# *Learning and Optimization Approaches for Super-resolution Imaging of Organelle Dynamics in a Human Fungal Pathogen*

# Master 2 Internship Proposal

M2 Internship proposal for spring 2020.
Location: Morpheme team, I3S Lab, Sophia Antipolis with regular meetings at iBV Lab, Nice.
Expected duration: 5-6 months.
Advisors: Laure Blanc-Féraud and Luca Calatroni (I3S), Sebastien Schaub and Rob Arkowitz (iBV)

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**Context of the intership**

Fungal infections cause significant morbidity and mortality worldwide. In particular, *Candida* species are major etiological agents of several life-threatening infections. For instance, *candida albicans* is a normally harmless commensal bacterium found on the mucosal surfaces in most healthy individuals, which can nonetheless cause superficial as well as life-threatening systemic infections. Its ability to switch from an ovoid to a filamentous form, in response to environmental cues, is a critical sign of its pathogenicity. The apical zone of the filament is densely packed with multiple highly dynamic membrane compartments, including secretory vesicles and Golgi cisternae. To understand the complex regulation of its apical polarized growth, it is critical to follow the movement of these compartments in a 3D setting, with high spatial and temporal resolution. Standard fluorescent microscopy cannot achieve this goal, hence the use of super-resolution microscopy techniques is necessary.

**Goal of the internship**

The goal of this internship is to develop, optimize and apply advanced super-resolution imaging approaches, in particular those taking advantage of fluorescent molecule blinking and their independent fluctuations in time, to study membrane traffic reorganization during filamentous growth in this human fungal pathogen. Several numerical algorithms have already been developed within the Morpheme team including tensor approaches and non-convex sparse optimization methods. However, these techniques have not been tested on real images of apical zone of the filament, which states the question of defining the best acquisition protocol, adapting the observation model to take into account perturbations due to the real environment, and, crucially, defining parameter setting methods. The main tools employed in this internship will be (non-)convex and (non-)smooth optimization approaches and learning methods.

**Candidate profile**

Second year of Master degree or Engineers School.

Strong background in applied mathematics, image processing, learning algorithms and numerical analysis.

Involvement in numerical simulation (MATLAB, C++, Python, ...) and in applications.

A general interest in health and biology is welcome.

**Practical information**

Morpheme team is a joint research group between I3S Lab (Côte d'Azur university and CNRS) and INRIA Sophia Antipolis Méditerranée.

Remuneration: internship gratification + accommodation facilities.