Filtered back-projection reconstruction for scattering proton CT along most likely paths

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Abstract

This work investigates the multiple Coulomb scattering (MCS) of protons to reconstruct the relative scattering power map of the object. For each proton reaching the downstream detector, the angular deviation was recorded and then binned at different distances from the source while taking into account a curved proton path. The angular variance of each pixel as a function of depth was then converted to the water equivalent path length (WEPL) of the MCS angle through a fifth-order polynomial approximation. A filtered back-projection (FBP) algorithm was then used to reconstruct the image of the 360 projections taken at 1 degree interval. The relative scattering power map is related to the radiation (or scattering) length of the material and this quantity is also related to two intrinsic properties of the material, i.e. the atomic number and density. The preliminary results show that the scattering proton CT images could provide an additional information about the material which could be used in combination with the conventional energy-loss proton CT specifically in the lateral dose calculation.

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