Chair of Computational Modeling and Simulation
TUM Department of Civil, Geo and Environmental Engineering
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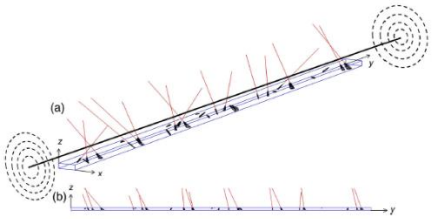
Modeling:
Mathematics:
Programming:
Science:

Software Lab:

AI-supported recognition of natural imperfections for reconstruction of timber

Knot detection [1]



Knot reconstruction with its origin [3].

Description

Wood is a natural fiber-based composite material with orthotropic material properties. Natural imperfections such as knots in timber boards have a significant impact on the distribution of fibers and need to be recognized and cathergorized. These locations can then describe the weak points in timber boards, which may cause failure initiation and propagation under mechanical loadings. By means of machine learning approaches and surface image analysis, these locations can be detected and classified [1-3]. However, knowing/estimating the geometrical origin of these imperfections [2,3] may help to classify the shape and geometrical configuration of these components.

Task

- Configure the scanning system; create and label data in addition to the current available database.
- Apply deep learning based object detection or semantic segmentation method (e.g. Yolo,U-Net) for automatic knot detection; extract the knot information (size, shape, ect.) [1].
- Detect and compute the geometrical origin of knots based on the 6-side surface information [2-3].
- Reconstruct the knot in 3D based on the information of recognized knot and its origin.

Further tasks

- Validate and improve the method's performace taking into account the material scatter and develop a FEM model for simulations.

Supervisor

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References

[1] Lopes Jr, D. Verly, G. Dos Santos Bobadilha, and Karl Michael Grebner. "A fast and robust artificial intelligence technique for wood knot detection." BioResources 15.4 (2020): 9351.
[2] Habite, Tadios, Osama Abdeljaber, and Anders Olsson. "Automatic detection of annual rings and pith location along Norway spruce timber boards using conditional adversarial networks." Wood Science and Technology 55.2 (2021): 461-488.
[3] Briggert, Andreas, Anders Olsson, and Jan Oscarsson. "Three-dimensional modelling of knots and pith location in Norway spruce boards using tracheid-effect scanning." European Journal of Wood and Wood Products 74.5 (2016): 725-739.