Validation and Reliability of the Discriminative Power of **Geometric Wood Log End Features**

Rudolf Schraml [a], Alexander Petutschnigg [b] and Andreas Uhl [a]

[a] University of Salzburg, Jakob Haringer Str. 2, 5020 Salzburg, Austria
[b] University of Applied Sciences Salzburg, Markt 136a, 5431 Kuchl, Austria

INTRODUCTION

Recent investigations on log end biometrics indicated that log end shapes are very discriminative. In this work the verification performance for different geometric features is assessed for groundtruth data and for automated segmentation and pith estimation procedures.

EXPERIMENTAL SETUP

Two testsets with 155 logs in total:

- TS_1 → 50 tree logs, each captured four times with and without flash.
- TS_2 → 105 tree logs, each captured three times without flash.

Figure 1. First two images (TS_1): Difference of capturing the log end with and without flash. Latter two images (TS_2): Two images from different logs.

Based on the pith position and the CS boundary a set of geometric features are computed and assessed:

Evaluation steps

1. Assess the verification performance in case of using GT data for the pith position and CS boundary.

2. Consider SEG/ PE accuracies and find the most accurate configuration.

3. Evaluate the verification performance in case of automated SEG/PE.

4. Assess the performance for score level fusion using Selective Floating Forward Selection (SFFS).

1. GROUNDTRUTH VERIFICATION PERFORMANCE

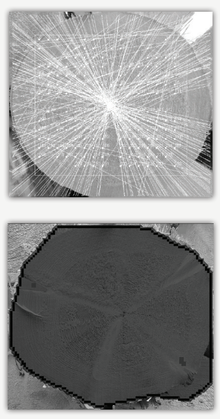
H_1	H_2	H_{3-7}	C	R	E	PEC	**CD**	**PD**	Z
11.6	13.8	>17.0	17.3	22.0	8.0	7.2	**2.81**	**1.43**	6.3

Table 1. EERs [%] for all geometric features based on groundtruth data for the pith position and the CS boundary

- **High discriminative power of E,PEC,PD,CD and Z → PD = 1.43%**

2. SEGMENTATION/ PITH ESTIMATION ACCURACIES

- PE = Intersection of local orientation estimates. Best configuration utilizes Fourier - PEAK analysis for local orientation estimation and a saw-cut suppression mode.
- SEG = Similarity based region growing procedure using the PE as seed point. Similarity is assessed using the earth mover's distance between local color histograms (SEG-C).



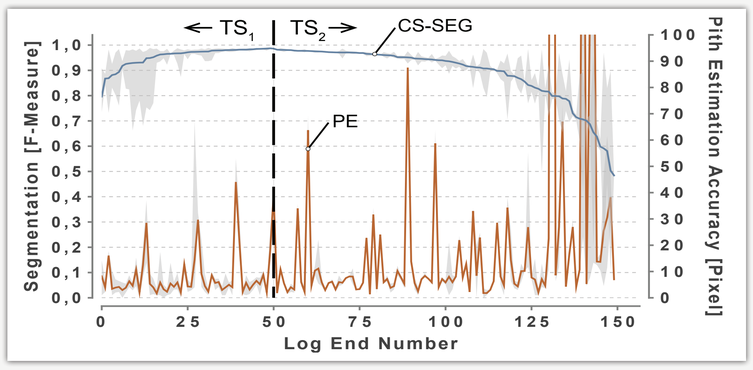
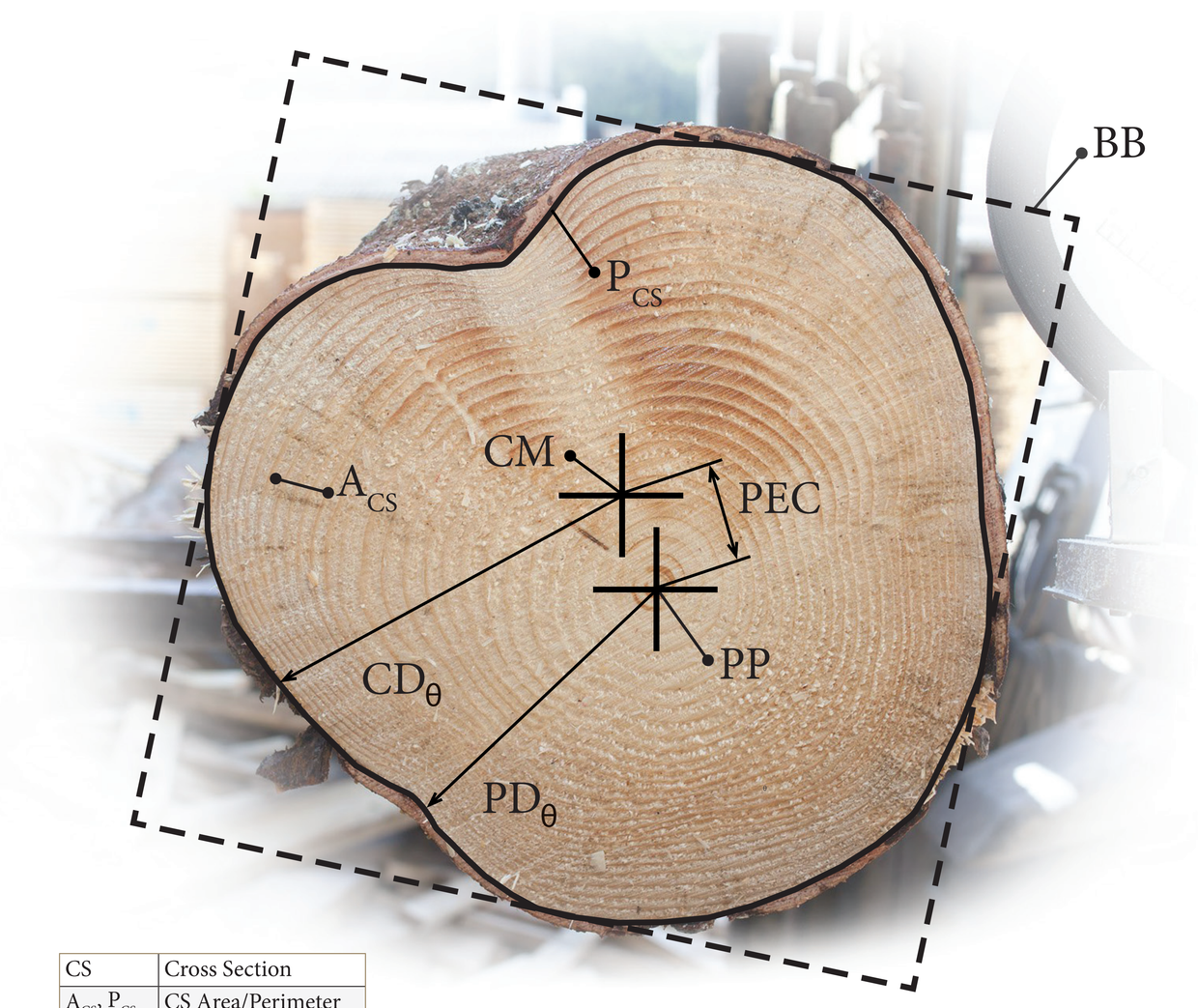


