Medical Images Rician Based Denoising

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Resumen

Medical image denoising and restoration are key steps for diagnosis and tracking of neurodegenerative processes such as Alzheimer and Parkinson diseases. We consider here a Rician-based denoising model suitable for structural MRI brain images. This model can be deduced using a Bayesian approach and it represents a modification of the model recently proposed in [1] where a Perona-Malik type operator is considered. Here we consider to regularize using the Total Variation operator. This provides a more robust mathematical and numerical treatment of the problem because of the well known properties of the Total Variation operator. The basic problem of this technique relies on the resolution of the following variational minimization problem: Let Ω be a bounded, open domain. Given $f \in L^\infty(\Omega)$ find $u \in BV(\Omega) \cap L^\infty(\Omega)$ such that $u = \min E(u)$, $E(u) = J(u) + \lambda H(u, f)$ where $J(u)$ is the convex nonnegative total variation regularization functional $J(u) = |u|_{BV} = |Du|(\Omega)$ and $|u|_{BV}$ denotes the semi-norm in the space $BV(\Omega)$. It is defined by the vectorial bounded Radon measure given by the generalized gradient Du. More details in [2]. Finally, the (hyper-parameter) λ controls the trade off between the energy terms. The likelihood term $H(u, f)$ is the following convex fitting functional

$$H(u,f) = \int_\Omega \left(\left(\frac{u^2 + f^2}{2\sigma^2} \right) - \log I_0 \left(\frac{uf}{\sigma^2} \right) \right) dx$$

where the parameter σ is the standard deviation of the noise and I_0 is the modified zeroth-order Bessel function of the first kind.

In this talk we shall present the numerical resolution of the variational problem and some preliminary results obtained with phantom and real brain images kindly provided by the Hospital Fundación Reina Sofía of Madrid. This research has been funded by the Project TEC2009-14587-C03-03.
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