Angiography System Equipped with Wide-Field 17" x 17" Direct-Conversion FPD BRANSIST safire VF17/VC17

Shimadzu Corporation, Medical System Division
Wataru Miyamoto

1. Introduction

In 2003, we released "DIGITEX safire", a digital cardiovascular system with a 9-inch direct-conversion flat panel detector (FPD). Since then, we have continued to produce multi-purpose, primarily cardiac, systems that incorporate modifications such as the development of a high-speed DSA acquisition function and faster digital image processors.
We recently developed "BRANSIST safire VC17/VF17", a new product that uses an X-ray detector with a field size of 17 inches square, the largest size in its class. In this article, I will give an overview of this system.
It is an X-ray angiography system that supports the examination and treatment of blood vessels throughout the entire body, from the head down to the lower limbs. It is primarily used for the abdominal region, for example, in embolization procedures performed to treat liver tumors and gastrointestinal bleeding. It is equipped with a direct-conversion FPD that ensures superior visibility, making it possible to easily observe fine objects, such as peripheral blood vessels and devices used for interventional procedures. Because the FPD has a wide 17-inch field, objects covering a large range can be viewed simultaneously. This makes it possible to reduce the number of times fluoroscopy or radiography needs to be performed, and thereby reduces the burden on the patient **(Fig. 1)**.

Fig. 1 17" x 17" BRANSIST safire VC17 (Ceiling-Mounted Type)

2. System Configuration and Specifications

The C-arm support for this system comes in two types, a ceiling-mounted type and a floor-mounted type. The two types have the same rotation speed and offer the same basic performance capabilities, such as the mobility to cover the patient's entire body. The C-arm is equipped with a 17-inch direct-conversion FPD and an X-ray tube with an anode heat capacity of 3.0 MHU.
The image processor that supports image quality and operability ensures extremely fast image acquisition and playback, and thereby eliminates the stress of waiting for processing to be completed. Direct-conversion FPD technology enables the display of high-definition images. The system is designed to allow expansion to applications such as 3D-angiography and CT-like imaging in the future.

Conversion method	Direct
X-ray conversion material	a-Se
Effective field size	432 x 432 mm
Effective number of pixels	2,880 x 2,880
Pixel pitch	150 µm
Density resolution	14 bits
Fluoroscopy	30/15/7.5/3.75 pps
DA imaging	30/15 fps
DSA imaging	7.5/5/3/2 fps
RSM-DSA imaging	Standard
Storage capacity	100,000 frames
DICOM capability	Storage, Q/R, Commitment MWM, PRINT, MPPS

Table 1 Specifications

3. System Features

3.1 Whole-Body Coverage

The ability to obtain the largest 17-inch-square field of view makes it possible to observe objects covering a large range simultaneously, and this system can be used to examine and treat blood vessels in all regions of the body, from the head to the lower limbs, and particularly in the abdominal region **(Fig. 2)**. Also, both the ceiling-mounted and floor-mounted C-arms allow the imaging chain to be moved freely in the longitudinal and transverse directions with respect to the table **(Fig. 3)**. This enables the operation of catheter to be conducted from the brachial region and examinations and treatments to be conducted smoothly over a wide range down to the lower extremities, without moving the patient, and thereby reduces the burden on both the patient and the physician.

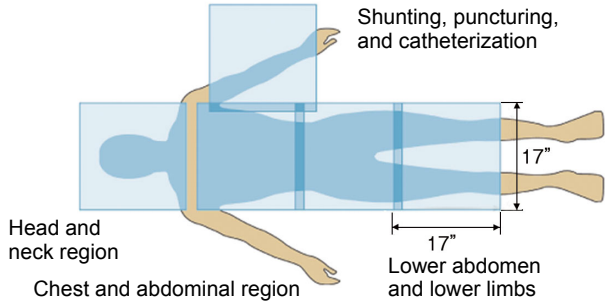


Fig. 2 Whole-Body Coverage

Fig. 3 Parallel Movement of Floor-Mounted C-Arm Support

3.2 High-Definition Images and Low Dose

Because the direct-conversion FPD used by the system converts X-rays directly to electrical signals using an X-ray conversion film (a-Se) without first converting them to light, there is no image blurring due to light scattering, and very sharp images can be obtained. Also, the FPD pixel pitch of 150 µm makes it possible to produce ultrahigh-definition images, and fine peripheral blood vessels and devices used for treatment can be observed easily. This system is particularly effective for the treatment of liver tumors and gastrointestinal bleeding, which requires images with high definition and contrast resolution.

