# Mobile C-arm

## Development of the Mobile C-arm System OPESCOPE ACTENO™ FD type

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## 1. Introduction

The mobile C-arm system OPESCOPE ACTENO, equipped with an Image Intensifier (I.I.), enables manual operation of all C-arm movements, including vertical movement, allowing for quick and safe positioning. This has led to high acclaim, with a worldwide cumulative installation of 2,100 units as of September 2022. We have now developed the OPESCOPE ACTENO FD type (Fig.1), which replaces the I.I. with an 8×8 inch Flat Panel Detector (FPD), maintaining the comfortable operation of the C-arm while enhancing image quality, achieving dose reduction, and improving usability. This article will introduce the following features:

- High-quality images that clearly show the desired objects
- Further realization of dose reduction
- Enhanced usability through new options

## 2. High-quality images that clearly show the desired objects

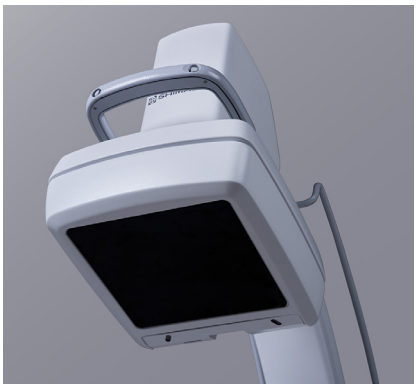
### 2.1 SCORE™ PRO Advance

We have equipped the system with the fluoroscopy image processing engine "SCORE PRO Advance," used in our flagship cardiovascular system "Trinias™" series and the RF table system "SONIALVISION™ G4 LX edition." It encompasses our unique noise reduction processing for dynamic time-series images and edge enhancement for fluoroscopic images, executed in real-time by a dedicated high-speed image processing algorithm. This offers fluoroscopy images with minimal residual images, even during the movement of the C-arm or surgical devices (Fig.2), and enables selective emphasis of specific elements such as spinal projections or needle tips.

### 2.2 Radiography SURE

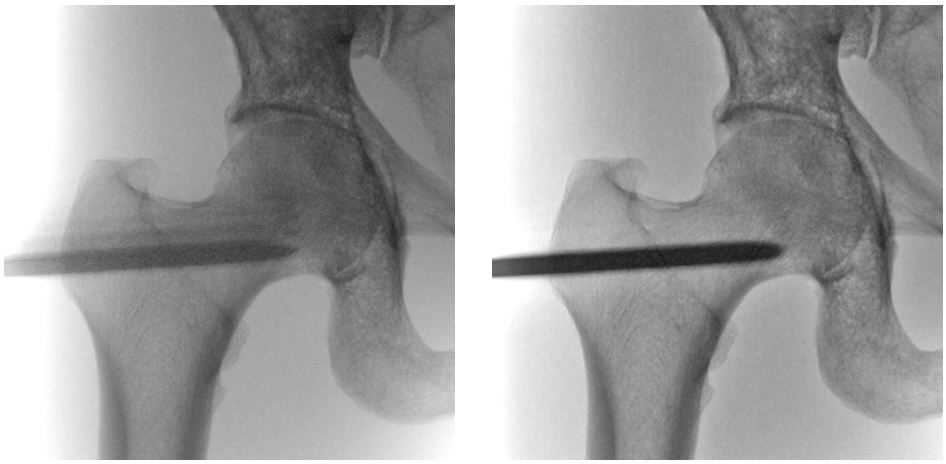
The mobile C-arm system now includes the image processing engine "Photography SURE," previously proven in our RF table system "SONIALVISION G4 LX edition" within the orthopedic domain. Implementing frequency enhancement and noise reduction processes not found in earlier models, the sharpness of radiographic images has been improved, and granularity reduced. This enhances the visibility of fine structures like carpal bones or fingertips. Although considering the Source to Image Distance (SID) is necessary, it allows for the verification of radiographic images in post-surgery as a substitute for mobile X-ray systems (Fig.3).

