NOISE REDUCTION USING BIO-INSPIRED AND SOFT COMPUTING

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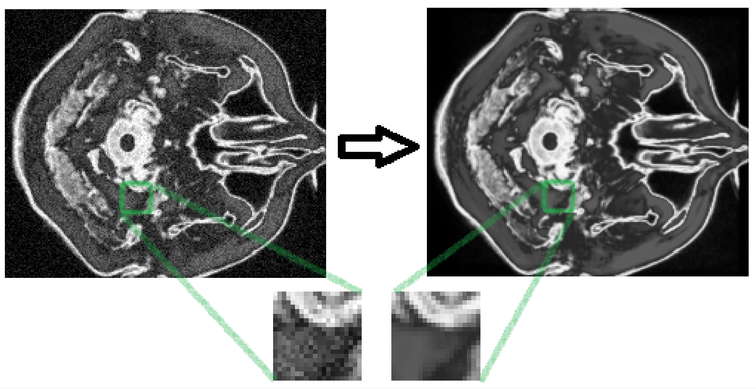
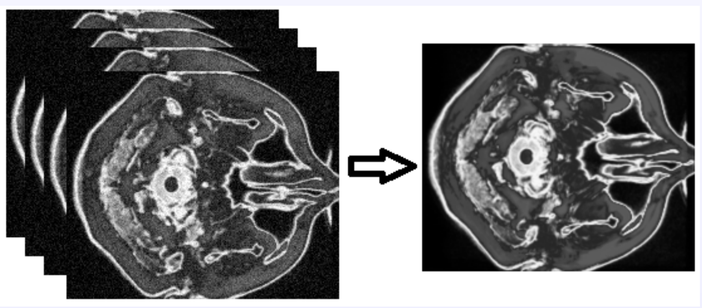
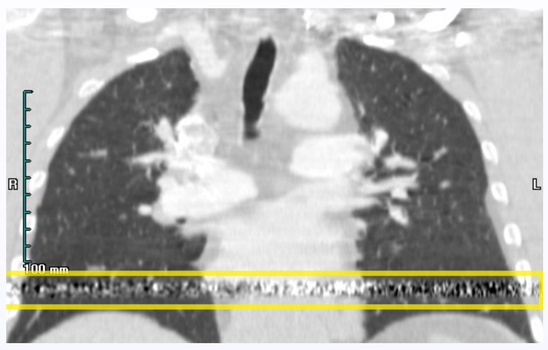
1. Medical Images

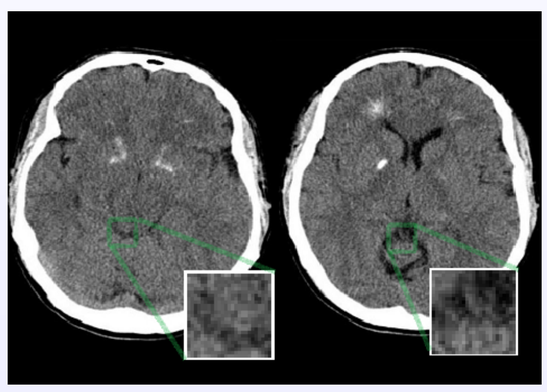
Magnetic Resonance Image (MRI)





Computer Tomography (CT)



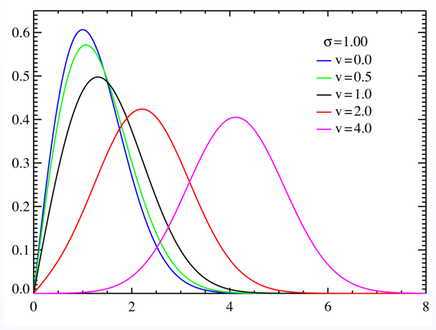


Abstract

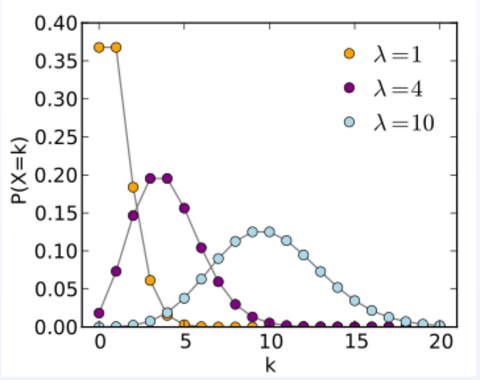
Image denoising is still a challenge for the research community. There exist many approaches to deal with it. However, the majority of these techniques are only capable of efficiently dealing with white Gaussian noise. Medical images are characterized for more complex noise (2a).
Our aim is to find new solutions to this issue applying different **bio-inspired and soft computing methods** (3), as *fuzzy logic* or *genetic algorithm* among others. To that end, they will be applied in different transform domains (2b).

