

How to see the forrest in spite of the trees

Applications of Euler-Lagrange,
Scale Space and Frequency analysis

Stefan Karlsson



Introductory Example 1

- What is the shape of Planet Earth?
 - Mountains, valleys deep ocean floors
 - Textured sphere
 - "A pale blue dot"



Introductory Example 2

- What is the difference between a mirror and a sheet of paper?
 - Reflectance properties?
 - Geometry?
 - Answer depends on what scale you are considering
 - What is surface texture?

Sampling Theory

- Ideal Sampler:

$$f[x] = \int \delta(t - x)f(t)dx$$

- Realistic Sampler:

$$f[x] = \int g(t - x, \sigma)f(t)dx$$

- Bandlimitation provides guarantees of no information loss
- Scale is fundamentally present for any kind of observation, commonly implicitly

Schools of Thought where scale comes to focus

- Scale Space
- Calculus of Variations
- Diffusion Processes
- Frequency Analysis
- Wavelet Theory
- Mean Field Theory

Course organization:

Course webpage found at:

islab.hh.se (go to Stefan Karlsson/Personal pages/education)

Contents:

1. Linear scale space (Stefan) -1 WEEK

- ONE PRACTICAL ASSIGNMENT

2. Directionality analysis (Fernando) -1 WEEK

3. Non-linear scale-space (Stefan) -1.5 WEEK

- ONE PRACTICAL ASSIGNMENT

4. Feature analysis (Fernando) -1.5 WEEK

- ONE PRACTICAL ASSIGNMENT

5. Applications for computer vision/object detection (Fernando, Stefan) - 1 WEEK

- FINAL PROJECT ASSIGNMENT