a) Monitor cart and C-arm cart



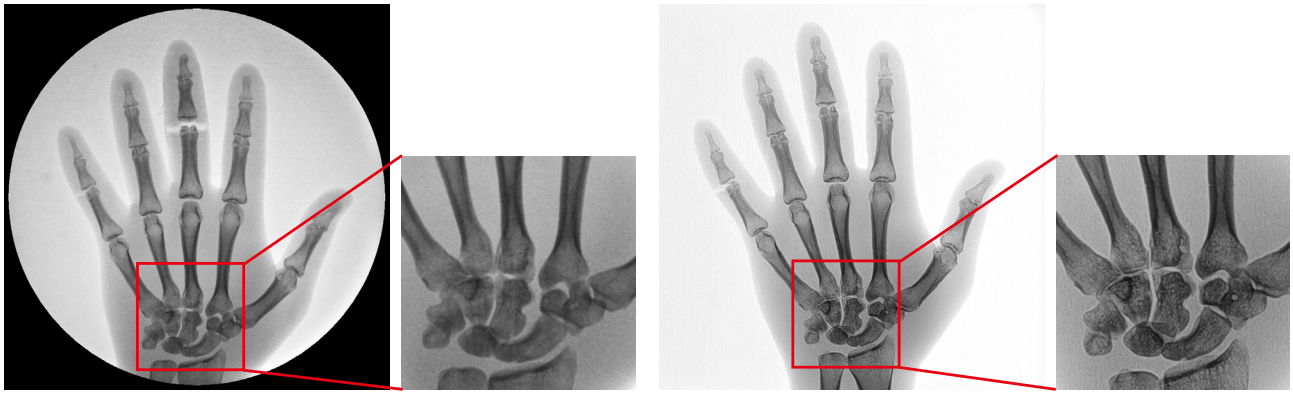
b) 8 × 8 inch size FPD

Fig.1 OPESCOPE ACTENO™ FD type



a) Without SCORE™ PRO Advance　b) With SCORE™ PRO Advance

Fig.2 Effect of SCORE™ PRO Advance



a) Previous model　b) Radiography SURE

Fig.3 Effect of Radiography SURE

### 2.3 Improved Visibility for subjects with higher thickness

We have refined the "Boost Pulse Mode" from previous models, which irradiates X-rays in a high-power pulse mode to achieve high-contrast fluoroscopy images while minimizing exposure. By fully utilizing the wide dynamic range characteristic of FPDs and optimizing X-ray control and image processing parameters, we have enhanced the clarity of fluoroscopy images in subjects with high thickness, such as lateral views of the lumbar spine (Fig.4). Consequently, the maximum thickness of subjects at which the boundaries of vertebrae and tips of surgical devices can be observed has increased compared to previous models.

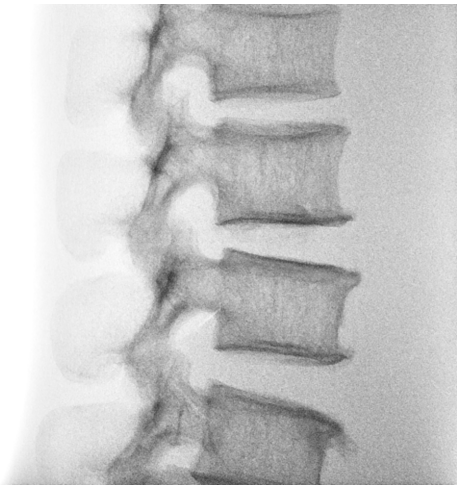


Fig.4 Lumbar spine side view in Boost Pulse Mode

## 3. Further Dose Reduction

### 3.1 Dose Reduction through SCORE PRO Advance

For all Anatomical Programs (APRs), a 0.1 mm Cu BH filter is now standard, and combined with image quality improvement by SCORE PRO Advance, it's possible to achieve image quality equivalent or better than previous models with a lower dose. As a result, exposure can be reduced by approximately 30% to 80% depending on the subject, compared to previous models without a BH filter. Especially for thin subjects like hands, where the removal of soft X-rays is more effective, the exposure reduction rate is about 60% to 80%.

