Letters

DOI:10.2214/AJR.07.2244
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Hybrid Reconstruction Kernel: Optimized Chest CT

In thoracic imaging, in which imaging of both the lungs and the mediastinum needs to be optimized, two separate data sets with different reconstruction algorithms are often created. The higher resolution algorithms, such as bone and lung, preserve the higher spatial frequencies at the expense of greater noise. On the other hand, softer algorithms, such as soft tissue, reduce the higher frequency contribution, decreasing the noise and the spatial resolution [1]. We have begun testing a hybrid CT algorithm to simultaneously optimize lung and soft-tissue characterization to limit the number of images that need to be generated and stored.

All CT examinations are performed on a 16-MDCT HiSpeed scanner (GE Healthcare) with our routine unenhanced clinical protocol of 120 kVp, 300 mA, 5-mm collimation, 0.8-second rotation time, and 1.375 helical pitch. All scans are reconstructed with the lung and standard reconstruction algorithms. CT images generated with separate lung and standard kernels are retrospectively combined so that soft-tissue algorithm pixels less than –150 H or greater than 150 H are substituted with corresponding lung kernel reconstructed pixels. Hybrid images are subsequently generated in Matlab (Math Works) and then reimported into an e-Film Workstation 2.0 (Merge Technologies) for the radiologist to view along with conventional images. For each case, corresponding image sections are simultaneously viewed in manufacturer-preset settings for lung (window, 1,500 H; level, –600 H) and mediastinum (window, 350 H; level, 40 H) with the ability to independently adjust the window and level settings.

For the depiction of lung in all cases, the hybrid-reconstructed images were noted to be equivalent to the lung kernel reconstructions but superior to the soft-tissue kernel (Fig. 1). For depiction of the mediastinal soft-tissue structures, the hybrid kernel was rated equivalent to the soft-tissue kernel but superior to the lung kernel (Fig. 2).

CT reconstruction algorithms differ principally in the choice of the reconstruction kernel, providing freedom to design kernels that suppress or enhance specific ranges of spatial frequencies to affect the visual properties of the reconstructed images [2], with the ultimate choice of reconstruction kernel affecting performance for lesion-detection tasks [2]. Judy and Swensson [3] showed that the detectability of small high-contrast lesions improved as the reconstruction kernel became smoother. Prevrhal et al. [4] showed that the accuracy of evaluating thin structures improved with the use of high-resolution kernels.

To maximize the benefits of both reconstruction kernels, we developed the hybrid technique. Although our experience is brief, we found the hybrid kernel equivalent to both the lung reconstruction algorithm, with its ability to detect lung parenchymal abnormalities, and the standard reconstruction algorithm to evaluate the soft tissues. A hybrid lung reconstruction kernel is a promising technique that optimizes lung and soft-tissue evaluation while significantly reducing the number of images needed to be transmitted, stored, and reviewed.

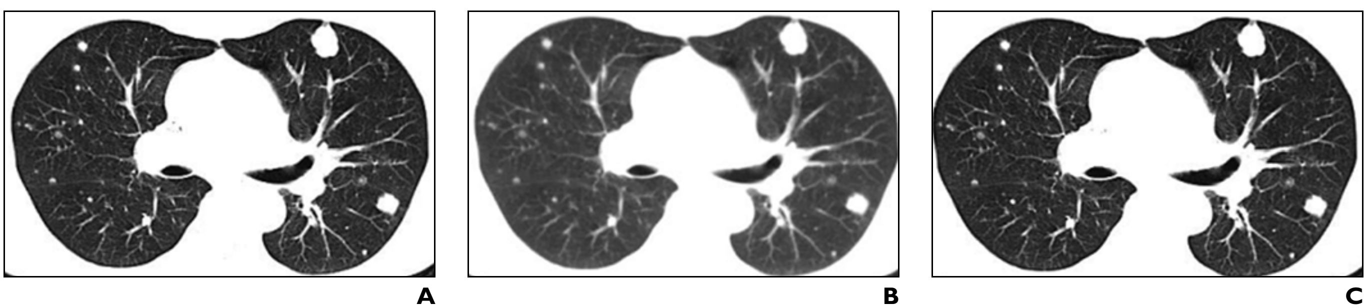

Fig. 1—53-year-old woman with known metastatic colon carcinoma of the lung.
A–C, Axial CT images of chest obtained with lung (**A**), standard (**B**), and hybrid (**C**) kernel reconstruction algorithms. Lung and hybrid kernels were thought to be equivalent with regard to their ability to display lung nodules.

AJR 2007; 189:W115–W116 0361–803X/07/1892–W115

Fig. 2—50-year-old woman with known liver metastasis who has undergone prior open biopsy of liver.
A–C, Axial images of upper abdomen from chest CT obtained in standard (**A**), lung (**B**), and hybrid (**C**) kernel reconstruction algorithms. Standard and hybrid kernels were thought to be equivalent in their ability to display soft-tissue abnormalities.

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Note—K. L. Weiss has a proprietary interest in the techonology described in this letter.