



Contribution ID: 17

Type: Oral presentation

Large area SiPM and high-throughput electronics for next generation time-domain diffuse optics

Friday, 4 October 2019 10:00 (20 minutes)

The use of large area SiPMs represents an impressive breakthrough in time-domain diffuse optics (TD-DO) for non-invasive diagnostics and imaging. Large area detector can improve light harvesting allowing to detect the very low number of photons re-emitted from the sample at relatively late times that have probed deep in the tissue. Large area SiPMs could thus foster the measurement of deep organs such as liver, lung and heart that conventional detectors aren't capable of.

We firstly present our system based on 3x3 mm² SiPM coupled to a new high-throughput (up to 160 Mcps) timing electronics MultiHarp 150 (PicoQuant). To better exploit the large area, we work with a very high throughput thus overcoming the single-photon statistics limit. Using a suitable post processing correction, we show an improved depth sensitivity and a still good linearity and accuracy in the retrieval of optical properties. Such a result allows us to assess the suitability of large area detectors coupled to high throughput electronics as a tool overcome the actual limits of TD-DO systems.

We will then present the aim of the "SP-LADOS" project (within Attract H2020 project, grant agreement number 777222): the realization of a 1 cm² SiPM detector, with low background noise (dark count rate lower than 2 Mcps in 1 cm²) and good timing resolution (full-width at half maximum < 500ps). This step represents a tough technological challenge but will pave the way to a completely new generation of instruments for non-invasive diagnosis and monitoring, potentially capable of revolutionizing the field.

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Session Classification: Medical applications