Non-destructive 3D imaging of biomaterials by high-resolution x-ray micro computed tomography and holotomography. Applications in orthopedics and dentistry.

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X-ray computed micro tomography (micro-CT) allows an easy 3D reconstruction, together with a complete morphological analysis, offering the possibility to perform *in-vivo*, *ex-vivo* or *in-vitro* experiments. The use of X-rays delivered by Synchrotron Facilities has several advantages compared to X-rays produced by Laboratory sources. It includes the possibility to take advantage of the high photon flux, which guarantees the achievement of high spatial resolution with a good signal-to-noise ratio. Furthermore, the Synchrotron-produced X-ray beam is tuneable, thus allowing to perform measurements at different energies. For specific applications, the imaging quality can be enhanced through the use of phase contrast tomography (PCT. The phase shift cross section is three orders of magnitude larger than the absorption cross section for materials with low atomic number, which is an indication that PCT is more sensitive to density variation than absorption-based X-ray imaging. Additionally, whereas PCT is based on a single distance between the detector and the sample, the holotomography (HT) involves imaging at several distances and then combining the phase shift information to produce 3D reconstructions, allowing the simultaneous imaging of both hard and non-mineralized tissues.

The use of the above-mentioned techniques for qualitative and quantitative data extraction for different applications in the fields of orthopaedics and dentistry, involving also stem cells, will be presented during the lecture. The applications vary from tooth or bone imagining to newly formed bone analysis or blood vessels visualization inside different types of scaffolds.