Ph.D. in Information Technology:

Thesis Defenses April 20th, 2021 online by TEAMS – at 09:00

Fai clic qui per partecipare alla riunione

SCIORTINO GIUSEPPE – XXXIII cycle

Advisor: Giorgio Ferrari

PhD Thesis Title : Multichannel CMOS Integrated Circuits for Broadband Spectroscopy Applications

Short Abstract:

Advanced spectroscopy techniques are more and more gaining the interest of the research community because find wide and outspreading applications in many different fields like industrial quality control, tumor analysis and new materials engineering. The thesis contributes to this field by designing and operating Application Specific Integrated Circuits (ASICs) for a fast, yet highly resolved, acquisition of spectra, obtained with two powerful techniques, namely broadband Stimulated Raman Scattering (SRS) microscopy and time-resolved Pump&Probe spectroscopy.
The first ASIC was developed in the framework of VIBRA (Very Fast Imaging by Broadband Coherent Raman), an ERC H2020 project coordinated by Prof. D. Polli of Politecnico di Milano. The challenge of the ERC project is to develop a stimulated Raman scattering microscope, that in real time can distinguish different chemical species with a spatial resolution of about 1 µm. The microscope finds its application in the histological field, allowing a fast, safe, contactless, and repeatable tumor analysis. To reach such a result, an ASIC implementing a pseudo-differential channel readout circuit was designed and integrated in the electronic acquisitions system. The ASIC allows to process in parallel many pulsed signals coming from a photodiode arrays, with an automatically balanced differential lock-in architecture, for the optical noise reduction. The developed system acquires a 32 wavelength SRS spectrum in only 100 µs, generating one biological sample image per second, well beyond the state-of-art for similar applications.
The second thesis framework has been dedicated to the development of a ground-breaking spectrometer for ultra-fast Pump and Probe spectroscopy. The limitations of the current instruments, in terms of speed, will be overcame using fast repetition rate lasers (up to 1MHz) and a parallel acquisition and processing of many wavelengths (up to 40). These improvements are made possible thanks to a very flexible 20-channels custom ASIC, specifically designed for Pump&Probe spectroscopy. The chip is switched capacitor technique based and can extract the useful optical information with few ppm resolution.

Committee Members

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