Rong Zou, Zhen-ying Xu, Jin-yang Li, Fu-qiang Zhou, 2015. Real-time monitoring of brake shoe keys in freight cars. *Frontiers of Information Technology & Electronic Engineering*, **16**(3):191-204. [doi:10.1631/FITEE.1400305]

Front Inform Technol & Electron Eng

Real-time monitoring of brake shoe keys in freight cars

Key words: Condition monitoring, Feature expression, Brake shoe key, Machine vision

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Introduction

- The traditional manual inspection is slow, laborious, and potentially hazardous, and the results are strictly dependent on the acuity, knowledge, and endurance of qualified inspection personnel.

- With the development of machine vision technology, many visual inspection systems have been developed and applied to an increasing range of fault types.

- A novel method for automated visual inspection of the brake shoe key (BSK) in freight cars has been presented in this work.

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Emphasis on this work

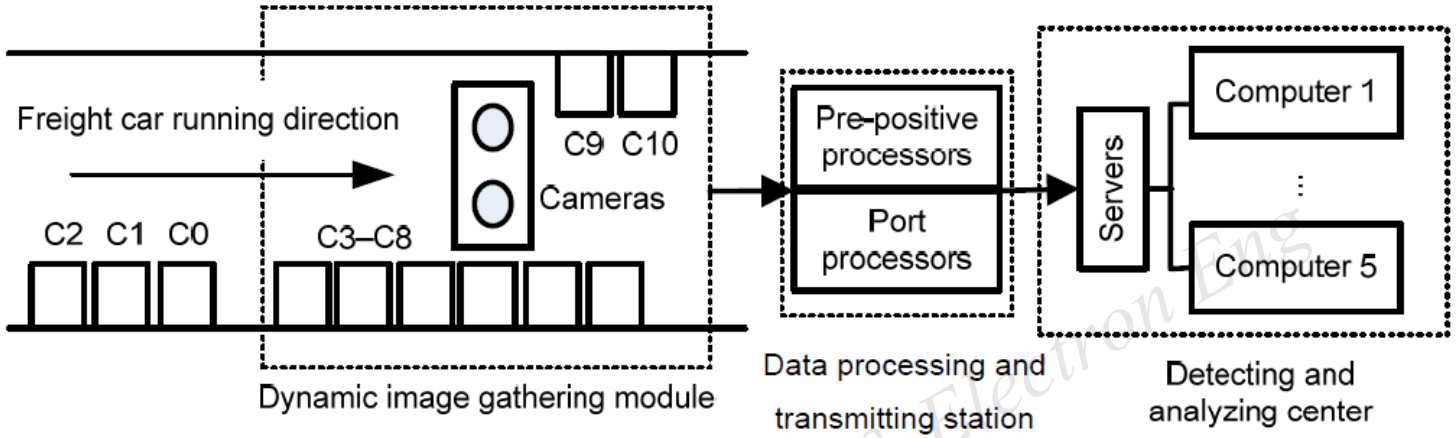


Fig. 1 Sketch of the system

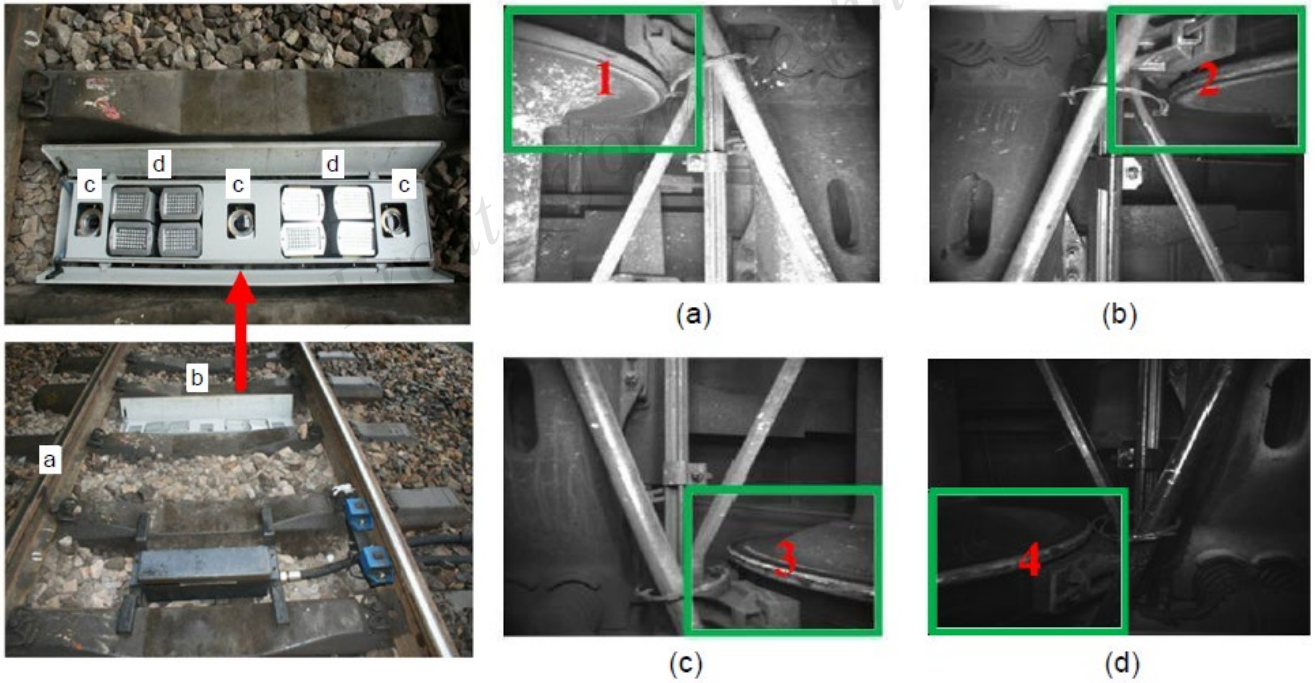
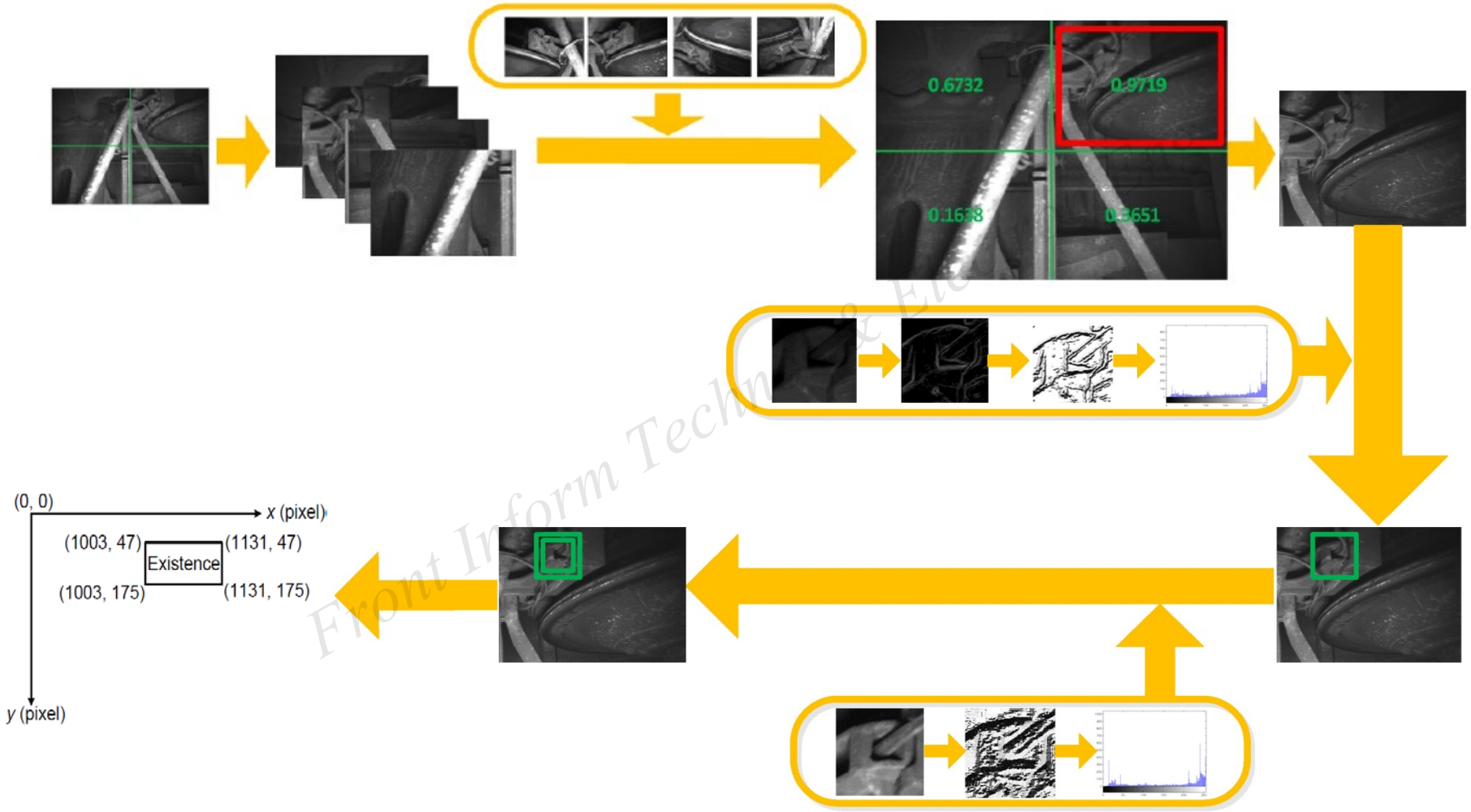


