Industrial Ray DR/ ICT integration inspection testing system

(2) Software and Testing

Liang Lihong [1] , Ding Kejian [2] , Ding Keqin [1], Sun Cuili [3]

（1. China Special Equipment Inspection and Research Institute
（2. Beijing Jiao Tong University School of Science
（3. Beijing University of Aeronautics and Astronautics
Building 2, Xi Yuan, He Ping Jie, Chao Yang District, Beijing 100013, China
Tel: +86-10-59068310, Fax: +86-10-59068319
E-mail: Liang-li-hong@163.com Web:http://www.csei.org.cn

Abstract

The paper introduces the component and function of the system software. The software adopts modular design as a detection system software development platform, which can develop professional testing software for the specific targets according to the user's requirements. The system testing showed that it can realize high quality image covering film radiography three class(A-class, AB class, B-class)according to the detection rate of speed and size of the acquisition frame rate.
[1]

Keywords: software integration, imaging quality, contrast, resolution, image processing

1 Composition and function of the system

The detection system's work is subjected to the large-scale application software CSEI-XIS control. The software is based on Windows XP platform, and uses VC + + languages to realize the function, including CSEI-XIS-FPD (based on flat panel detector subsystem), CSEI-XIS-LDA (based on linear array detector subsystem) and CSEI-XIS-II (based on the image intensifier subsystems) three software. Fig.1 is the system software startup interface.

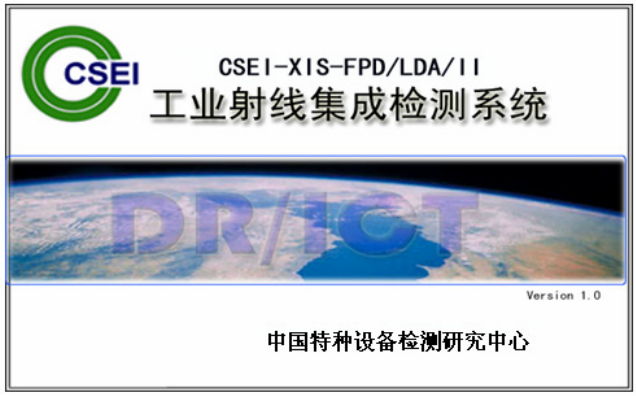

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Fig.1 detection system software startup interface

CSEI-XIS-FPD software includes hardware control module, RTR, DR,3D-ICT detection module and image processing module. Among them, hardware control module controls the flat panel detector and scanning platform; RTR and DR detector modules includes the correction modeling of the detector, imaging parameters setting and multidimensional image acquisition; CT module includes projection acquisition, image pre-processing,post-processing, and image reconstruction in a variety of scanning mode; Image processing modules include image filtering, image computing, visual image, marking of the defect size and other functions. Four modules are all regulated by workstation; workstation send instruction for the controller to control scanning movement, the controller analyzes and implements these instructions, at the same time feedback current movement state to the computer. Fig.2 is the software structural framework.

In addition to detectors control module, the structure and functions of the sub-software for CSEI-XIS-LDA,CSEI-XIS-II as well as CSEI-XIS-FPD.Software system is installed in the detection system worktable, the worktable includes five parts: The First, a high-grade Dual-CPU PC is used to complete system control, image acquisition, parallel reconstruction and processing; The second, a set of common PC is responsible for image post-processing and interpretation; The third is ray source control module; The fourth is flat-panel detector command processor and image intensifier control terminal; The fifth is a systematic assistive devices control module.