Furthermore, the significant reduction of residual

images by SCORE PRO Advance allows for maintained visibility in moving subjects even at low pulse rates in fluoroscopy. By reducing the pulse rate (15 fps → 10 fps → 7.5 fps → 3.75 fps) according to the movement of the subject, further dose reduction is possible.

### 3.2 Shortening of Fluoroscopy Image Brightness Stabilization Time

The newly developed dedicated high-speed image processing algorithm allows for the generation of high-brightness, highly visible fluoroscopy images from the initial frame. Also, the refinement in feedback control based on pixel values enables faster setting of appropriate X-ray conditions. These improvements have shortened the time from the start of fluoroscopy to the point when sufficient brightness for visibility is achieved, faster than in previous models. Especially for the lumbar spine lateral view, which traditionally takes longer to stabilize brightness, high-quality fluoroscopy images can now be provided in about 0.5 seconds. This enables the confirmation of the subjects in operations involving repeated short exposures, further reducing dose.

## 4. Improved Usability through New Options

### 4.1 Wireless Features

**- Wireless Hand Switch**

Enables the operator to control exposure from behind the X-ray shield or to a position with better monitor visibility for X-ray exposure operation (Fig.6).

**- Wireless DICOM Connection**

Eliminates the need to connect a LAN cable for tasks such as receiving study information or transmitting images.

### 4.2 Long Cable Foot Switch

By connecting a 15 m long foot switch cable to the C-arm cart, X-ray exposure operations can be performed from a distance, such as from the control room while the C-arm cart is stationed in the examination room, making it suitable for barium swallow studies (Fig.7).

### 4.3 External Imaging Output Function

With the DVI output connector placed on the monitor cart, it has become easier to output images to overhead monitors in the operating room (Fig.8).

Fig.6 Wireless Hand Switch
Not for sales in some countries.

Fig.7 Image of a barium swallow study using OPESCOPE ACTENO™ FD type

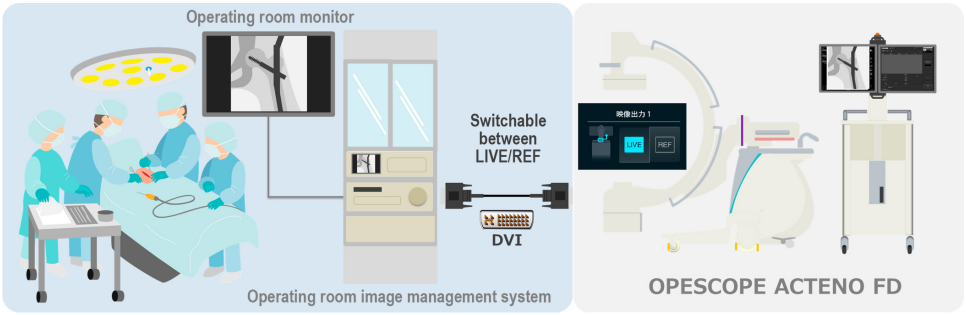



Fig.8 Surgical image using the external imaging output function

## 5. Conclusion

In the OPESCOPE ACTENO FD type introduced here, while inheriting the comfortable operation of the C-arm from previous models, we have changed the X-ray detector from I.I. to FPD and completely revamped both fluoroscopy and radiography image processing, achieving higher image quality and further dose reduction. Additionally, by incorporating new options, we have enhanced usability.

We anticipate that by providing images that clearly show what is needed, the quality of surgeries and examinations will improve, and the burden on operators, surgeons, and patients will be reduced due to lower radiation exposure. We will continue to develop devices that contribute to high-quality healthcare, taking into account feedback from our customers.