Multiple View Geometry: Exercise Sheet 10

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Exercise: June 30th, 2014

Part I: Theory

The following exercises should be **solved at home**. You do not have to hand in your solutions, however, writing it down will help you present your answer during the tutorials.

1. Compute the gradient descent equations for the following two functionals:

   (a)
   $$E_1(u) = \frac{\lambda}{2} \int_\Omega (u(x) - f(x))^2 \, dx + \frac{1}{2} \int_\Omega |\nabla u(x)|^2 \, dx$$

   (b)
   $$E_2(u) = \frac{\lambda}{2} \int_\Omega (u(x) - f(x))^2 \, dx + \int_\Omega |\nabla u(x)| \, dx$$

   where $\Omega \subset \mathbb{R}^2$, $\lambda > 0$ and $f, u : \Omega \to \mathbb{R}$.

   Hint:
   - E has the form: $E(u) = \int \mathcal{L}(u, u')dx$
   - Determine the Euler-Lagrange equation: $\frac{dE}{du} = \frac{\partial \mathcal{L}}{\partial u} - \frac{d}{dx}\frac{\partial \mathcal{L}}{\partial u'}$.
   - Use: $-\frac{dE}{du} = \frac{\partial u}{\partial t} = \frac{u^{t+1} - u^t}{\tau}$, where τ is the stepsize to get the update scheme for u
   - If you need to divide by $|\nabla u|$, use a regularized version of the gradient norm: $|\nabla u|_\varepsilon = \sqrt{u_x^2 + u_y^2 + \varepsilon^2}$ for a small constant $\varepsilon \in \mathbb{R}_{>0}$.

Part II: Practical Exercises

This exercise is to be solved **during the tutorial**.

1. Download the package `mvg_exerciseSheet_10.zip` from the website and extract the files.
2. Implement the gradient descent for E_1.
3. Implement the gradient descent for E_2.