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Performance assessment of a data processing chain for THz imaging

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Nowadays, TeraHertz (THz) imaging is deserving huge attention as very high resolution diagnostic tool in many applicative fields, among which security, cultural heritage, material characterization and civil engineering diagnostics. This widespread use of THz waves is due to their non-ionizing nature, their capability of penetrating into non-metallic opaque materials, as well as to the technological advances, which have allowed the commercialization of compact, flexible and portable systems. However, the effectiveness of THz imaging depends strongly on the adopted data processing aimed at improving the imaging performance of the hardware device. In particular, data processing is required to mitigate detrimental and unavoidable effects like noise, signal attenuation, as well as to correct the sample surface topography.
With respect to data processing, we have proposed recently a strategy involving three different steps aimed at reducing noise, filtering out undesired signal introduced by the adopted THz system and performing surface topography correction [1]. The first step regards noise filtering and exploits a procedure based on the Singular Value Decomposition (SVD) [2] of the data matrix, which does not require knowledge of noise level and it does not involve the use of a reference signal. The second step aims at removing the undesired signal that we have experienced to be introduced by the adopted Z-Omega Fiber-Coupled Terahertz Time Domain (FICO) system. Indeed, when the system works in a high-speed mode, an undesired low amplitude peak occurs always at the same time instant from the beginning of the observation time window and needs to be removed from the useful data matrix in order to avoid a wrong interpretation of the imaging results. The third step of the considered data processing chain is a topographic correction, which needs in order to image properly the samples surface and its inner structure. Such a procedure performs an automatic alignment of the first peak of the measured waveforms by exploiting the a-priori information on the focus distance at which the specimen under test must be located during the measurement phase.
The usefulness of the proposed data processing chain has been widely assessed in the last few months by surveying several specimens made by different materials and representative of objects of interest for civil engineering and cultural heritage diagnostics. At the conference, we will show in detail the signal processing chain and present several achieved results.

REFERENCES

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