

Vascular

Development of Trinias Series unity smart edition Angiography Systems

Medical Systems Division, Shimadzu Corporation

Isao Nakanishi

1. Introduction

The Trinias series of angiography systems has been introducing ever more functions and proprietary image guidance applications to support minimally invasive treatment (reduced exposure, reduced contrast media usage, and reduced examination times). Recent years have seen a rapid increase in the sophistication of interventional technologies, with therapeutic equipment becoming smaller and more delicate, just as a wider variety of functions are required of angiography systems.

Therefore, based on the "unity" concept*, the Trinias series unity smart edition model was designed to be more user-friendly and compact, and features unique imaging guidance software for supporting the latest treatment procedures. This article describes that software and functionality.

*unity: unlimited intelligent technology

2. Concepts of "unity"

In recent years, users have been demanding systems capable of sophisticated and diversified

interventional procedures for all areas of the body, such as the head, abdomen, heart, and four extremities. To offer a new minimally invasive experience for all sorts of interventional procedures anticipated from future advances in interventional technologies, the Trinias series unity model is a more advanced system that was designed based on the following three unity concept elements.

- Personalize your experience for ultimate flexibility
- Intelligent design for intelligent care
- Limitless potential for efficient workflow

3. Trinias Series unity smart edition

The unity smart edition was designed to enable a wide variety of procedures using a single system, so that sophisticated interventional procedures can be performed with few personnel and limited space. Equipped with either a 12 × 12-inch or 16 × 12-inch FPD, users can choose the best field of view for their target treatment area (**Fig. 1**).



Fig.1 Trinias Series unity smart edition
Available with 16 × 12-inch FPD (left) or 12 × 12-inch FPD (center and right)

3.1 Personalize your experience for ultimate flexibility

The unity smart edition features a completely updated system configuration, so that sophisticated interventional procedures can be performed in a confined space with minimal personnel. Requiring about 30 % less cabinet installation floor space as the previous model, the system offers more flexible room layout in installation planning. It also eliminates the cabinet from the control room, which ensures a larger workspace in the control room. To support diverse procedures throughout the

entire body, the FPD cover size was minimized, freedom of positioning was increased. It enables to approach close to the patient even at a steep angle in heart cases (Fig. 2). The 16 × 12-inch FPD can be rotated to either portrait or landscape orientations, so that the field-of-view size for fluoroscopy and radiography can be selected based on the target area (Fig. 3).

The new user interface ensures smooth examinations. By displaying X-ray parameters, dose information, and positioning information on the live monitor (Fig. 4) to minimize having to look away, physicians



Fig.2 Supports Imaging the Heart Area

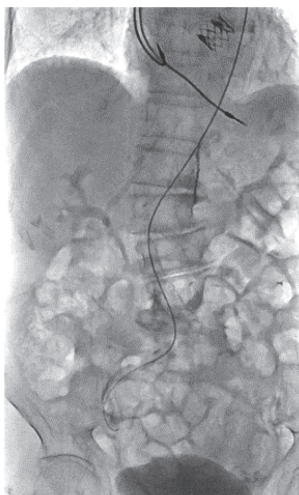
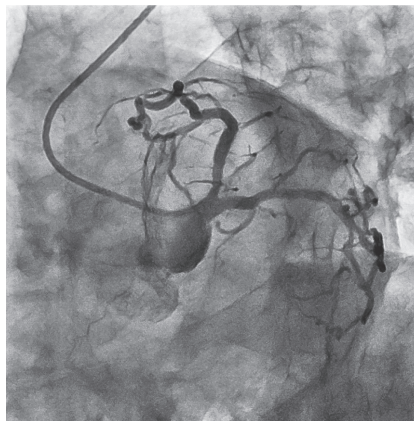


