School of Engineering and Physical Sciences
Electrical Electronic and Computer Engineering

B31XM – Advanced Image Analysis
Lab 3: Total Variation image processing

Total Variation flow

show your solution either to Ahmed Karam (TA) or Alex Belyaev (instructor)

Matlab script tv2.m implements a simple gradient descent flow for a total variation energy $\frac{\partial u}{\partial t} = \mathrm{div}\left(\frac{\nabla u}{|\nabla u|_\varepsilon}\right) + \lambda(f-u)$ where $|\nabla u|_\varepsilon = \sqrt{\left(\frac{\partial u}{\partial x}\right)^2 + \left(\frac{\partial u}{\partial y}\right)^2 + \varepsilon}$. So we can write

$$\frac{\partial u}{\partial t} = \frac{u_{xx}\left(u_y^2+\varepsilon\right) - 2u_x u_y u_{xy} + u_{yy}\left(u_x^2+\varepsilon\right)}{\left(u_x^2+u_y^2+\varepsilon\right)^{3/2}} + \lambda(f-u)$$

One possible extension of the total variation approach consists of applying it the first-order derivatives of a given image and then reconstructing a smoothed image from smoothed derivatives (a good matlab-based reconstruction-from-gradient code can be fount at http://web.media.mit.edu/~raskar/photo/code.pdf).

Your task is to implement such an extension and test whether it is useful for image denosing purposes.