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AI-Driven Wood Sorting: Automating Quality Assessment with Computer Vision

Wood is a sustainable material with the ability to capture CO_2, but its heterogeneity requires extensive manual sorting in production. AI-driven computer vision offers new opportunities to automate this processes, improving efficiency and reducing errors across the value chain. This work investigates deep learning for automating wood sorting at various processing stages, focusing on roundwood and wooden boards in sawmills. We acquired a diverse image dataset of over 18,000 samples, including roundwood cross-sections, debarked stems, and hardwood and softwood boards with corresponding quality labels. Using this dataset, we trained and evaluated deep learning models—including convolutional neural networks, autoencoders, and vision transformers—to classify wood and detect key features. Additionally, we explored knowledge transfer, leveraging models trained on softwoods to accelerate adaptation to hardwood species. To ensure industry applicability, we emphasized model explainability. Our results demonstrate the effectiveness of computer vision in automating wood sorting, achieving quality classification accuracies above 80% and species recognition exceeding 90%. Moreover, we show that softwood-trained models enable faster adaptation to hardwood species, unlocking new opportunities for wooden product innovation. These findings highlight AI's potential to enhance efficiency, sustainability, and scalability in the wood industry, paving the way for more advanced and automated production processes.

Keywords
Wood Sorting, Convolutional Neural Networks, Instance Segmentation, Process Automation, Transfer Learning, Computer Vision

Biography
Julia Achatz received her B.Sc. in Media Informatics in 2020 and her M.Sc. in Computer Science from LMU Munich in 2022. During her Master's program, she worked in the Data Science department at Philips Healthcare and served as a working student at Controme GmbH, where she developed AI solutions for heat control. Since 2022, she has been a Ph.D. student at Empa and ETH Zurich, focusing her research on deep learning, computer vision, and explainable AI applications in the wood industry.

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