Figure 2. Mean, min. max. accuracies grouped by the CS-Images of each log end

- Accuracies for TS_1 are better than for TS_2 → large amount of deformed log ends caused by reaction wood.



CS	Cross Section
A_{CS}, P_{CS}	CS Area/Perimeter
GT	Groundtruth
SEG	Segmentation
PE	Pith Estimation

GEOMETRIC WOOD LOG END FEATURES

HU Moments (H_{1-7})	Seven invariant image moments proposed by HU
Zernike Moments (Z)	10 orders of complex Zernike moments
Circularity (C)	$4\Pi\cdot(A_{CS}/P_{CS})$ = similarity to a circle
Rectangularity (R)	A_{CS}/A_{BB} = ratio between the CS area and the area of the minimum bounding box (BB)
Eccentricity (E)	BB_W/BB_H = ratio between width and height of BB
Pith Eccentricity (PEC)	Distance between the center of mass (CM) and the pith position (PP)
Centroid Distances (CD)	Centroid to border distances per degree (CD_Φ, $\Phi \varepsilon \{0°, \ldots ,360°\}$) normalized by max CD_Φ
Pith Distances (PD)	Pith to border distances per degree (PD_Φ, $\Phi \varepsilon \{0°, \ldots ,360°\}$) normalized by max. PD_Φ

3. REAL WORLD VERIFICATION PERFORMANCE

H_{1-7}	C	R	E	PEC	CD	PD	**Z**
>34.0	30.5	46.7	24.0	26.1	19.4	15.2	**5.4**

Table 2. EERs [%] for all geometric features based on SEG-C/PE-PEAK

- **Zernike moments (Z) outperform all other features!**

4. SCORE LEVEL FUSION RESULTS

SEG/PE	k=2	k=3	k=4
GT	PD,CD 0.74	PD,CD,Z 0.54	PD,CD,Z,R 0.68
SEG-C/ PE-PEAK	PD,CD 15.36	PD,CD,R 15.34	PD,CD,R,E 15.61

Table 3. EERs [%]: SFFS-based score level fusion. Z is not considered in case of SEG-C/PE-PEAK

- GT: EER is improved by feature fusion → PD,CD,Z = 0.54%
- SEG-C/PE-PEAK: No significant improvement.

For further informations please visit *http://www.wavelab.at/project-treebio.shtml* **or contact** *rschraml@cosy.sbg.ac.at*
This work is partially funded by the Austrian Science Fund (FWF) under project number TRP-254.

WAVELAB Multimedia Signal Processing and Security Lab

UNIVERSITÄT SALZBURG