

# Implementasi Image Fusion dengan Algoritma Non Subsampled Contourlet Transform dan Discrete Wavelet Transform untuk Meningkatkan Kualitas Citra X-Ray CT pada Material Heterogen = Implementation of Image Fusion using Non Subsampled Contourlet Transform and Discrete Wavelet Transform Algorithm in Improving X-Ray CT Quality on Heterogenous Material

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## Abstrak

Tomografi terkomputasi/CT memiliki keterbatasan dalam mendiferensiasikan material heterogen. Diantara solusinya adalah menggunakan CT dengan sinar-X bervariasi, lalu melakukan image fusion untuk menggabungkan citra proyeksi beda energi tersebut. Dalam penelitian ini, digunakan algoritma image fusion berupa Discrete Wavelet Transform (DWT) dan Non Subsampled Contourlet Transform (NSCT) untuk mengamati performanya dalam meningkatkan kualitas sistem CT sinar-X di BRIN. Digunakan tiga jenis sampel: threaded pipe union PVC, busi, dan set sampel multimaterial berupa lima silinder beda material. Dihasilkan 7 set slice citra yang difusi menggunakan MATLAB. Dari hasil fusi, didapat bahwa algoritma DWT dengan aturan fusi max-max memberikan hasil fusi dengan kontras tertinggi, dengan rerata STD  $0.1852 \pm 0.0002$ . Metode NSCT memberikan kesamaan per piksel tertinggi antara citra sumber dan citra fusi, dengan rerata FMI  $0.9284 \pm 0.0016$  dan PSNR tak hingga dari kalkulasi MATLAB. Algoritma DWT dengan aturan fusi mean-mean memberikan kesamaan struktural terbaik dengan rerata SSIM  $0.9221 \pm 0.0004$ . Namun, evaluasi visual menunjukkan kedua algoritma tersebut kurang efektif menghilangkan noise dan artifact. Oleh karena itu, diperlukan peningkatan kualitas pra-pemrosesan citra hasil rekonstruksi sebelum fusi, pemilihan sampel yang lebih sesuai dari tipe material hingga geometri sampel, serta bereksperimen dengan bermacam-macam algoritma fusi lainnya

.....Computed tomography/CT has limitations in differentiating heterogeneous materials. Among the solutions is to use CT with varying X-rays and image fusion to combine the different energy projection images. In this study, Discrete Wavelet Transform (DWT) and Non Subsampled Contourlet Transform (NSCT) image fusion algorithms were used to observe their performance in improving the quality of the X-ray CT system at BRIN. Three types of samples were used: PVC threaded pipe union, spark plugs, and a multimaterial sample set of five cylinders of different materials. Seven sets of image slices were fused using MATLAB. From the fusion results, it was found that the DWT algorithm with max-max fusion rule gave the highest contrast fusion results, with a mean STD of  $0.1852 \pm 0.0002$ . The NSCT method provides the highest per-pixel similarity between the source image and the fused image, with a mean FMI of  $0.9284 \pm 0.0016$  and infinite PSNR from MATLAB calculations. The DWT algorithm with mean-mean fusion rule provided the best structural similarity with a mean SSIM of  $0.9221 \pm 0.0004$ . However, visual evaluation showed that both algorithms were less effective at removing noise and artifacts. Therefore, it is necessary to improve the pre-processing quality of the reconstructed image before fusion, select more suitable samples from material type to sample geometry, and experiment with various other fusion algorithms.