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A comparative study of medical CT, X-ray micro-CT and high-speed thermal neutron tomography as non-destructive material evaluation techniques

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For years computerized X-ray tomography has been widely used as a medical diagnostical tool. This non-destructive technique soon turned out to be an important research tool for a wide variety of scientific subjects. X-ray micro-CT is based on the same principles as the medical scanner, but provides higher resolution images compared to the medical CT. This X-ray micro-CT has recently been introduced as a non-destructive material evaluation technique for engineering and geology purposes. The fact that X-ray micro-CT visualizes the internal structures of natural building stones in combination with porosity values and pore-size distributions, is a major advantage for the study of their conservation. Localization of doped consolidants inside natural stones made possible with this X-ray micro-CT technique, offers an extra dimension to the cultural heritage research. The penetration of fluids like water, consolidants or water repellents inside porous materials is a hot topic when dealing with conservation and restoration research. Due to its weak attenuation, water is very difficult to locate on radiograms. Therefore high-speed thermal neutron tomography was used to produce three-dimensional models of the dynamic process of water penetration. During this study, the advantages and limitations of medical CT, X-ray micro-CT and high-speed thermal neutron tomography in the domain of conservation and restoration research were examined and discussed.