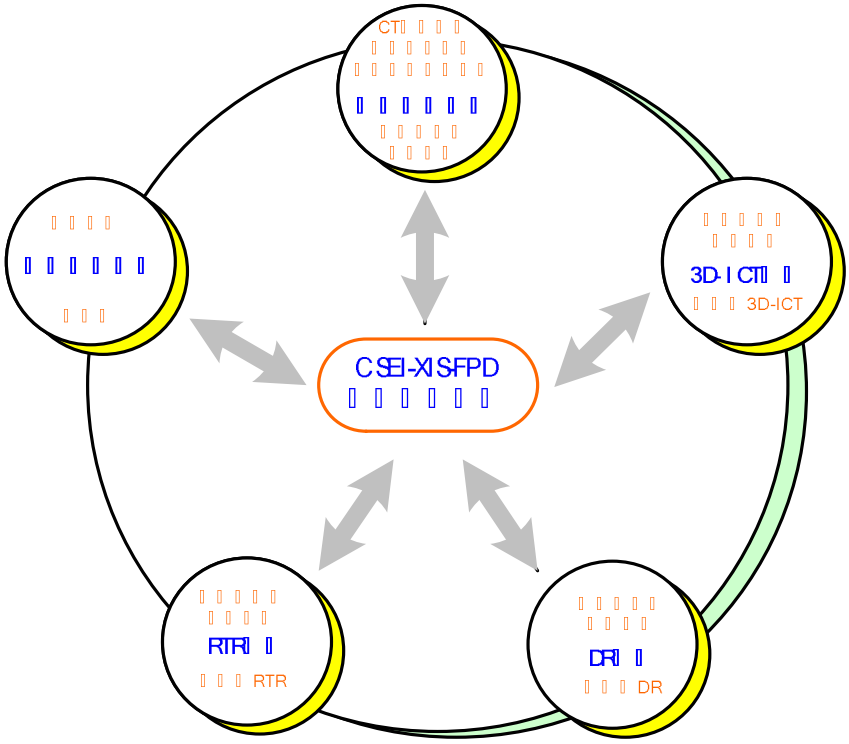


Fig.2 CSEI-XIS-FPD software framework

2 Testing results

Table 1 gives the testing results of the entire system, the image quality of the system can cover film radiography three class according to the detection rate of speed and size of the acquisition frame rate.

2.1 Imaging testing based on flat-panel detector

(1) DR indicators testing

Table 1 Summary of test results

Examination of the indicators			Test standard parts	Test results
Subsystem based on the flat panel detector	RTR	View field and frame rate	10mm Plate + radiochrometer wire (φ0.1~0.4mm)	250×200mm2/f 30f/s
		Image quality (IQI sensitivity)		2~3%
		Detection speed Rate		3000~4000mm/min
	DR	View field and frame rate	10mm Plate + radiochrometer wire (φ0.1~0.4mm)	250×200mm2/f 3.75f/min
		Image quality (IQI sensitivity)		better than Film radiography class B
		Detection Rate		750×250 mm2/min
	3D-ICT	Spatial resolution	Spatial resolution work piece	4.5~5lp/mm
		Contrast resolution	Contrast resolution work piece	0.3%
		the detected work piece diameter	Assembly work piece	standard scanning 200mm Wide view field scanning 300mm
		Scanning, reconstruction time	Spatial resolution work piece	Scanning time 5~25min ; reconstruction time 6s/layer
Subsystem based on linear array detector	DR	View field and frame rate	5mm Plate + radiochrometer wire (φ0.1~0.4mm)	Scan speed 45mm/min
		Image quality (IQI sensitivity)		Film radiography class B
		Detection Rate		150*150mm2/min
	2D-ICT	Spatial resolution	Spatial resolution specimen	5lp/mm
		Contrast resolution	Contrast resolution work piece	0.3%
		the detected work piece diameter	Assembly work piece	standard scanning 120mm Wide view field scanning 180mm
		Scanning, reconstruction time	Spatial resolution work piece	Scanning time 5~15min ; reconstruction time 6s/layer
Subsystem based on the image intensifier	RTR	View field and frame rate	10mm Plate + radiochrometer wire (φ0.1~0.4mm)	Φ215mm ; 25f /s
		Image quality (IQI sensitivity)		2 ~ 3%
		Detection Rate		3000~4000mm/min
	DR	View field and frame rate	5mm Plate +	Φ215mm ; 10f /min

		Image quality (IQI sensitivity)	radiochrometer wire （φ0.1~0.4mm）	Film radiography class B
		Detection Rate		1000×120mm2/f

- Test conditions: The voltage 140kV; The current 2mA; frame rate 2f/s; the number of Superposition frame 32f.
- Test result：B-class image quality requires to distinguish the 14th wire, see Fig.3.

Fig. 3 DR contrast images (10 mm) of flat panel detector system

(2) 3D-CT indicators testing

- Test conditions: The voltage 140kV; The current 2mA; frame rate 2f/s; the number of Projection:720.
- Test result：Resolution of up to 4.5~5 lp/mm，see Fig.4.

4.5lp/mm 5lp/mm

Fig. 4 Flat-panel detector 3D-CT resolution images

2.2 Imaging testing based on linear array detector

(1) DR indicators test

- Test conditions: The voltage 180kV; The current 3mA; Scanning speed 0.75mm/s(45mm/min).
- Test result：B-class image quality requires to distinguish the 14th wire, see the Fig.5.

