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Master in Photonics – “PHOTONICS BCN” ERASMUS+ “EUROPHOTONICS”

MASTER THESIS PROPOSAL

Dates: April - September 2020

Laboratory: SLN – Live cell superresolution microscopy

Institution: ICFO – The Institute of Photonic Sciences

City, Country : Castelldefels, Barcelona

Title of the master thesis:

Structured Illumination localization microscopy at lowest photon budget

Name of the master thesis supervisor: Stefan Wieser

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Keywords : Superresolution microscopy, MINFLUX, SIMPLE, SMLM

Summary of the subject (maximum 1 page) :

We have recently developed a Structured Illumination Microscopy method (SIMPLE) that achieves a 2-fold increase in single molecule localization precision compared to conventional centroid estimation methods [1]. SIMPLE advances the recently introduced MINFLUX [2] concept from the Stefan Hell group by using precisely phase-shifted sinusoidal wave patterns as nanometric rulers for simultaneous particle localization based on photon count variation over a 20 μm field of view . We validated SIMPLE in silico and experimentally on a TIRF-SIM setup using a digital micromirror device (DMD) as a spatial light modulator.

In the proposed master thesis we will improve the novel superresolution method to a 6x gain in localization precision using smaller phase shifts of the structured illumination pattern. First the method has to be validated in simulations, second we will use immobilized single Alexa 488 dyes on glass slides to experimentally justify the localisation precision, third the 6x improvement factor will be tested on nuclear pore complexes in fixed cells.



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Additional information :

* Required skills :

Matlab

* Miscellaneous :

1. Reymond L, Ziegler J, Knapp C, Wang FC, Huser T, Ruprecht V, Wieser S: **SIMPLE: Structured illumination based point localization estimator with enhanced precision.** *Opt Express* 2019, **27**(17):24578-24590.
2. Balzarotti F, Eilers Y, Gwosch KC, Gynna AH, Westphal V, Stefani FD, Elf J, Hell SW: **Nanometer resolution imaging and tracking of fluorescent molecules with minimal photon fluxes.** *Science* 2017, **355**(6325):606-612.