Neuro BestContrast

A New Approach to Enhance Image Quality in Head CT Imaging

White Paper

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While head CT images are relatively easy to acquire (especially compared to cardiac CT), they are one of the most challenging applications in CT to read due to very small differences in attenuation (signal intensity) between gray and white matter. As a consequence, a relatively high dose is required to achieve diagnostic image quality (i.e., better gray-white tissue differentiation).

Neuro BestContrast (or Multi-Band Filtration-MBF), which made its world debut at RSNA 2009, (Diehn et al., Mayo Clinic, Rochester, MN)* tackles this challenge by increasing the contrast between gray and white matter, but not significantly increasing noise. In order to achieve this, the fundamental nature of the CT data itself was utilized. CT data consists of two main components: high-frequency data, which predominantly contains edge details and noise, and the low-frequency data, which predominantly contains the image contrast.

Neuro BestContrast separates the original CT data into these two (high and low) frequency bands (Figure 1).

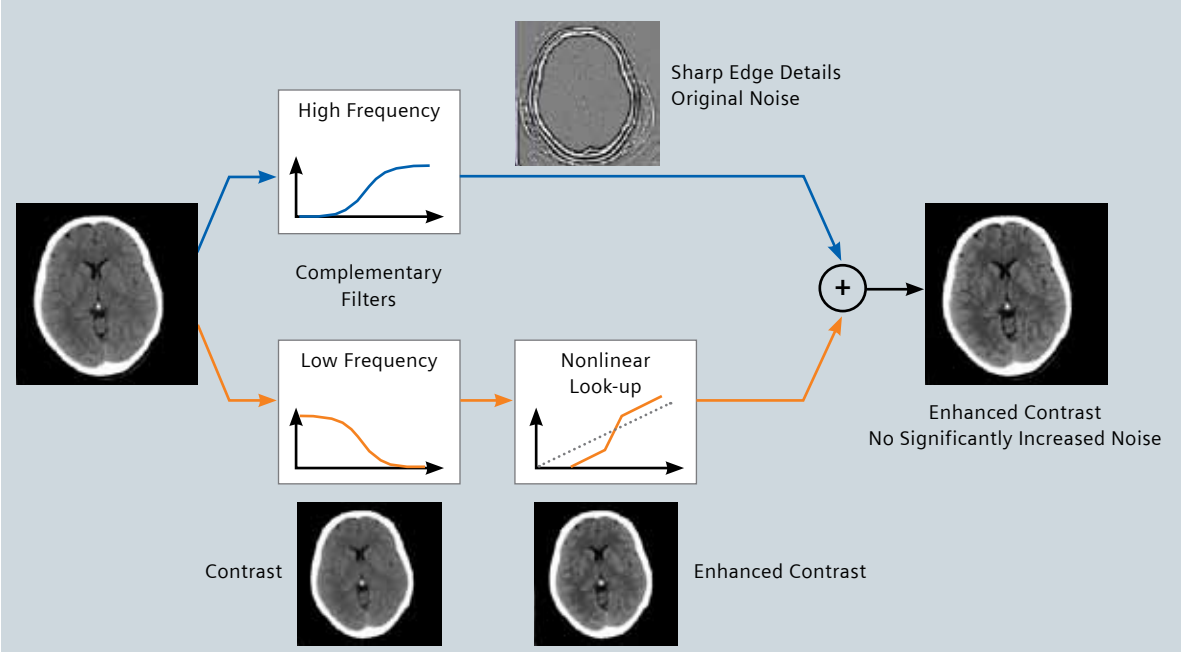

Figure 1. Neuro BestContrast: Illustration of the basic concept.

The high-frequency data is filtered as usual, while the low-frequency data is filtered and then modified in a second step. This modification, the critical step of the Neuro BestContrast algorithm, involves applying a nonlinear scaling function to the low-frequency data. The nonlinear scaling function is centered on the average CT number between the gray and white matter, which essentially results in a minimal increase in CT numbers above, and a minimal decrease in CT numbers below, this center point (Figure 2). This spreading of CT numbers is perceived by the reader as improved contrast between gray and white matter.

