

COST E53 Lisbon 2009

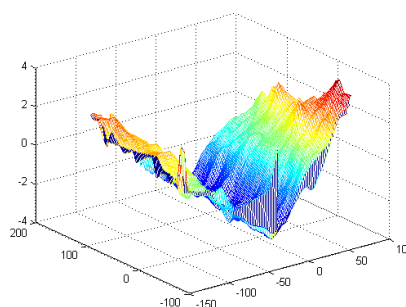


**A LOW COST METHOD FOR DETERMINATION
OF WOODEN BOARD DISTORTION PART 2.
TWIST, CROOK AND BOW**

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PART 1

**Camera-linear laser
low cost system**




2000 €

±0.3mm




OUTLINE

- Motivation
 - Objectives
 - Method
 - Results
 - Conclusions
- 

MOTIVATION

- Scanning systems for grading allow to:
 - Increase yield
 - Speed up grading time
 - Be more objective in grading
 - Utilize wood mass in a better way

Unfortunately:

- They are not affordable for some wood processing SMEs
- 

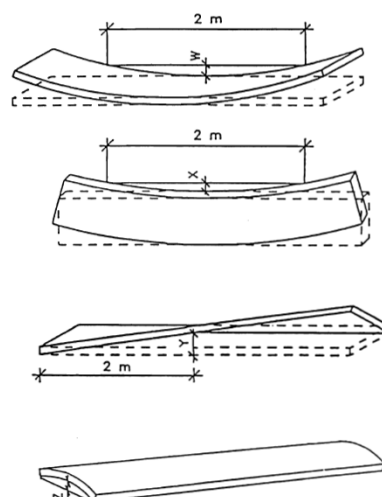
OBJECTIVES

- To build a low cost method for grading of wooden boards based on shape distortion.
 - To test the a proposed equipment
 - Cup, Bow, Twist, Crook
 - To enhance software (image) processing
 - To perform semi-industrial tests



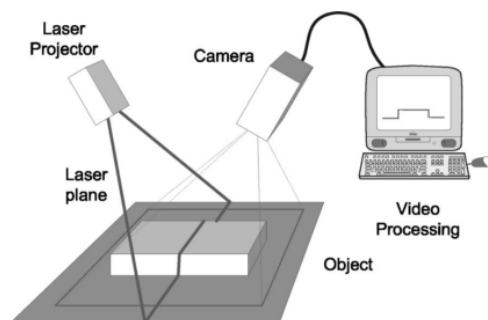
OBJECTIVES

- Requirements
 - To measure of all shape distortion characteristics
 - Bow, crook, twist, cup
 - Fast
 - Reliable
 - Affordable (bellow €2000)



LOW COST SLIT SCANNER

- Camera – laser system
- Problem
 - Precision



courtesy of Blais 2004

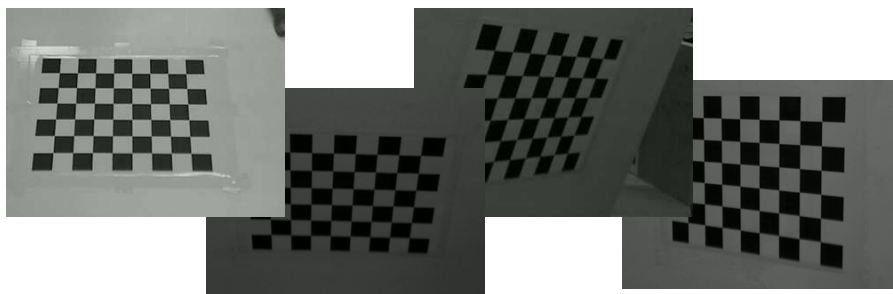
LOW COST SLIT SCANNER

- CCD camera (max pixel resolution 1200x1700)
- Hand-held laser
- Image analysis using Matlab



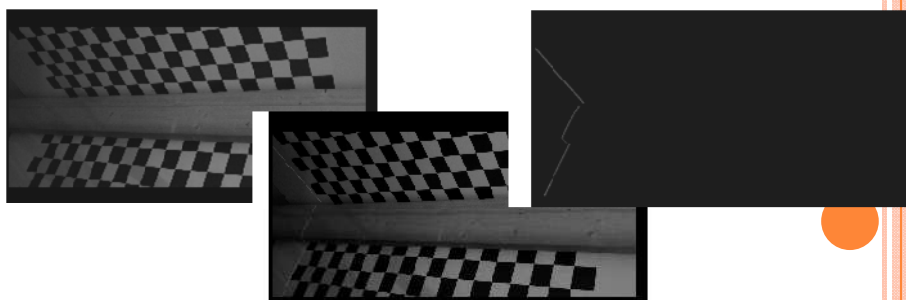
LOW COST SLIT SCANNER

- Image processing
 - Camera calibration (intrinsic and extrinsic parameters)
 - Camera Calibration Toolbox for Matlab (Bouguet 2008)



