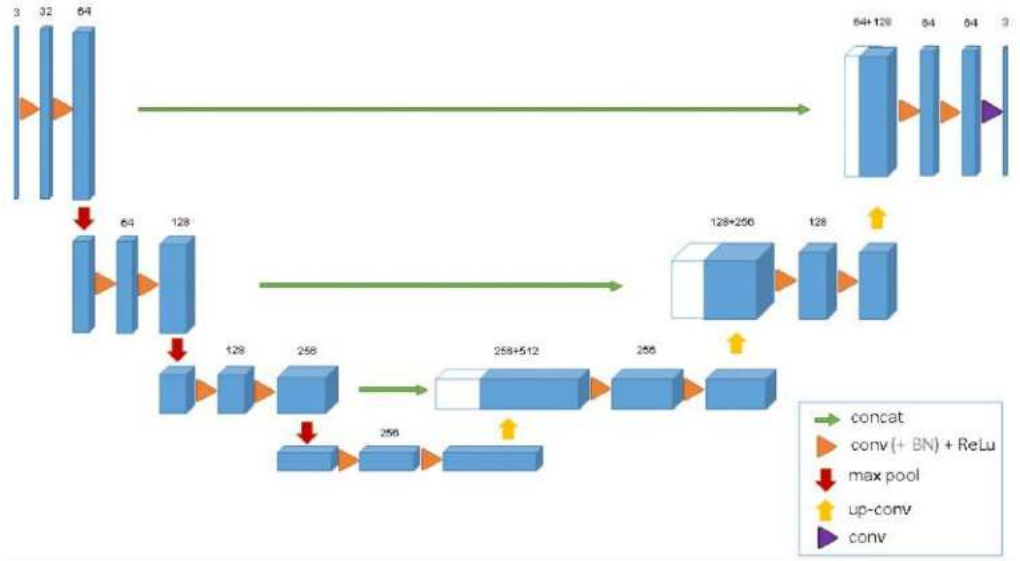
Satellite image time series

Panoptic segmentation

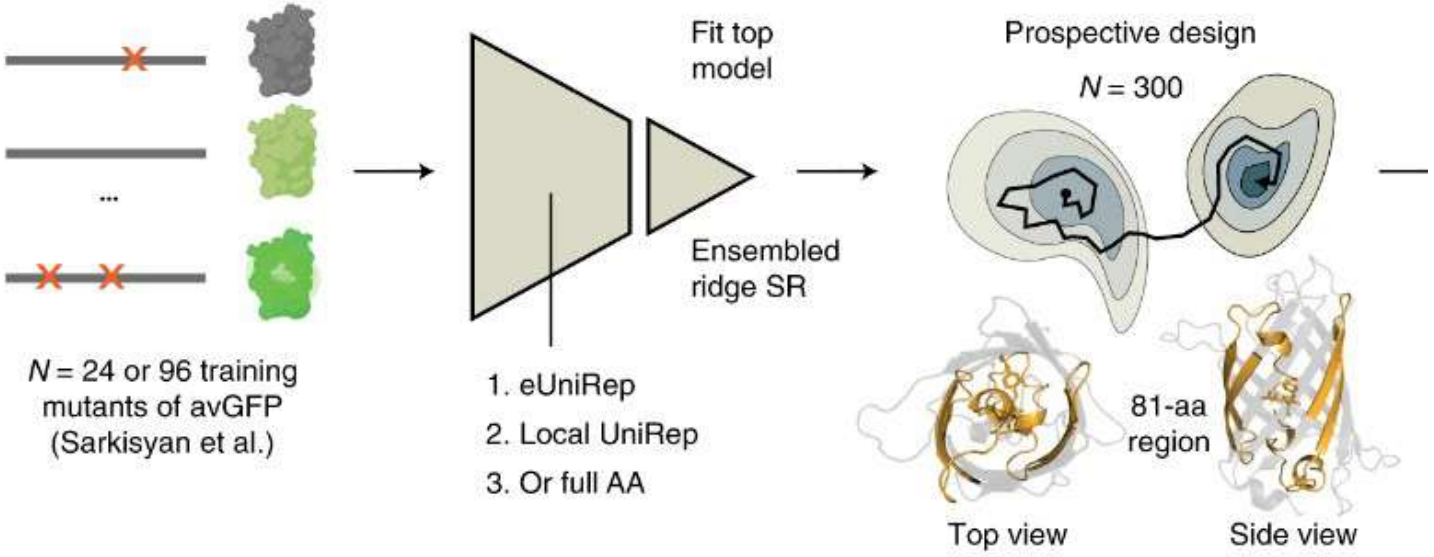


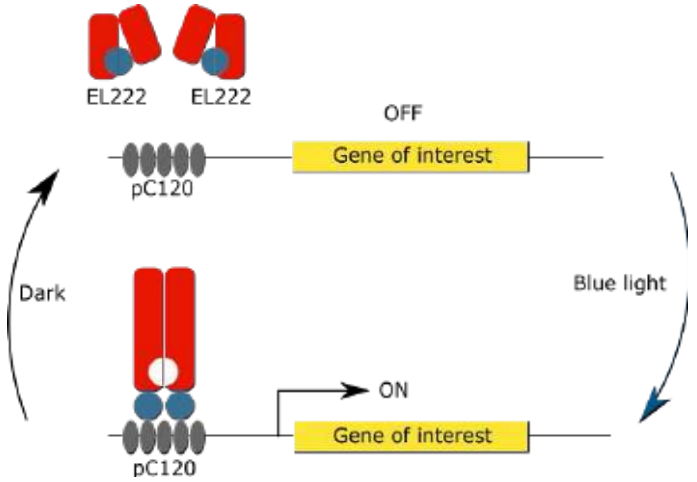
Project #4: 3D-unet temporal segmentation of fission yeast microscopy





Project #5: Optogenetic protein function prediction using deep-learning





Dataset: Mutants of optogenetic proteins with different level of light-sensitivity

Method: evolutionary UniRep