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One of the goals of the INFN HASPIDE project (Hydrogenated Amorphous Silicon DEtectors) is to explore the possibility to use a-Si:H detectors for medical physics applications. The choice of this material as sensitive layer is driven by its resistance to radiation damage which allows the sensors to operate in very harsh conditions like, *e.g.*, in FLASH therapy. Furthermore, the sensitive layer could be very thin (order of a few micrometers) and it could be deposited on a variety of substrates, including thin flexible plastic layers of Polyimide which allows to develop sensor matrices with a great variety of shapes. First tests with a 1D prototype on clinical photon beams demonstrate that the device has a linear response as a function of the dose rate and it is fast enough to detect and measure the dose delivered by every single pulse.

A smart optical and ultrasound device for the diagnostics of breast cancer.

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SOLUS is a H2020 funded project devoted to the design, development and testing in clinics of a Smart Optical and Ultrasound device for the diagnostics of breast cancer. Smartness stems from the purpose (discrimination of benign and malignant lesions), the method (non-invasive characterization of the tissue) and the technology (multimodal and compact device). In fact, the collaboration of all partners allowed the first integration of time domain multi-wavelength diffuse optical tomography (composition) and commercial ultrasound (morphology), color doppler (vascularization) and shear wave elastography (stiffness) in a hand-held probe. The development of miniaturized optical components was essential: laser drivers generating picosecond pulses, large-area time-gated detectors and dedicated acquisition electronics. Data analysis required a custom-made approach as well for diffuse optical tomography. After the assembly, the instrument has been thoroughly characterized in laboratory on phantoms mimicking the optical and ultrasound properties of a breast. Early results of the clinical validation of the SOLUS system now ongoing on patients with breast lesions will be presented.

Validation of a perturbative approach for the analysis of data obtained from diffuse optical monitoring of neoadjuvant chemotherapy in breast cancer patients: From simulations to tissue phantom tests.

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A multi-wavelength optical mammograph that works under time domain diffuse optical spectroscopy, developed by our research group, is applied to monitor the breast cancer patients' response to neoadjuvant chemotherapy. So far, a simple homogeneous data model approach to estimate tissue composition averaged along compressed breast thickness proved sensitive to therapy induced changes. The application of a perturbative model, describing the lesion as a perturbation in healthy tissue, would allow a quantitative characterization during therapy. This study validates a perturbative fitting procedure through a systematic approach starting from simple to complex scenario: first on simulations, then phantoms ("stand-in" for human tissue). This kind of systematic assessment helps us to estimate the errors in the reconstructed parameters when there are uncertainties in the input, when applied to a real case scenario like that of *in vivo* studies. Hence, by varying input parameters like perturbation volume, geometry, position and signal level, one at a time, their effect and the overall model efficiency are studied. The final aim would be to analyse the *in vivo* measurements' data.

Muscle MRI in facioscapulohumeral muscular dystrophy.

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