R/F

Development of the SONIALVISION G4 LX edition

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1. Introduction

SONIALVISION G4 R/F systems feature a large FPD and provide exceptional image quality and easy operability for tomosynthesis, and an extensive assortment of other applications. Consequently, customers have especially praised their ability to be used for such a broad range of clinical applications.

Shimadzu has now developed the SONIALVISION G4 LX edition that includes a wide variety of new functionality (referred to as "G4 LX edition" below and shown in **Fig. 1**), an even more advanced version of the SONIALVISION G4 ("G4" below). This article describes the following new functionality.

- SCORE PRO Advance enables fluoroscopy with even lower radiation dose and higher image quality levels.
- An R/F table with 1.8 m SID and a wireless FPD expands the applicability of radiography.

Note that some of the new functionality can be optionally added to existing G4 systems.

Fig.1 SONIALVISION G4 LX edition

2. SCORE PRO Advance

Using SUREengine FAST image processing engine to control fluoroscopy parameters, the G4 provided excellent image quality and low radiation levels for endoscopic examinations, which have become increasingly popular in recent years.[1, 2] To achieve even higher fluoroscopic image quality, while also achieving low radiation dose levels, and expand applicability to gastrointestinal X-ray examinations, the G4 LX edition features a new SCORE PRO Advance fluoroscopic image processing engine that significantly increases processing capacity.

2.1 SCORE PRO Advance Features

In addition to the multi-frequency processing and recursive filter processing functionality included previously, SCORE PRO Advance also offers motion tracking noise reduction and object extraction-based edge enhancement that selectively enhances edges based on their structure **(Fig. 2)**. That achieves higher noise reduction and improved visibility of detailed structures than previous image processing, while also minimizing image lag effects during inter-frame processing. Such complex image calculation processes are performed on Shimadzu's unique high-speed image processing board that prevents delays in displaying images, which can interfere with examination procedures.
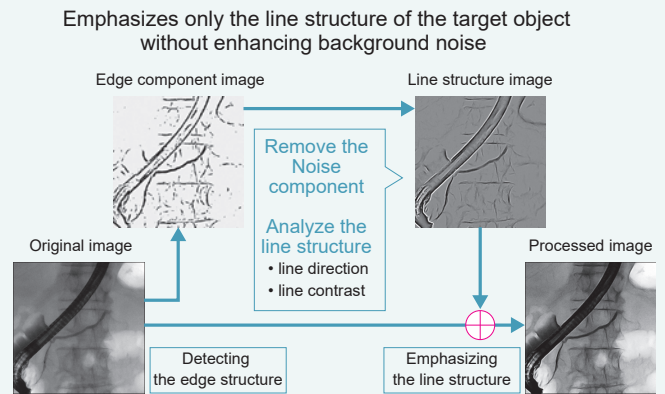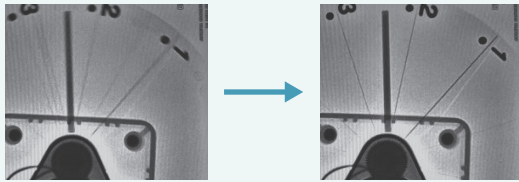
2.2 Benefits of SCORE PRO Advance

An example of using SCORE PRO Advance for a gastric X-ray examination is shown in **Fig. 3**. It shows that SCORE PRO Advance results in less blurring due to image lag than previous image processing and clearly indicates the stomach edges and direction of gastric rugae.

As a result of such image quality improvements, SCORE PRO Advance can provide equivalent image quality using only about 40 % of previous X-ray dose levels, which means it can reduce

■ Adoption of the latest motion tracking noise reduction

By performing block matching between frames, and recursive processing between the most matched blocks, noise is efficiently reduced without any lag.

Emphasizes only the line structure of the target object without enhancing background noise

