

Task – Classification of timber board cross-sections according to the pith location

Background

Our new PhD student will work partly with X-ray CT scans of timber boards. The rich data obtained by CT scanning can be processed to extract detailed information regarding wood features, such as the pith location, knots, growth rings, heart- and sapwood, early- and latewood, etc.

In softwood species, such as Norway spruce, strong relationships exist between the distance to the pith and different mechanical and physical properties. For instance, density, longitudinal modulus of elasticity (MOE), and modulus of rupture (MOR) increase significantly in the radial direction from pith to bark, whereas the longitudinal shrinkage coefficient decreases in the same direction. Knowledge of the location of the pith is useful for the assessment of stiffness, strength, and shape stability of sawn timber.

This task deals with board cross-sections obtained by CT scanning. The goal is to develop a method that determines whether the pith is inside or outside the cross-section (see Figure 1).

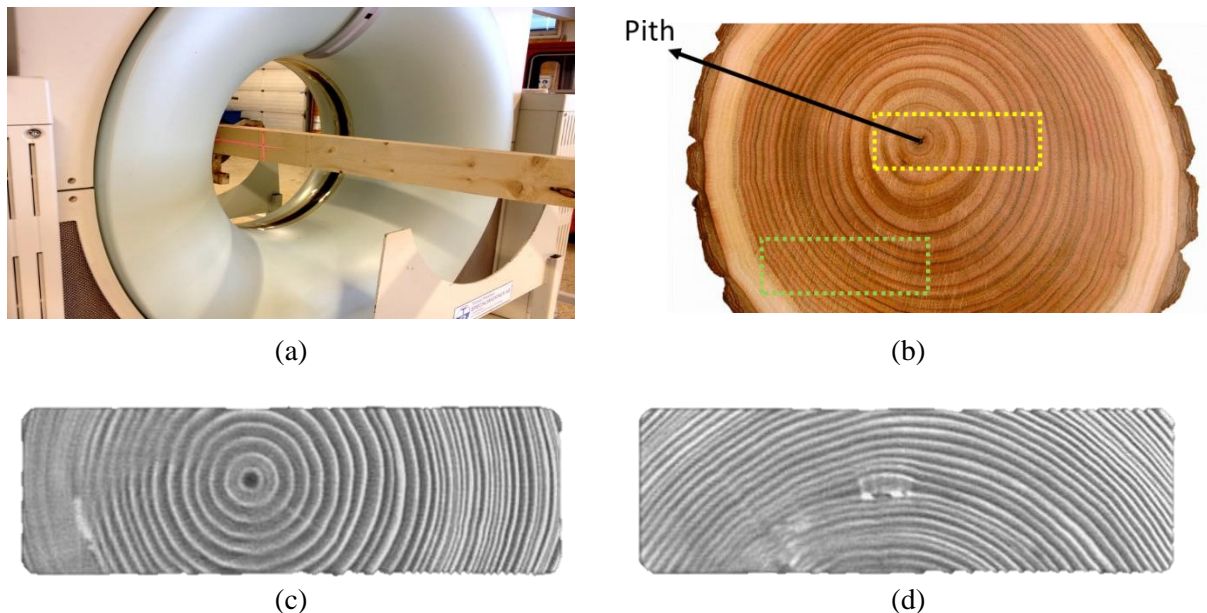


Figure 1. (a) CT scanning of a board. (b) A log cross-section showing the pith location. The yellow dashed rectangle represents a board cross-section with the pith inside. The green dashed rectangle represents a board cross-section with the pith outside. (c) A board cross-section obtained by CT-scanning (pith inside). (d) A board cross-section obtained by CT-scanning (pith outside).

Task

Several boards have been scanned using a CT scanner, resulting in thousands of cross-section images that include:

- 1500 CT images for cross-sections with the pith inside (Figure 1c).
- 1500 CT images for cross-sections with the pith outside (Figure 1d).

All images have a resolution of 270×550 pixels.

Your task is to develop a method that determines whether the pith is inside or outside given an input CT cross-section (Figure 2). Feel free to choose any machine learning or non-machine learning approach. Also, feel free to write your code in any programming language you are comfortable with (e.g., Python or Matlab).

The folder “Train” contains the 3000 images you are supposed to use for training/optimizing your algorithm.

The folder “Test” contains additional 800 images you can use for evaluating your method.

Use this link to download the training/testing data:

<https://drive.google.com/file/d/1xdtxNx04BcakpFnIDGLtm-oDS3-ssJvt/view>

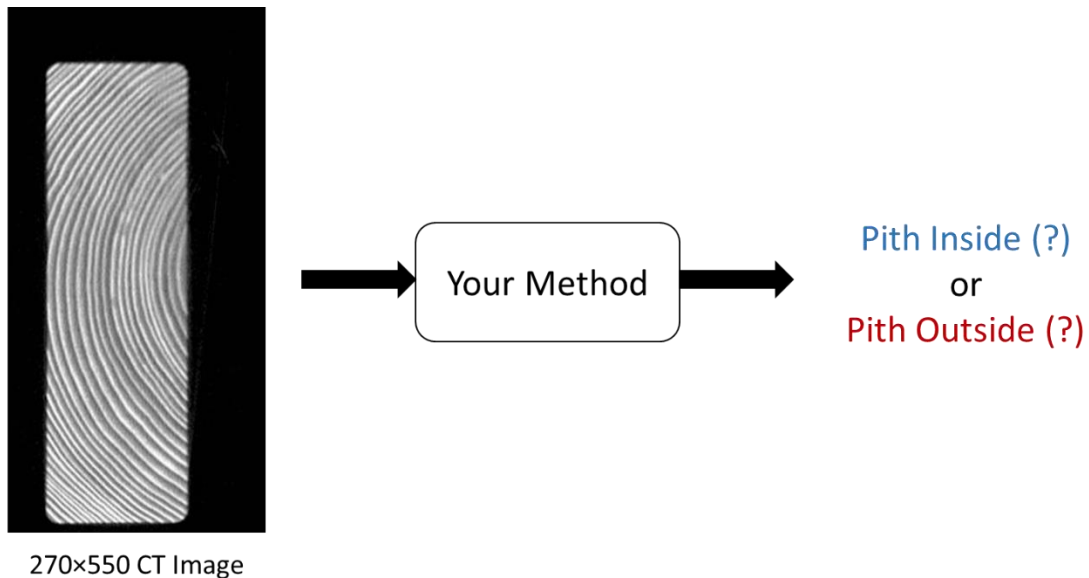


Figure 2. (a) WoodEye scanner. (b) Four surface images of a Norway spruce board.

Your submission

1. A code that implements your algorithm to determine whether the pith is inside or outside in the 800 testing CT cross-sections.
2. Any additional files required to run your code.
3. A short PowerPoint presentation explaining your classification technique and showing the classification accuracy of the classifier over the testing dataset.