In order to minimize exposure to both the patient and the physician, this system also inherits, from earlier products, an "MBH filter", which effectively removes soft X-rays that do not contribute to image quality, and "grid-controlled pulsed fluoroscopy", which eliminates unnecessary X-ray wave tails.

Fig. 4 Angiography of the Portal Vein

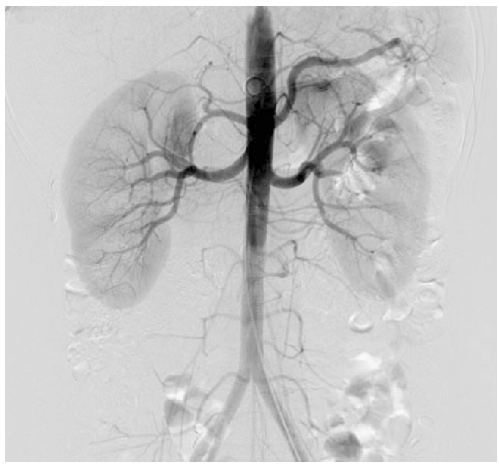


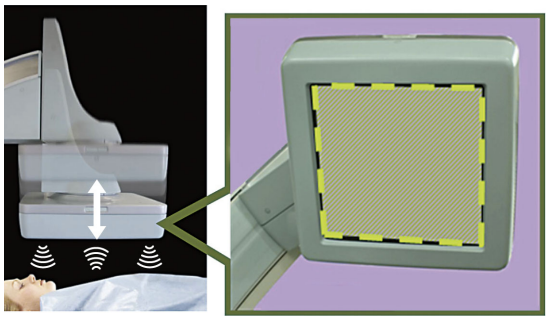
Fig. 5 Angiography of Renal Arterie

3.3 Superior Operability

(1) INTELLISHIELD

In order to improve safety in line with the increase in X-ray detector size, this angiography system is the first to be equipped with an "INTELLISHIELD" hybrid sensor.

INTELLISHIELD is a safety mechanism that consists of two components: non-contact sensors that automatically stop operation when the presence of the patient is detected and a contact sensor positioned in the center of the detector where non-contact sensing is difficult. This feature allows the physician to concentrate on the examination or treatment **(Fig. 6)**.



Non-Contact Sensors Contact Sensor

Fig. 6 INTELLISHIELD

(2) System Display

We have developed a "system display" X-ray console specifically for angiographic examinations **(Fig. 7)**. It is equipped with various new functions enabling, for example, the automatic aging of the X-ray tube and fluoroscopic density monitoring.

Fig. 7 System Display

Furthermore, a color LCD is used to display information inside the examination room, and information about the C-arm support and X-ray tube can be displayed in an easy-to-view format consisting of color-coded combinations of illustrations and characters.

(3) Fast Workflow

The advanced image processor inherits the features of multi-purpose cardiac systems, and attains an extremely fast processing response. Images can be played back just 0.5 s after acquisition.

Also, the system incorporates a "dynamic reference" function that, utilizing the fact that image acquisition is completely independent from the image playback system, supports interventional procedures by allowing the physician to play back reference images while performing fluoroscopy or radiography.

4. Summary

We have developed an angiography system equipped with a direct-conversion FPD that offers a large field of view, high image quality, and excellent operability. It was designed as a system that utilizes the high-definition images obtained with direct-conversion FPD, and allows the physician to focus on treatment.

In the future, we will continue to work on the development of clinical applications, such as 3D-angiography and CT-like imaging, and strive to make further contributions to medical treatment.