Edge component image

Line structure image

Remove the Noise component

Analyze the line structure
• line direction
• line contrast

Original image

Processed image

Detecting the edge structure

Emphasizing the line structure

Fig.2 SCORE PRO Advance Motion-Tracking Noise Reduction (left) and Object Extraction-Based Edge Enhancement (right)
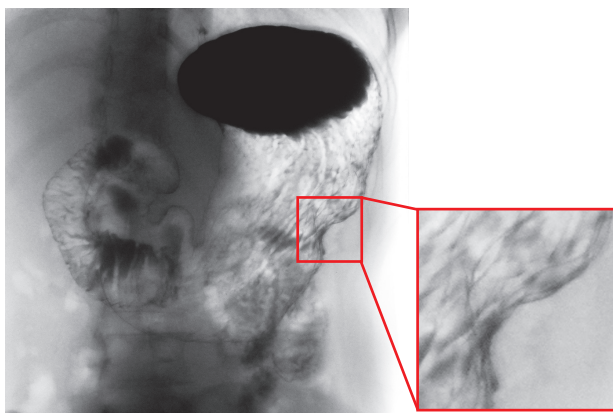
(a) Previous Processing
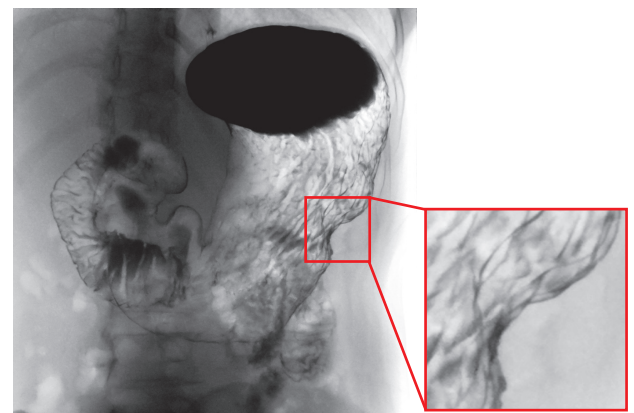
(b) SCORE PRO Advance

**Fig.3** Applicability of SCORE PRO Advance for Gastric X-Ray Examination

radiation exposure levels by 60 % from previous levels. Also, due to significantly lower image lag, visibility decreases can be minimized even at low pulse rates. That means exposure rates can be reduced even further by decreasing the pulse rate setting (example: 15 → 7.5 → 3.75 fps) based on the amount of movement of the target object being observed.

4. R/F Table with 1.8 m SID (Optional)

The SID (source-to-image distance) setting on the G4 can be switched to 1.1, 1.2, or 1.5 m, whereas the G4 LX edition was developed with a redesigned telescoping column mechanism on R/F table, so that the SID can be switched to 1.1, 1.5, or 1.8 m. The ability to select the 1.8 m SID setting on the R/F table allows chest and abdominal radiography to be performed easily in the standing position **(Fig. 4)** without using a ceiling-mounted X-ray tube support (for a second X-ray tube) and a Bucky stand.

5. Wireless FPD (Optional)

The G4 LX edition can be used in combination with a 14 × 17-inch wireless FPD for radiography **(Fig. 5)**. Previously, adding an FPD unit for radiography required installing a separate image processing console for the radiography FPD, but the G4 LX edition is able to perform all display and control functions via the image processing console on the main unit. That leaves more space in the control room and dramatically improves operability, with examination information and images for both the fluoroscopy FPD and the radiography FPD units managed from a single location. The system can switch smoothly between either FPD unit during examinations, which is even helpful for myelography and other examinations that involve using a ceiling-mounted X-ray tube support system to acquire radiography images from the side during fluoroscopic examinations.
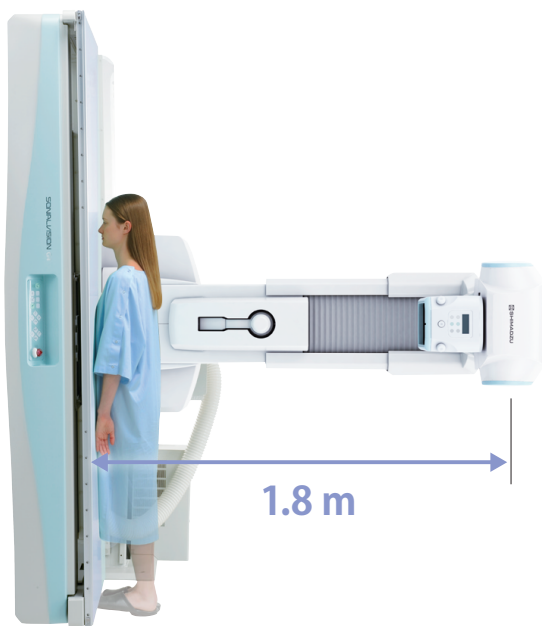
Fig.4 Chest Radiography with a 1.8 m SID

1.8 m

(a) Radiography with FPD Placed on the Table

(b) Lateral Radiography

Fig.5 Radiography Using Wireless FPD
(In combination with a ceiling-mounted X-ray tube support)

6. Conclusion

This article describes the new SONIALVISION G4 LX edition R/F system, which offers lower radiation levels, higher image quality, higher labor efficacy, and better examination room space efficacy. Based on feedback from customers, we will continue to offer new advancements for providing better healthcare in the future as well.

Lastly, we wish to thank everyone at the Nippon Koukan Hospital for providing clinical images and all the doctors and many others that offered such generous help and advice during the development of the system.

References:
1) Yoshitaka Nakai. Cutting Edge of ERCP—Experience Using the SONIALVISION G4 and Reducing Scattered Radiation Dose Level. MEDICAL NOW No. 85. 18-22. 2019
2) Yoshinao Mori, et al. SONIALVISION G4 USERS' VOICE, Low Dose Mode of SUREengine FAST Highly Rated for Use in Biliopancreatic Endoscopy. MEDICAL NOW No. 85. 23-25. 2019