Statistical Image Analysis

Lecture 13: Comments

David Bolin
University of Gothenburg

Gothenburg
May 16, 2018

Deadlines

For Parts 1 and 2:

- A PDF containing these two parts should be submitted via PINGPONG at the latest May 18, 23:55. Include the Matlab code as a zip-file.

For Part 3:

- A PDF containing a preliminary version of the report should be submitted together with Parts 1 and 2 at the latest May 18, 23:55. It does not need to be complete.
- The final version of the report should be submitted at the latest June 1, 23:55, together with the Matlab code as a zip-file, as a revision of the submitted project in PINGPONG.

Project report

- Parts 1 and 2 should be documented as lab reports, describing what you did and the results you obtained but it does not need a detailed introduction and discussion.
- The ideal form of the report for Part 3 is in principle a journal paper, containing:
  1. Project title, author names, course name, date of report.
  2. Abstract/Summary: about 10-15 lines
  3. Introduction: Statement of problem, earlier work with references.
  4. Data description and source.
  5. Methods: Mathematical, statistical, computational, image analysis.
  6. Results with tables and figures.
  7. Discussion: include if possible here also comparison with results from literature.
  8. Conclusions, suggested continued studies.
  9. References.

Project seminars

- The lectures next week, as well as the computer exercise on Monday, will be devoted to project seminars.
- In the seminar there will be 9 minutes allotted to each student.
- You are expected to use 7 minutes (not more) for each participant in your project describing what you have done so far and what you plan to do.
- After this there will be $2N$ minutes left for discussion, where N is the number of students in the project.
- The object of the seminar is that you should get feedback from the audience, both to point out parts that are less clear and suggestions on what to do, the goal being to help you to write as good a report as possible.

Preliminary schedule

Monday 10:00-12:00:

- G9 2 persons, 18 minutes
- G13 3 persons, 27 minutes
- G19 3 persons, 27 minutes
- G3 2 persons, 18 minutes
- G7 1 person, 9 minutes

Wednesday 10:00-12:00:

- G5 1 person, 9 minutes
- G4 1 person, 9 minutes
- G16 2 persons, 18 minutes
- G18 1 person, 9 minutes
- G2 3 persons, 27 minutes
- G20 2 persons, 18 minutes

Monday 13:15-15:00:

- G6 3 persons, 27 minutes
- G1 1 person, 9 minutes
- G17 1 person, 9 minutes
- G10 2 persons, 18 minutes
- G8 1 person, 9 minutes
- G12 1 person, 9 minutes
- G11 2 persons, 18 minutes

Calibration of industrial robots using Bayesian methods

Every individual industrial robot deviates slightly from the ideal design. Therefore, an expensive calibration is required after purchase to optimize performance. The calibration is done at the robot manufacturer. If the calibration instead is done after mounting in the production line it is supposed to work, there are usually spatial constraints, i.e., the robot cannot move everywhere. This project investigates

- Bayesian methods for calibration.
- The effect of the spatial constraints on the calibration performance.

For more details, see https://www.syntronic.com/careers/calibration-of-industrial-robots-using-bayesian-methods/

Exam

- The exam can give 20 points, and the project reports another 20 points. The final grade is based on the sum of these two.
- The only aid you may bring to the exam is a "Chalmers allowed" calculator (will likely not be needed).
- The exam this year will be quite different from the previous exams in the course: Focus on what we have gone through in the course instead of looking at old exams.
- To give you an idea of the structure of the exam, we will go through a mock exam.

Using spatial statistics to estimate snow loads

The Swedish National Board of Housing, Building and Planning, Boverket, publishes the Swedish building code. The building code contains mandatory provisions and general recommendations that should be followed when constructing new buildings. Among the rules are regulations for dimensioning buildings to withstand loads from snow. In order to apply these rules, one needs an estimate of the expected snow load for the specific location where the house will be built.

The purpose of this project is to investigate the reliability of their current estimates and produce an updated version.

For more details, see www.math.chalmers.se/ bodavid/misc/master_project_proposal.pdf

Fast estimation of integrals of GMRFs

In spatial extreme value theory, a common model is $vX(s)$, where $X(s)$ is a Gaussian random field, and v a positive random variable. Likelihood-based inference then requires computing integrals

$$\int \Phi(\mathbf{x}/v)\pi(v)\,\mathrm{d}v$$

where $\Phi(\mathbf{x}/v)$ denotes the CDF of a high-dimensional Gaussian distribution and $\pi(v)$ is the density for v. These integrals are extremely costly to evaluate, which limits the use of these models to small problems (say at mot 200 spatial locaitons).

The purpose of this project is to investigate how integrals of this form can be computed more efficiently in the case when the random field is a GMRF. The method will then be used to analyze large extreme-value data sets.

For more details, ask me.