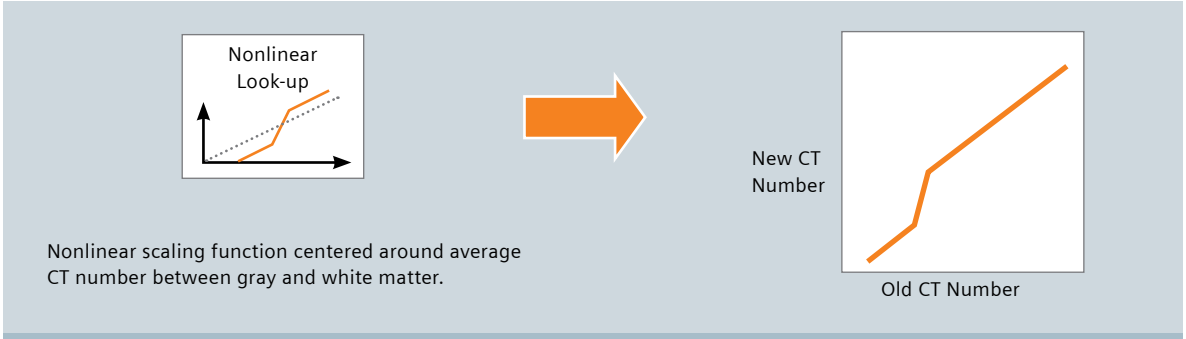

Figure 2. Illustration of how the nonlinear scaling function works by spreading CT numbers.

This minimal spreading in CT number results in an increased slope of the CT number variability around the center point, which, in turn, results in improved gray-white differentiation due to accentuated image contrast. Finally, the modified low-frequency band component is recombined with the original high-frequency component. Thus, as can be seen in the CT images in Figure 3, Neuro BestContrast achieves improved contrast without significantly increasing noise and preserves image texture.

Clinical Example

In a preliminary study on 33 patients (Diehn et al.)*, Neuro BestContrast data sets were preferred to the original data sets in a statistically significant majority of the cases. In those patients with significant intracranial pathology, readers also tended to prefer the Neuro BestContrast data set in terms of lesion conspicuity. The Neuro BestContrast images provided enhanced tissue contrast without significantly increased noise.

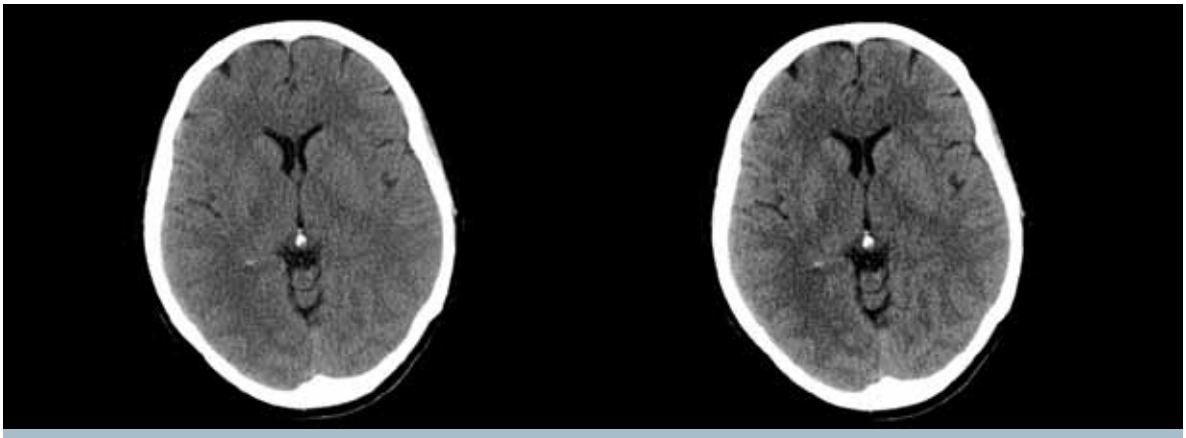

Figure 3. Conventional (left) and Neuro BestContrast-processed (right) non-contrast head CT images.

Important Points

- Neuro BestContrast is fully integrated into the data reconstruction process and thus, does not impact clinical workflow
- Neuro BestContrast provides enhanced tissue contrast without significantly increasing noise
- Neuro BestContrast is utilized in both spiral and sequential acquisition modes
- Initial end-user testing suggests Neuro BestContrast provides up to 20% dose reduction
- Neuro BestContrast is currently available in newly released software versions *syngo* CT2010A (for dual source scanners) and *syngo* CT2010B (for the AS platform)

Conclusion

Neuro BestContrast provides enhanced tissue contrast without significantly increasing noise. This post-processing step is rapid and is already incorporated into clinical workflow. Given the inherent increase in image contrast, Neuro BestContrast also allows the potential for dose reduction. In addition, further dose reduction can be achieved when combined with Iterative Reconstruction in Image Space (IRIS).

Further studies are needed to determine if use of Neuro BestContrast can result in earlier and/or more accurate detection of pathology, such as acute stroke.

*(Felix E. Diehn, David R. De Lone, Rainer Raupach, Christian D. Eusemann; 'A Preliminary Study of a Novel Post-processing Tool: Multi-band Filtration of Noncontrast Head CTs'; 95th Radiological Society of North America Annual Meeting. Chicago, IL, 2009:SSE23-03)

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