LOW COST SLIT SCANNER

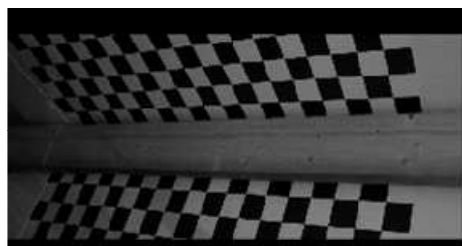
- Image processing
 - Laser plane (corner background + laser projection on the background)
 - Object position (laser plane + laser projection on the surface)



METHOD

METHOD

- Material
 - × spruce boards – 5
 - × air dried
 - × distorted
 - × 40x250x4000
- Camera–object distance – 2,5 m
- Two measuring methods
 - Slit scanner
 - Tapered caliper



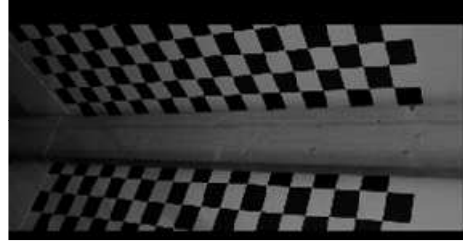
METHOD

- Confidence test based on repeated measurements
- Accuracy – 95% confidence limit of means

$$P = \pm 1.96 \cdot s \cdot \sqrt{n}$$

✗ s – standard deviation

✗ n – number of scans

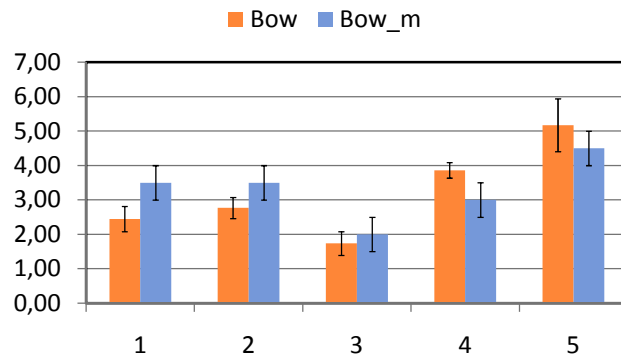
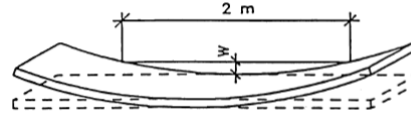


RESULTS



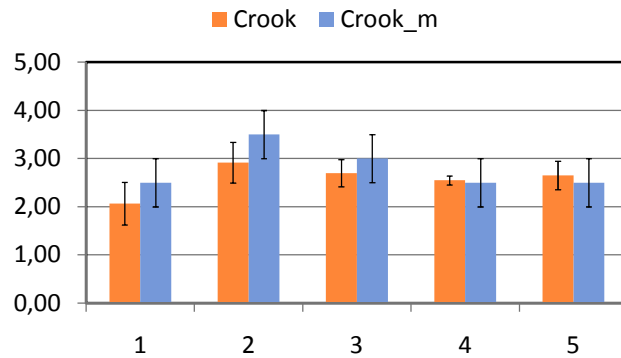
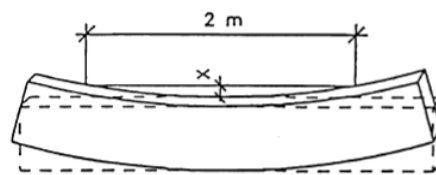
RESULTS

○ bow



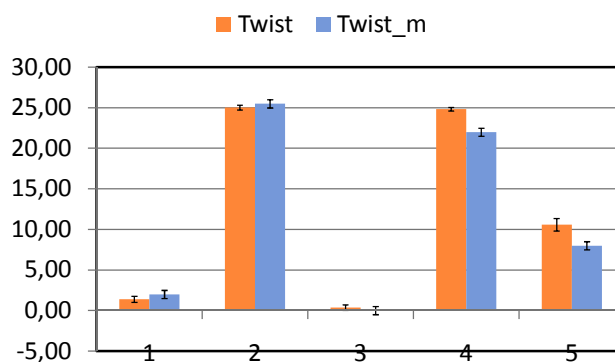
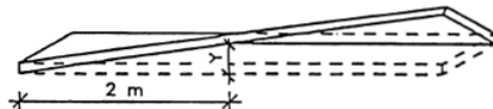
RESULTS

○ crook



RESULTS

○ twist



RESULTS

○ Accuracy

Board No.	A_{Bow} [mm]	A_{Crook} [mm]	A_{Twist} [mm]
1	0,37	0,44	0,26
2	0,31	0,42	0,44
3	0,34	0,28	0,42
4	0,22	0,09	0,24
5	0,77	0,29	0,72

CONCLUSIONS

- × Accuracy
 - × lower than ± 0.44 mm
 - × improvements requires more scans (slow down the process of evaluation).
- × Low cost slit scanner gives comparable results of all distortion characteristics
- × Future
 - × Speed up the process
 - × Test at the semi-industrial conditions



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QUESTIONS OR SUGGESTIONS?

