Suggested Homework

Nonlinear Multiscale Methods for Image and Signal Analysis

Exercise 1 (4 points). Let $E : \mathbb{R} \to \mathbb{R}$ be a continuously differentiable convex function. Show that for all $u \in \mathbb{R}$ it holds that

$$\partial E(u) = \{E'(u)\}.$$

Exercise 2. Write the following Matlab functions

- A function *[ux, uy] = grad(u)* which computes the gradient of an input image u with zero Neumann boundary conditions.
- A function *diver = div(ux,uy)* which computes the divergence of the input vectorfield (ux,uy) in such a way that your divergence is the negative adjoint of your gradient.
- Verify for a random vectorfield (v_x, v_y) and a random image u that

  $$\left\langle \nabla u, \begin{pmatrix} v_x \\ v_y \end{pmatrix} \right\rangle = -\left\langle u, \nabla \cdot \begin{pmatrix} v_x \\ v_y \end{pmatrix} \right\rangle$$

  i.e. that for

  [ux, uy] = grad(u);

  epsi = abs(sum(vx(:).*ux(:)) + sum(vy(:).*uy(:)) + sum(sum(div(vx,vy).*u));

  epsi is (almost) zero.