2a. Noise estimation

Medical images are characterized for complex noise distribution. For instance, MRI is characterized by a *rician noise* distribution, which is signal dependant. While CT is characterized for *poisson noise*. Other aspects must be considered in CT as the patient level dose. Low level X-ray doses are better for the patient. Nevertheless images suffer more signal attenuation, which could be reflected in artifacts and/or higher levels of noise.



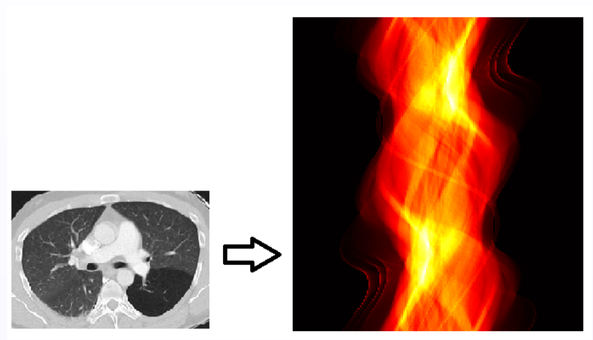
Rice distribution



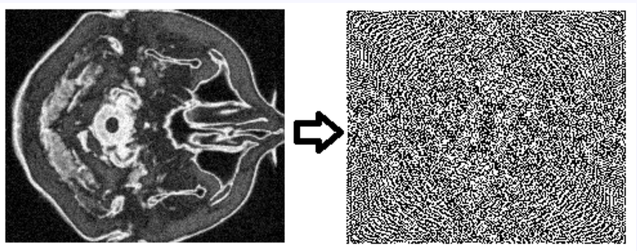
Poisson distribution

2b. Domain Transform

Sinogram



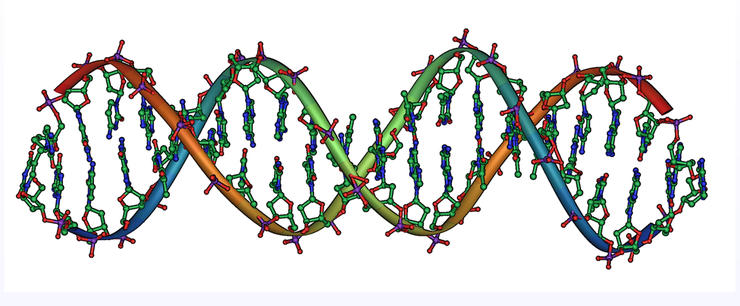
Frequency domain



Besides the spatial domain, other domains can be used. *Sinogram domain* will be explored over CT, as well as *wavelet frequency* domain for MRI.

3. Bio-Inspired and Soft Computing

Genetic algorithm



The application of **soft computing** and **bio-inspired** methodologies in medical images has increased during the last years. Moreover, it has been showed that these techniques are able to manage imprecision, uncertainty, partial truth, and approximation to achieve tractability, robustness, low-cost solutions and better rapport with reality. Our aim will be to probe the effectiveness of these methodologies in the noise reduction problem. To that end, new algorithms mainly based in *fuzzy logic*, *genetic algorithm* and *swarm algorithm* will be investigated.

References

[1] MR images from BrainWeb
http://mouldy.bic.mni.mcgill.ca/brainweb/
[2] CT image with artifacts (CC license)
http://www.radpod.org/2007/05/20/x-ray-tube-arcing-artefact/
[3] Brain CT image
http://www.radpod.org/2008/03/31/bronchial-atresia
[4] CT image sinogram transform
http://www.jmedicalcasereports.com/content/1/1/167
[5] Other images used from WikiCommons
http://commons.wikimedia.org/