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P01.33**Multimodal medical image fusion in stereotactic electroencephalography**J. A. Pérez Hinestroza¹, C. Mazo², M. Trujillo¹, A. Herrera³¹Universidad del Valle, Cali, Colombia, ²University College Dublin, Dublin, Ireland, ³Centro Médico Imbanaco, Cali, Colombia

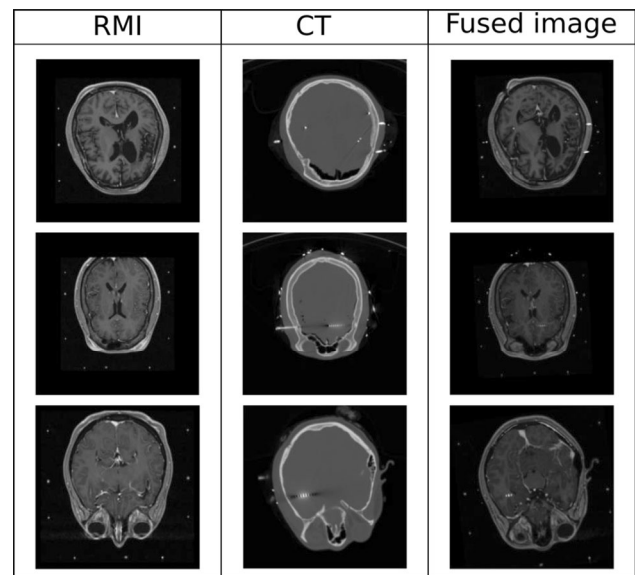
Introduction: Epilepsy is one of the most frequent neurological disorders, with a global prevalence of 0.8% to 1.2% and significant social and economical burden. The main treatment for epilepsy uses anti-epileptic drugs (AED). However, 20% to 30% of epilepsy cases cannot be controlled using AED. A reliable treatment for these cases is a surgical intervention to remove the epileptogenic tissue. One of the two methods for invasive evaluation to detect the epileptogenic tissue is the stereo electroencephalography (SEEG). The SEEG is a procedure that uses depth electrodes and neuroimaging to monitoring the electromagnetic signals during ictal seizures in the brain, mapping de cortical functions; and thereby define the tissue to resect to obtain seizure freedom or control. The SEEG uses two different modalities of medical images, Computed Tomography (CT) and Magnetic Resonance Image (MRI), to obtain the anatomical location of the contacts of electrodes. The localization of electrodes in the SEEG can be done using image fusion, which is a technique in computational vision that combines two or more images. However, there is not development, in image fusion methods, which consider external elements. In this work, we present a method to fuse CT and MRI considering the presence of electrodes.

Subjects/Methods: We propose a three-fold fusion procedure: Initially, the registration of a postsurgical CT with a presurgical MRI is done; then, electrodes from the CT are segmented; finally, the segmented electrodes and the registered RMI are fused superposing the segmented image with the registered image. Since the registration is the hardest part, we compare five different registration methods for selecting the registration method to use: Euler, Affine, versor, similarity, and scale versor.

Results/Discussion: For the comparison, we used 10 pairs of CT and MRI images and the performance was measure using four metrics: Root Mean Square Error (RMSE), Peak Signal to Noise Ratio (PSNR), Structural Similarity Index (SSIM), and Mutual Information (MI). The results of registration, of a postsurgical CT with a presurgical MRI, by the Euler method produced the better performance among the five methods, and also the minimum RMSE and PSNR (see Table 1). However, the Affine and the ScaleVersor methods produced a better MI, of 0.43, since MI is a more significant metric to evaluate multimodal image fusion.

TRANSFORM	MSE	RMSE	PSNR	SSIM	MI
Euler	15798.84	125.69	128.73	0.31	0.41
Affine	15991.97	126.45	128.67	0.31	0.43
Versor	15971.50	126.37	128.68	0.31	0.42
Similarity	15909.43	126.13	128.70	0.31	0.42
ScaleVersor	15974.86	126.39	128.68	0.31	0.43

Table 1: Average metrics results of registration evaluation.



References: Dogra A, Goyal B, Agrawal S. From Multi-Scale Decomposition to Non-Multi-Scale Decomposition Methods: A Comprehensive Survey of Image Fusion Techniques and Its Applications, IEEE Access, 2017

H. B. Mitchell, Image Fusion: Theories, Techniques, and Applications. Berlin Heidelberg: Springer-Verlag, 2010.

P01.34**The effect of noise in measurement of the ²³Na modulation transfer function (MTF): a simulation study**

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Introduction: Imaging systems can be described with the use of the point-spread function (PSF) and the modulation transfer function (MTF). Measurement of these functions are usually performed in a low noise environment in order to reduce interference on the MTF. However, the effect of noise in some contexts, such as with ²³Na MRI, cannot be avoided since these have inherently low SNR [1]. This work will examine the performance MTF quantification under varying noise conditions in a Monte-Carlo simulation study.

Subjects/Methods: MTF calculation methods:

1. Direction Modulation (DM): $= (I_{\max} - I_{\min}) / (I_{\max} + I_{\min})$,

I_{\max} and I_{\min} are the maximum and minimum intensities across the profile.

2. Fourier Harmonic (FH): $= |F_{1,f} / G_1|$,

$F_{1,f}$ and G_1 denote the first odd harmonics of the Fourier transforms for the output and ideal output [2].

A simulated bar phantom was created with 25 combs of differing resolutions (200 to 10 pixels). This binary phantom had values (100 and 0), representing signal / empty, created to a size of 3360x3360 (Fig. 1a).