



Thesis Project Form

Title (tentative): Toward Standardized Microscopy Analysis of Marine Parasites: Feature Extraction and Early Classification of Infection Outcomes

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Description

Motivation and application domain

Brown algal parasites such as *Eurychasma dicksonii* are key players in marine disease ecology, yet their infection dynamics are still poorly quantified. Building on an existing deep-learning segmenter+tracker for time-lapse microscopy, this thesis will extract quantitative features to standardize lifecycle analysis and support biological interpretation.

General objectives and main activities

The thesis will build on an existing pipeline that automatically segments and tracks *Eurychasma dicksonii* inside brown algal hosts from time-lapse microscopy videos, developed jointly by the Clinical Bioinformatics Unit of Istituto Giannina Gaslini, the Station Biologique de Roscoff and DIBRIS. The main objective is to convert trajectories and masks into biologically meaningful descriptors of parasite development and outcome. Core activities include: (i) definition of quantitative features (e.g. per-cell volume, volume expansion rate, shape descriptors); (ii) systematic extraction of these features from curated videos; (iii) analysis to relate dynamic patterns to life-cycle stages and infection outcome; (iv) development and evaluation of machine-learning classifiers to distinguish parasites completing their life cycle vs aborting early, with possible extension to multiple parasite subtypes or classes; (v) contribution to guidelines for a standardized experimental and analytical setup for this class of microscopic acquisitions, helping to address the current lack of automatization in the field.

Training Objectives (technical/analytical tools, experimental methodologies)

The student will gain experience in biomedical image analysis, feature engineering and model evaluation on time-lapse microscopy data. They will learn to handle annotated datasets, implement feature extraction from segmentation/tracking outputs, perform exploratory statistics, and train and validate classification models in close interaction with bioinformaticians and biologists.

Place(s) where the thesis work will be carried out: DIBRIS-University of Genoa, Clinical Bioinformatics Unit - IRCCS Istituto Giannina Gaslini

Additional information

Pre-requisite abilities/skills: Basic Python programming; familiarity with data analysis libraries (e.g. NumPy, pandas, scikit-learn); interest in computer vision or image analysis. Prior exposure to deep learning frameworks (PyTorch or TensorFlow) and a basic understanding of biology or biomedical imaging are desirable but not strictly mandatory.

Maximum number of students: 1