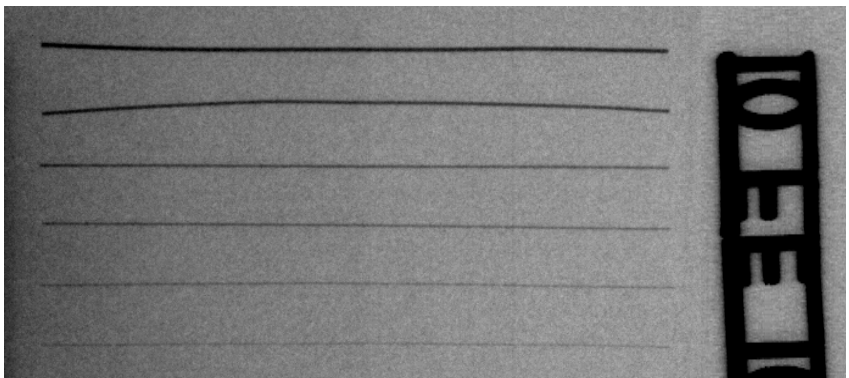


Fig. 5 DR contrast images based on linear array detector system (10 mm)

(2) 2D-CT indicators testing

- Test conditions: The voltage 120kV; The current2.5mA; Integral time: 50ms; scanning time:13min.
- Test result：Resolution is up to 4.5~5 lp/mm，see Fig.6.

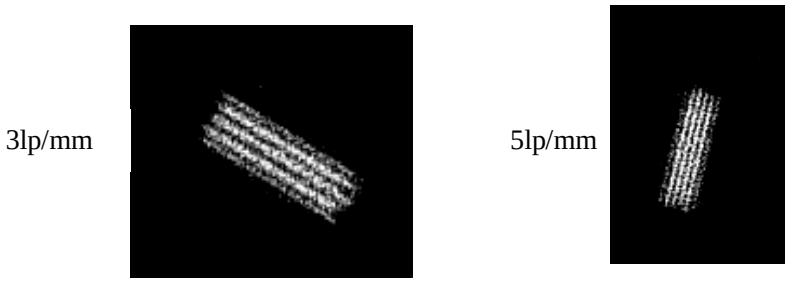
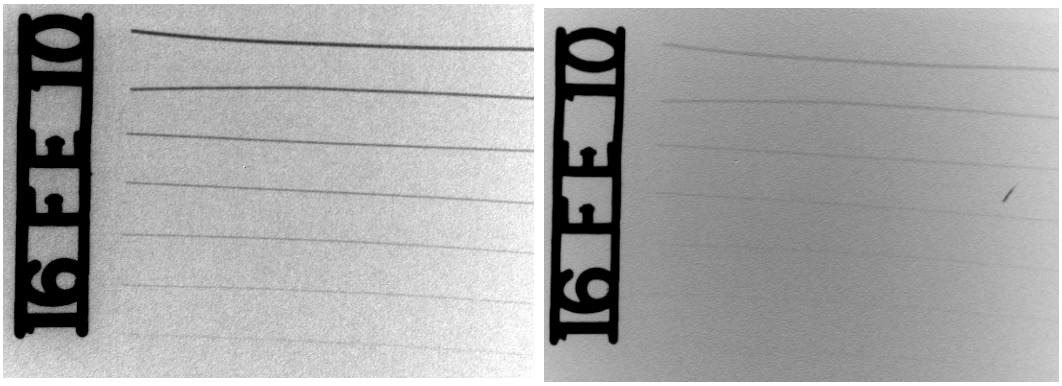


Fig. 6 Linear array detector 2D-CT resolution images

2.3 Imaging testing based on the image intensifier

DR indicators testing

- Test conditions: The voltage 150kV; The current 2.1mA; frame rate 2f/s; the number of Superposition frame 128f.
- Test result：Better than Film radiography class B, see Fig. 7.



5mm 10mm

Fig. 7 DR contrast images based on image intensifier system

4 Conclusion

System software is divided into three subsystem software, which has acquisition, data transmission function of three imaging detector. It can control four degrees of freedom scanning table movement, and complete DR and CT imaging for different sizes and shapes of parts. At the same time system software has a powerful data reconstruction and image processing function, and has a high integration, high sensitivity, transmission and tomography

function characteristics.

After the expert group exams the system, who agreed that the system integrates testing, research and development to the unity, and provides for the support which comprehensively upgrades of the ray detection technology and level, reduces the difference of ray detection technology and system between China and developed countries, and achieves high efficiency, high image quality ray detection ; which establishes a solid technical basis for China's ray digital detection system development, provides an experimental and research platform, and brings notable social and economic benefits.

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