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Application of 3D sensitive voxel detector for X-ray color imaging and beam hardening effect correction

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The X-ray imaging is today widely used in broad area of applications. One of the X-ray imaging limitations is in distinguishing between thick layer of low Z and thin layer of the high Z material. The background effect is called Beam hardening. It is the effect where the incident X-ray spectrum is modified by the object itself according to its material composition and thickness. This causes problems in many applications e.g. CT reconstruction where it leads to reconstruction artifacts and lower resolution. This work presents a new technique for estimation of beam hardening using a new 3D voxel detector based on Timepix chip. The device is designed as a layered stack of several Timepix pixel detectors. The single Timepix device (256 x 256 pixels with pitch of 55 μm) consists of sensor chip (typically 300 μm of silicon) bump bonded to a readout chip (typically 700 μm). The readout chip is thinned down to 120 μm to reduce amount of insensitive absorbing material in the stack. Individual layers in the stack act as a filter, i.e. each stack layer visualize different part of the spectra attenuated by the object giving further information about the object composition. Comparing attenuation levels observed in different detector layers can be used to estimate the level of a beam-hardening effect in the imaged object and thus to distinguish differences in material composition.

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