VRIJE UNIVERSITEIT BRUSSEL

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

DOCTOR OF ENGINEERING SCIENCES

of **Thomas Lapauw**

The public defense will take place on **Wednesday 6th March 2024 at 4:00 pm** in room **D.2.01** (Building D, VUB Main Campus)

To join the digital defense, please click here

TAUCAM: A HIGH-SPEED TIME-GATED CAMERA FOR FLUORESCENCE LIFETIME IMAGING

BOARD OF EXAMINERS

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Abstract of the PhD research

In the field of medical imaging, there is an ever-ongoing search for new ways to image tissue in less invasive ways to create more contrast and get more information about the biological processes that are happening. Fluorescence imaging has gained much interest due to its safety, low cost, and high sensitivity. This is especially the case in the field of pre-clinical research with small animals, where a lot of research is being done towards the development of targeted fluorescent contrast agents and the clinical translation thereof.

Fluorescence intensity imaging depends on many variables: concentration, absorption, scattering, illumination power, ... By using the inherent temporal behavior of the fluorophores, the lifetime, some of these issues can be mitigated, and additional information can be gained. This fluorescent emission is very faint and happens within a few hundred picoseconds to a few nanoseconds after excitation, this timescale makes measuring lifetime challenging.

This work presents the development of the tauCAM, a widefield high-speed time-gated camera, intended for widefield fluorescence-lifetime imaging in the NIR-I band. The tauCAM uses a watercooled 64x64 pixel CAPS array based on our proprietary Current-Assisted Photonic Sampler (CAPS) pixel. The hardware development, (embedded) software, and the related engineering choices are covered in detail, in addition to the characterization of different performance aspects of the tauCAM.

The realization of this camera and software framework around it enables a whole slew of new applications and research opportunities aside from fluorescence lifetime imaging, ranging from timeresolved spectroscopy and time-domain multiplexed RGB; to the development of targeted fluorescent dyes and studying lifetime modulation in relation to binding status and environment.