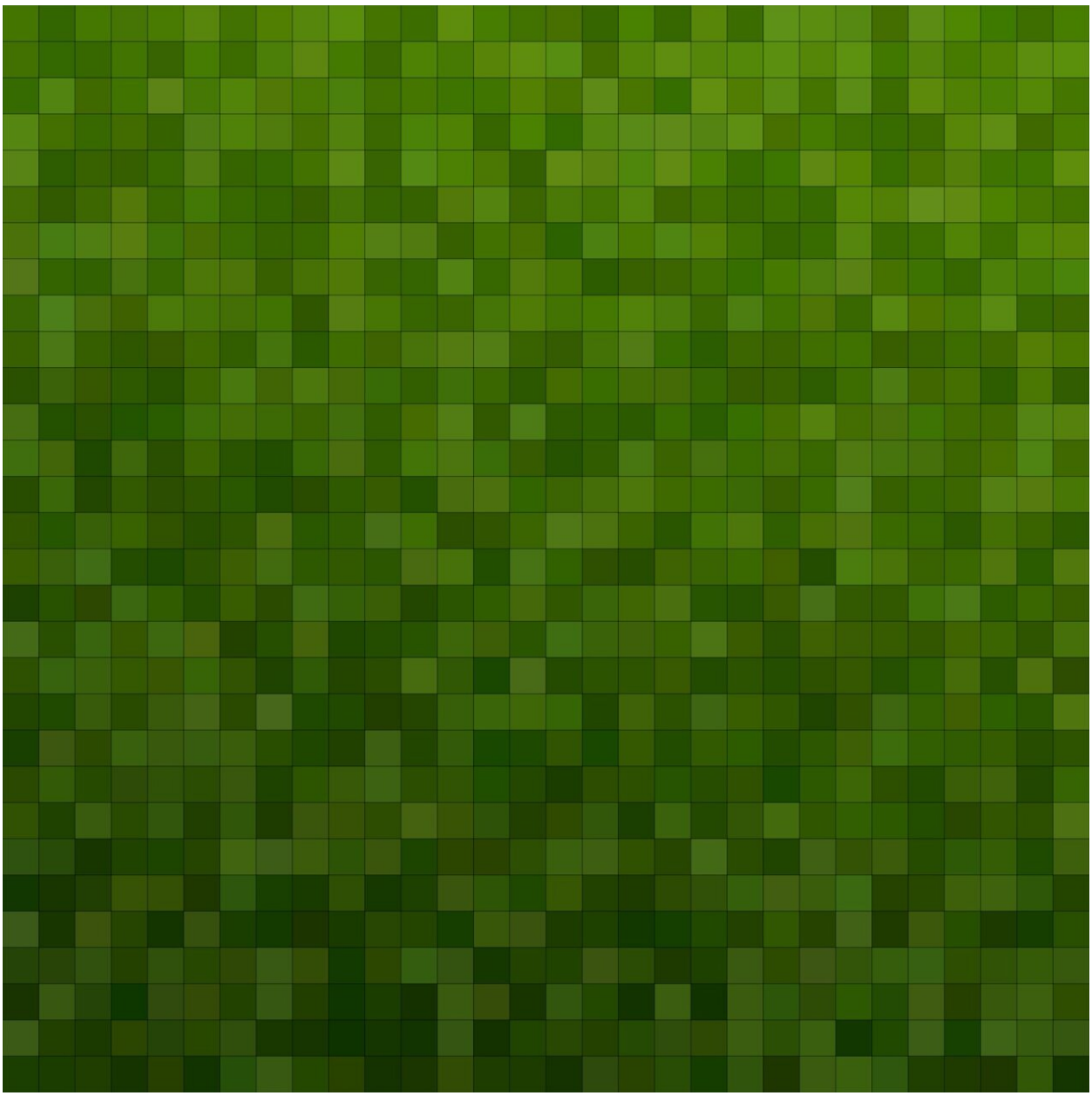
Novel data acquisition method for high-resolution cone-beam computed tomography imaging

October 13 2023, by Li Yuan



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For the three- and four-dimensional cone-beam computed tomography (CBCT) imaging, flat-panel detector (FPD) is critical among applications such as oral imaging, image-guided radiation therapy and interventional therapy.

However, the dilemma between the pixel-size-defined high spatial resolution and the pixel-number-confined slow data acquisition speed in FPD impedes its further development in advanced CBCT imaging tasks, which require both high spatial and high temporal resolution simultaneously. In addition, the current FPD is also difficult in performing dual-energy CBCT imaging to generate quantitative material-specific images.

Recently, a research group led by Prof. Ge Yongshuai from the Shenzhen Institute of Advanced Technology of the Chinese Academy of Sciences has proposed a super-resolution dual-energy CBCT (DE-CBCT) imaging method, named as suRi, based on the dual-layer FPD.

The study was published in *IEEE Transactions on Medical Imaging* on Sept. 27.

In this method, sub-pixel (half pixel in this study) shifted binning is utilized between the two detector layers to double the spatial sampling rate of the dual-layer FPD during signal acquisition. By doing so, high-spatial-resolution CBCT imaging can be achieved at high signal readout speed (large detector binning rate).

In addition, the researchers developed a penalized likelihood material decomposition algorithm to directly reconstruct the high-resolution material bases from the obtained dual-energy CBCT projections.

At the same signal readout speed (detector binning level), the proposed suRi method can improve the image spatial resolution by more than 23% compared with the conventional dual-layer-FPD-based DE-CBCT imaging.

Moreover, accurate basis images with high spatial resolution can be directly reconstructed from such dual-energy projections acquired by suRi.

"We believe our method would greatly enhance the imaging performance of dual-energy CBCT systems based on dual-layer-FPD in the future," said Prof. Ge.

More information: Ting Su et al, Super resolution dual-energy cone-beam CT imaging with dual-layer flat-panel detector, *IEEE Transactions on Medical Imaging* (2023). DOI: 10.1109/TMI.2023.3319668

Provided by Chinese Academy of Sciences