Fig.3 16 × 12-Inch FPD in Portrait and Landscape Orientations

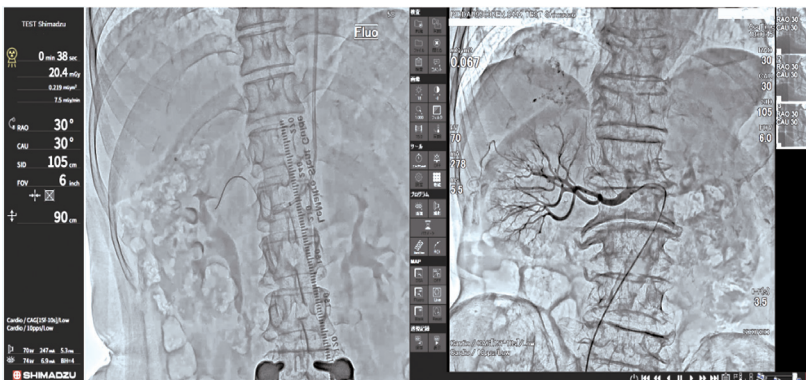


Fig.4 New GUI Minimizes Moving the Line-of-Sight

can focus more on the procedure. To provide more intuitive operations, all system come standard with a SMART Touch digital system controller, with functions that can be freely customized based on the operating circumstances. A wireless foot switch is also available that can be assigned to fluoroscopy, radiography, or even table up/down movement operations (Fig. 5).

3.2 Intelligent design for intelligent care

The unity smart edition was designed to prioritize highly reliable and worry-free performance for both the user and patient.

To improve system reliability, the system was designed for simplicity, such as a new communication method that reduces the cables between the control room and machinery room to one seventh the previous level. Furthermore, high product quality is achieved by performing all manufacturing and quality control process steps at the Main Factory in Japan.

3.3 Limitless potential for efficient workflow

A major design concept of even previous Trinias systems has been “minimally invasive experience” to minimize overall invasiveness, such as by reducing exposure, reducing contrast media usage, and reducing examination times and by developing applications that provide a real-time operability.

The unity smart edition features a more advanced version of Shimadzu's proprietary SCORE imaging technology, which achieves a new minimally invasive experience.

3.3.1 SCORE StentView and SCORE StentShot PCI Support Applications

The ability to accurately confirm device information, such as for accurate stent positioning and degree of stent expansion after placement, is very important during PCI.

SCORE StentView is an application that provides support for accurate real-time device placement. Based on images with a heartbeat, it displays moving images with minimal noise and with the stent enhanced (Fig. 6). Because images are displayed in real time on the live monitor, in the same manner as during regular fluoroscopy or radiography, positioning can be adjusted while viewing the live monitor.

SCORE StentShot is especially useful for confirming the shape of stents in detail. While offering the same real time performance as SCORE StentView, SCORE StentShot can provide more detailed stent images by successively integrating all frames during X-ray exposure (Fig. 7). Because successively integrated stent images are displayed in real time on the live monitor, X-ray exposure can be

