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## Examination in Statistical Image Analysis, August 24, 2016

Course code Chalmers: TMS016, Gothenburg University: MSA300

Written examination August 24, 2016, 14-18.

Literature and notes may be brought for this written examination. Neither pocket calculators nor computers are allowed at this examination. In the written examination there is one page with two problems. You are supposed to answer both problems, and in the judgement they have the same weight. Answers may be given in English or Swedish.

### Problem 1.

Figure 1 shows part of a tree beam of width 145 mm. The beams are typically 3000 mm long but the image shows only a 937 mm long part of the beam. One is interested in finding image analysis methods that can identify and locate the knots (shown as black spots in the image).

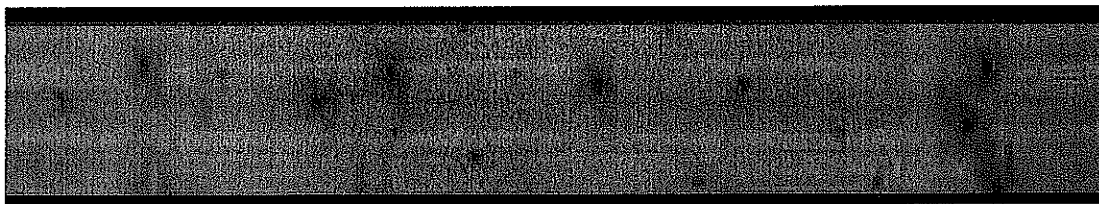


Figure 1: Part of a 145 mm wide tree beam with about 18 knots shown. The part of the beam shown is 937 mm long.

- a) Describe a method based on thresholding that can identify knots and locate the knot centres in images such as those shown in Figure 1.
- b) Describe a method based on template matching that can identify knots and locate the knot centres in images such as those shown in Figure 1. Describe possibilities to construct templates, either by a suitable mathematical model or by manually locating knots in an image and by cropping (cutting out) from the image a small part around the knot.
- c) Discuss possible advantages and disadvantages of thresholding and template matching methods for finding and locating knots.

### Problem 2.

Suppose that you have identified  $n$  knots in Figure 1 (with  $n$  equal or close to 18) and found the positions of the knot centres. Regard the knot centres as a point process.

- a) Estimate the intensity of the knot centre point process.
- b) Describe in some detail two methods to estimate the  $K$ -function of the knot centre point process. Discuss advantages and disadvantages of the methods.
- c) Discuss in some detail how one can test if the knot centres form a Poisson process with constant intensity. Hint: one possibility is to simulate a suitable number of Poisson processes with constant intensity and to estimate the corresponding  $K$ -functions.