LASER SCANNING SYSTEMS: FROM INDUSTRIAL TO HIGH-END BIOMEDICAL APPLICATIONS USING OPTICAL COHERENCE TOMOGRAPHY

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We report the analysis and optimization of several laser scanning systems, with regard to the requirements of industrial and biomedical imaging applications, with a focus on Optical Coherence Tomography (OCT) [1,2].

Polygon mirror (PM) scanners, as applied in the fast scan necessary for broadband laser sources scanned in frequency, for Swept Source (SS) OCT [3,4], have been analyzed, and a novel theory with regard to the state-of-the art has been developed [5]. The characteristic functions of the PM scanners are discussed, and their relevant features to make the best of these devices for high-end applications are pointed out.

Galvanometer scanners (GSs) are approached with regard to the optimization of their duty cycle/time efficiency, as well as to the distortions they display when used at high scan frequencies and amplitudes [6]. The necessary procedure when a larger field-of-view than that of an individual image is required is discussed [7]. The GS-based handheld scanning probes we have developed for both Non-destructive Testing (NDT) and for biomedical imaging with OCT are presented [8] – with several of their applications. Starting from our researches on the optimal scanning functions of GSs for a maximum duty cycle [9], we discuss the progress that has been done in handheld scanning probes based on different scanning devices [10], including Micro-Electro-Mechanical Systems (MEMS) [11,12]. Finally, several applications of the above systems are presented, with the emphasis on our latest research [13], on the possibility to replace the gold standard in the field of metallic fractures, i.e. Scanning Electron Microscopy, with OCT. Although the latter technique has a much lower resolution than the former, it also has much lower costs, it does not require trained operators, and it is not lab-based. Thus, mobile OCT units have been developed [10], equipped with handheld scanning probes [8,10-12], therefore *in situ* NDT can be performed, including for forensic investigations in various incidents (e.g., for plane, train, or car accidents, pipe ruptures, etc.).

Conclusions and directions of future work are pointed out, both with regard to scanner developments and to on-going scanning and OCT applications.

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