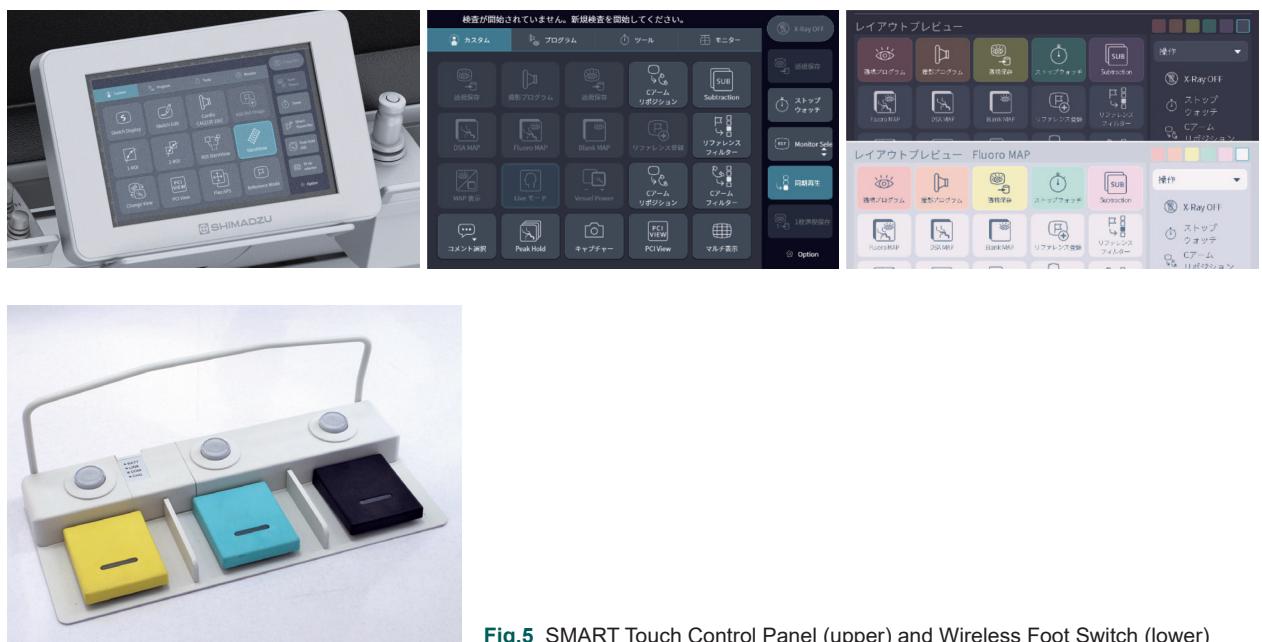


Fig.5 SMART Touch Control Panel (upper) and Wireless Foot Switch (lower)

stopped as soon as the stent shape is adequately confirmed, so that unnecessary exposure can be avoided.

3.3.2 SCORE Chase EVT Support Application

Frequency subtraction application “SCORE RSM” doesn’t require mask acquisition, and is free from motion artifact. So it has been widely used for motion-tracking radiography of the lower extremities and other long areas. SCORE Chase strengthens the link between a digital system and the patient table and automatically stitches motion-tracking images, obtained with SCORE RSM or another application, so that the entire imaged area can be observed at the same time (Fig. 8).

The stitched image of the entire area is displayed immediately after acquiring motion-tracking images, so that the images can be used during examinations without any wait time. The application not only supports table movements in the longitudinal

direction, but also in the transverse direction (Fig. 9). It can also create an image of all areas acquired by motion-tracking in the free-panning mode. Consequently, it offers a simple and smooth workflow.

3.3.3 Flex-APS Real-Time Nonlinear Pixel-Shifting Process

Pixel-shifting processes that translate, rotate, enlarge, or reduce the mask image with respect to the live image can be used to correct misregistration artifacts in DSA images, but sometimes adequate correction cannot be achieved, because actual clinical applications often involve three-dimensional movement with twisting. Flex-APS (flexible active pixel shift) calculates appropriate correction factors for the entire image by calculating the patient movement between mask and live images for each individual pixel of the exposure area and then applying different correction factors for each

