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Developments of mobile X-ray methods at the XRAYLab/ISPC in the Italian node of the European Infrastructure for the Heritage Science (E-RIHS)

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The XRAYlab group of the ISPC-CNR in Catania conducts scientific activity in the Italian node of the European Infrastructure for the Heritage Science (E-RHIS) providing access to advanced mobile X-ray based techniques for non-invasive cultural heritage applications. Recently, in the framework of the infrastructural project SHINE (StrengtHening the Italian Node of E-RIHS), the group upgraded several analytical techniques in operation in the laboratory. A new 3D array of 6 SDDs (total active area equal to 300mm2) operated in parallel was installed in our MA-XRF/micro-XRF scanner based on real-time technology. The novel detection system significantly improved the sensitivity of the device allowing the acquisition of pixel XRF spectra during the scanning sessions by maximizing the measured vs. the input count rate while minimizing the dead time with respect to a single detector setup under a 6-time beam intensity. In addition, a novel mechatronic allowed us to increase the scanning speed up to 150 mm/sec, and to record XRF pixel spectra with a dwell-time down to 5ms in a fast continuous mapping. The lateral resolution achievable by the device in macroscopic contexts (i.e., large dimension paintings) is down to 50um for the MA-XRF and 7um for the micro-XRF (achieved with modular optics installed in the primary X-ray source - i.e., a microfocus Rh-anode tube of 30W power). Finally, the scanner a new software suite was programmed in the scanner with the ability of analyzing XRF pixel spectra by using AI models and providing the elemental distribution images on-the-fly during the scanning. MA-XRF/micro-XRF investigation is now supported by two ancillary mobile techniques developed in the framework of SHINE, namely CXRF and MA-XRPD, providing complementary information on the artworks investigated. A 3D mapping with CXRF is typically used to investigate stratigraphies and MA-XRPD for gaining specific information on the (polycrystalline) nature of materials under study. Some compelling applications are presented and discussed.

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