ID contributo: **0** Tipo: **non specificato**

X-ray computed tomography using synchrotron sources and advanced lab setups for comprehensive microstructural properties of materials and biomaterials

mercoledì 1 marzo 2017 09:00 (45 minuti)

Imaging techniques based on the use of hard X-rays play an important role in several research fields and industrial applications. Many topics in medicine, biology, material science, geosciences and cultural heritage studies can be afforded thanks to the high potential and large applicability of X-ray imaging.
In the last twenty years a great interest has been devoted to the development of X-ray computed microtomography (micro-CT) techniques, both employing microfocus and synchrotron radiation sources. These techniques allows to produce 3D or 4D (dynamic micro-CT) images of the internal structure of objects at the micron- and submicron- scale. Investigations performed directly in the 3D domain overcome the limitations of stereological methods usually applied to microscopy-based analyses and a non-destructive method is more suitable for further complementary analyses and for precious or unique samples (fossils and archeological finds, in-vivo imaging, etc ⋯).
An intriguing challenge is to extract directly from 3D and 4D images quantitative parameters related to the physical properties of the studied materials. However, accurate image processing, analysis and visualization methods for an effective assessment of these parameters are still an open issue especially in the case of 4D micro-CT experiments.
In this talk, several scientific applications of advanced hard X-ray imaging techniques will be presented trying to critically expose advantages, limitations and open problems in the different fields.

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