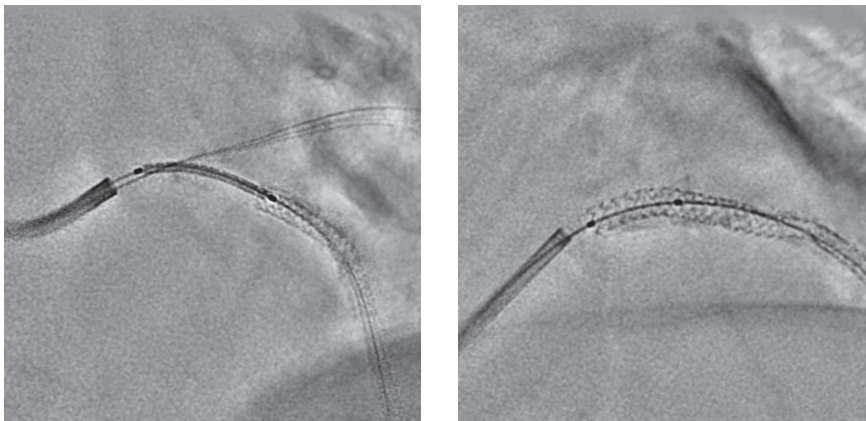


Fig.6 SCORE StentView

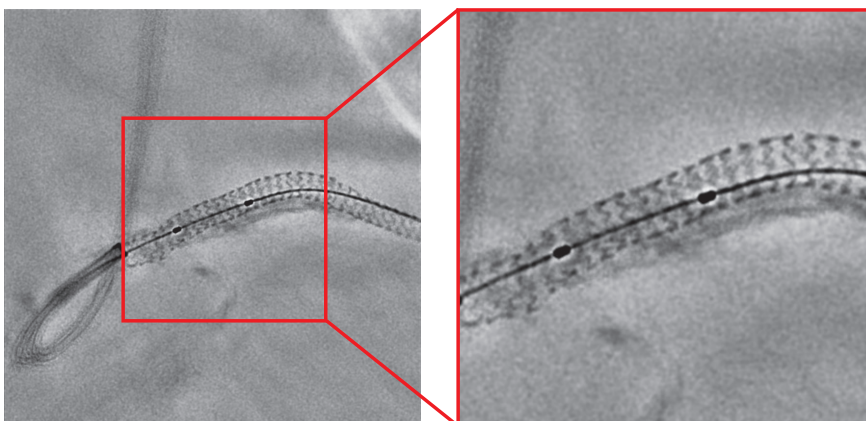


Fig.7 SCORE StentShot



Fig.8 SCORE Chase

pixel (Fig. 10). Because the series of correction steps are performed in real time, images of blood vessels can be observed with misregistration artifact correction even during acquisitions, which can significantly reduce the time and trouble required for post-processing. It can also help avoid unnecessarily high X-ray dose and contrast media levels by decreasing the number of repeated acquisitions.

4. Summary

Trinias series unity smart edition angiography systems are based on technology included in previous models for supporting minimally invasive procedures, but the unity smart edition also has been developed to support increasingly sophisticated and diverse interventions. Together with everyone involved in interventional procedures, we will continue to develop advancements intended to achieve less invasive and higher quality healthcare. Finally, we would like to thank the doctors and others that offered their generous help during product development.

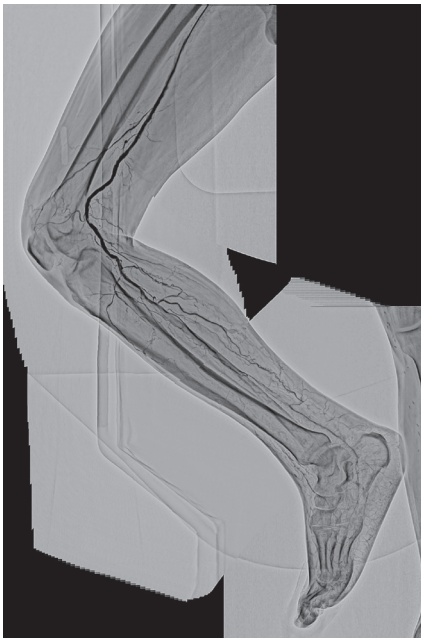
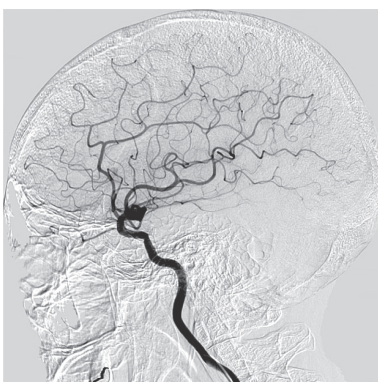
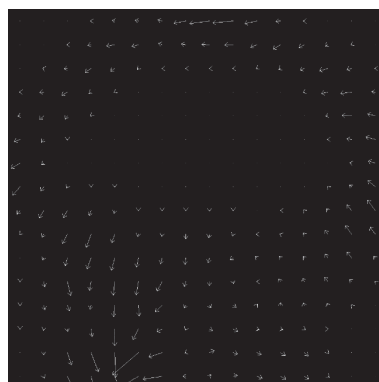


Fig.9 Free-Panning Mode



a) Without Correction



b) Dynamic Motion Vector



c) After Correction

Fig.10 Flex-APS