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CT imaging in small animal research: Have we reached the limit? (I)

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X-ray computed tomography (CT) imaging is an integral part of small animal research. It is not only used for diagnosis of disease and monitoring of disease progression, but also for targeting of radiation therapy of cancer in image-guided small animal irradiators. CT imaging in small animals, known as microCT imaging, differs from clinical CT imaging in a number of aspects. Since smaller objects are imaged, the required spatial resolution is an order of magnitude higher. This has some implications on image acquisition technique as well as x-ray interactions in the small animal. X-ray source, detector, and imaging geometries for small animal microCT imaging will be discussed and methods for quality assurance developed at the University of Victoria in collaboration with AAPM will be presented. A Monte Carlo model of microCT imaging of the Small Animal Radiation Research Platform (SARRP) that was used to study various imaging parameters will be shown.
Since x-ray CT has a low sensitivity for contrast imaging, a novel microCT imaging technique, x-ray fluorescence CT (XFCT), will be introduced. XFCT imaging has the potential to be used for high-sensitivity molecular imaging of high-atomic number elements, such as gold nanoparticles. Recent advances in XFCT imaging in terms of x-ray source and detector technology will be discussed, as well as L-shell and K-shell XFCT reconstruction techniques. Simulation and experimental data will be presented to demonstrate the capability of XFCT to image gold nanoparticles at low concentration and to perform multiplexing (imaging multiple probes at once). Finally, a short study on proton beam XFCT of gold will be presented.

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