Fig. 2 (left) The system used to acquire dynamic BSK images: a, railroad; b, bottom box; c, high-speed cameras; d, lighting sources

Fig. 3 (right) Acquired BSK images: (a) First quadrant; (b) Second quadrant; (c) Third quadrant; (d) Fourth quadrant. Green rectangle: BSK region.

Emphasis on this work



Algorithm framework

Experimental results (1)

Table 1 Computing time distribution statistics

Main module	Time consumption (ms)	Percentage
ROI segmentation	90	48.1%
BSK localization		
Gradient image	15	8.0%
Integral image	16	8.6%
CT computing	31	16.6%
Slide window search	16	8.6%
Condition recognition	19	10.2%

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Table 2 Fault inspection result statistics

Place	Number of correct inspections	Number of false inspections	Correct inspection rate
Wuhan	4962	38	99.2%
Shenyang	4970	30	99.4%
Beijing	4974	26	99.5%

Note: the total number of images for all the three places is 5000

Experimental results (2)

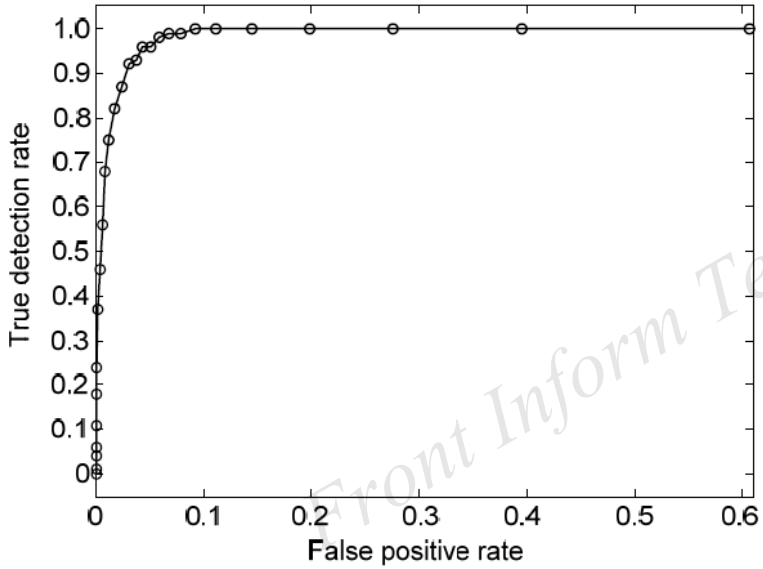


Fig. 22 ROC curve for classifier H_{lin}

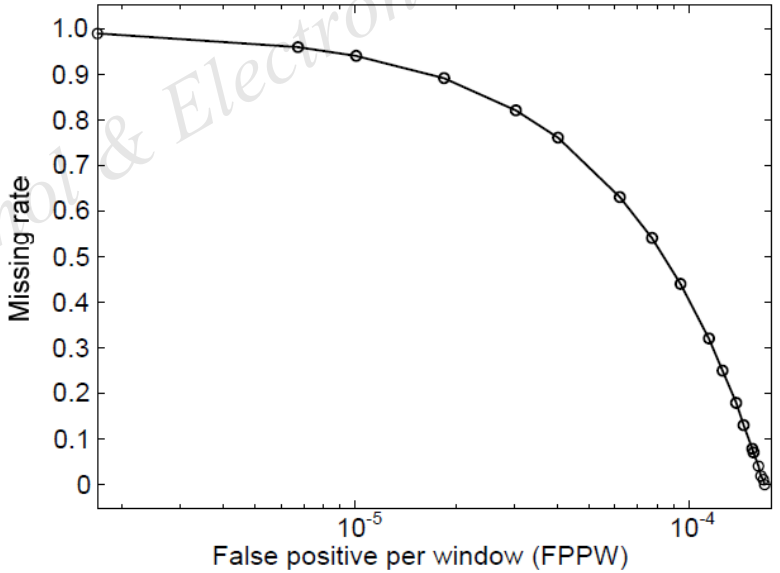


Fig. 23 FPPW results for classifier H_{lin}

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Conclusions

- Experimental data proved that the proposed system has high speed and accuracy.
- Another major contribution is the realization of a completely automated visual inspection. At present, in the railway transportation field many visual inspection systems are actually semi-automatic, and require some degree of manual operation.

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