Representing the spatial distribution of strength related timber material properties by means of hierarchical modeling

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For modeling the performance of timber structures the probabilistic representation of the variability of timber material properties is an issue of special interest. Timber is a complex building material and its properties are in general highly sensitive to scale, climate and loading variations. Material properties can be represented by random variables and the statistical characteristics of these variables can be described by distribution models together with the corresponding parameters which are calibrated based on data taken from standard test samples.

In the context of this COST Action E55, Working Group 3 special emphasis is given on how to represent multiscale spatial variation of timber material properties. This is an important task because timber material properties vary remarkably in space. In general it can be distinguished between three hierarchical levels of variation:

- *macro level variability*
  Variation between samples of different geographical origins, due to different locally limited growth characteristics.
- *meso level variability*
  Variation between the specimens within one sample.
- *micro level variability*
  Variation within one particular specimen caused by internal irregularities like e.g. knot clusters or slope of grain.

Spatial variability of timber material properties is considered on these different levels and subsequently, brought together to one consistent hierarchical model.

For future research it is intended to apply hierarchical modeling for the determination and control of grading machine settings as well as the identification of common growth areas.