3° Πανελλήνιο Συνέδριο
Ιατρικής Φυσικής

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Ακτινολογίας

Radiomic Feature Robustness, Image Quality and Machine Learning Classification Model Performance in I-131 Thyroid Scintigraphy: Evaluating Noise Reduction Techniques

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Εισαγωγή

- Radiomics enables quantitative characterization of medical images, but feature stability and classification performance under preprocessing are essential for clinical use.
- I-131 thyroid scintigraphy images are inherently noisy due to the statistical nature of photon counting and noise reduction is commonly applied before feature extraction.
- Its impact on image quality, radiomic robustness and classification has not been systematically investigated.

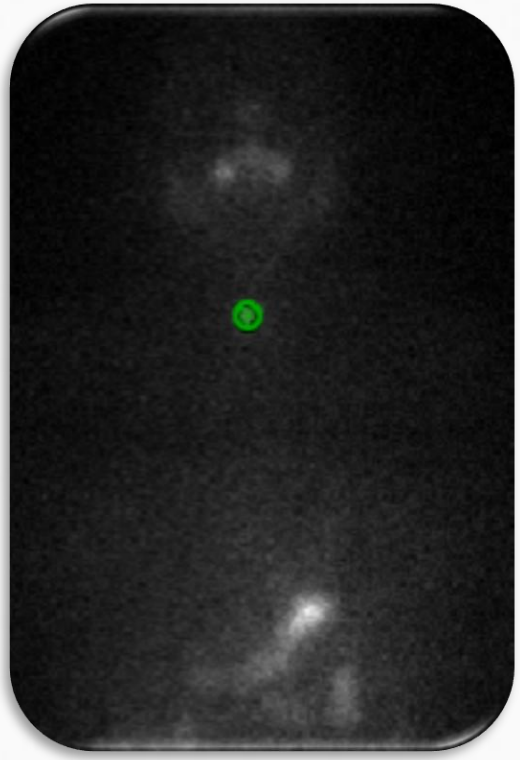
AIM

Evaluate four noise - reduction techniques for their combined effect on:

- image quality
- radiomic feature stability
- ML classification performance

Μέθοδοι & Υλικά

I-131 thyroid scintigraphy images → **Noise reduction 4 filters + unfiltered (Python - SimpleITK)** → **Radiomic feature extraction (PyRadiomics)** → **Random Forest classification**



Denoising filters evaluated

- **Gaussian** - σ = 0.8
- **Median** - radius = 2
- **Anisotropic diffusion** - iterations = 10, conductance = 3
- **Wavelet** - Daubechies-2, BayesShrink

Evaluation

Image quality

SNR, CNR, PSNR, SSIM

Radiomic stability

Mean ICC per feature category

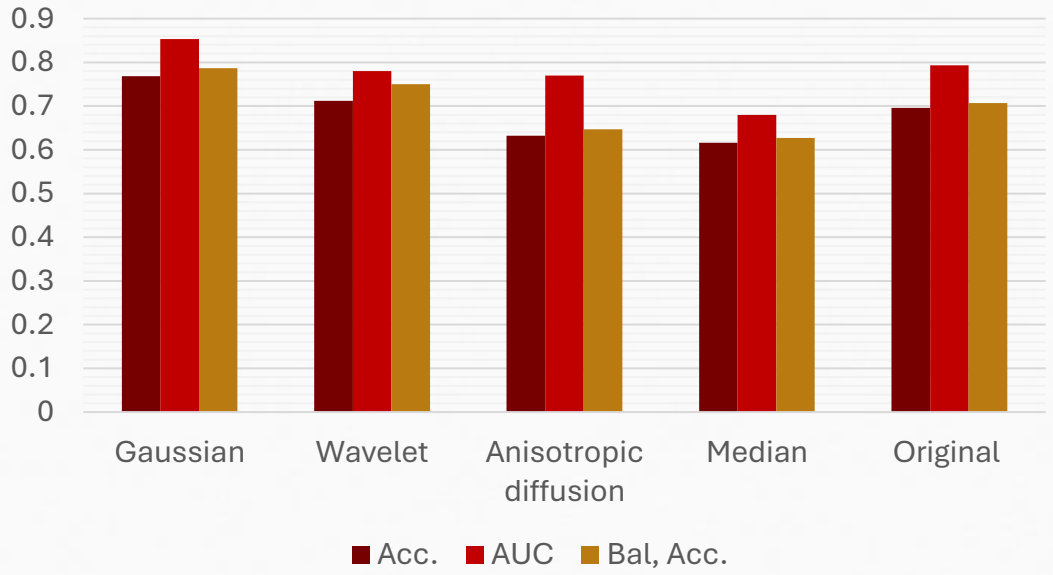
Classification

Random Forest - accuracy , AUC , balanced accuracy

Αποτελέσματα

Filter	Acc.	AUC	Bal. Acc.	ICC FO	ICC GLCM
Gaussian	0.768	0.853	0.787	0.977	0.959
Wavelet	0.712	0.780	0.750	0.996	0.973
Anisotropic diffusion	0.632	0.770	0.647	0.993	0.997
Median	0.616	0.680	0.627	0.731	0.678
Original	0.696	0.793	0.707	-	-

Classification performance by filter



Key finding: Gaussian filtering achieved the best classification (AUC 0.853), exceeding the unfiltered image - consistent with the Poisson nature of photon counting noise in I-131 scintigraphy, which approaches a Gaussian distribution at high mean counts.

Συμπεράσματα

BEST CLASSIFICATION

Gaussian: Highest accuracy (0.768) and AUC (0.853), exceeding the unfiltered image. Consistent with the Poisson nature of photon counting noise.

BEST REPRODUCIBILITY

Anisotropic diffusion & Wavelet

Highest radiomic feature stability (ICC up to 0.997). Preferable when radiomic reproducibility is the primary concern.

NOT RECOMMENDED

Median

Lowest classification performance and the least radiomic feature stability.

Awareness of filter effects on both image quality and radiomic feature stability is essential for reliable radiomic analyses.

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