GE HealthCare

Dose optimization with the Precision™ 180

White paper

Introduction

Radiographic/fluoroscopy (R/F) is a medical imaging technique that shows a continuous X-ray image on a monitor. During a fluoroscopy procedure, an X-ray beam is passed through the body and the image is transmitted to a monitor so the movement of a body part or of an instrument or contrast agent through the body can be seen in detail. Fluoroscopy procedures are performed to help diagnose disease, or to guide physicians during certain treatment procedures[1].

Although image quality (IQ) is the ultimate goal for accurate diagnosis and treatment, minimizing radiation dose is equally important. This is particularly important in pediatric patients because they are ten times more sensitive to radiation exposure and the associated cancers. Additionally, pediatric patients with complex congenital heart and/or vascular defects may have as many as eight to ten X-ray-monitored interventions during their lifetime[2].

Dose management is especially important for pediatric patients as the consideration of lifetime radiation risk versus procedural benefit is a fundamental consideration for the clinician. It is imperative for a manufacturer to exploit advances in X-ray component technologies, image processing, system design and advanced imaging techniques to provide the clinician with the appropriate imaging tools and controls to effectively perform procedures at the lowest possible X-ray dose.

This article expands upon GE HealthCare's approach to help manage dose optimization with its Precision 180 R/F system.

About Precision 180

Precision 180 is a flexible R/F system which can be used remotely or patient side. Simple and intuitive, it provides a streamlined clinical workflow optimized for quality-infused value-based care. It's also one of the only systems that can conduct a wide variety of exams including tomosynthesis, stitching and digital subtraction angiograpy (DSA) – helping ensure unprecedented performance, uptime and fast return on investment.

Dose-saving features

- **The latest low-dose flat panel detector technology,** including a 74% detective quantum efficiency (DQE) detector (@ 0 lp/mm) and GE HealthCare's optimized imaging chain.

- **Significant dose reduction vs. industry norm of 3.75 fps** – Fluoro frame rates as low as 1 fps, and configurable dose rates.

	1 fps	2 fps	3.75 fps
High	-62%	-36%	Reference

- **Seven protocol patient sizes,** including 4 pediatric selections, and the ability to include filtration and removal of grid into protocols

- **Motorized Cu/Al filters,** that are built into protocol or easily added. Various thicknesses of copper located within the collimator can be inserted in the X-ray beam. Such filtration removes the lower energy photons, which typically do not contribute to the image (as they do not penetrate through the patient) but do contribute to the patient skin dose.

Utilizing combinations of these filters can result in up to 59% reduction in dose*.

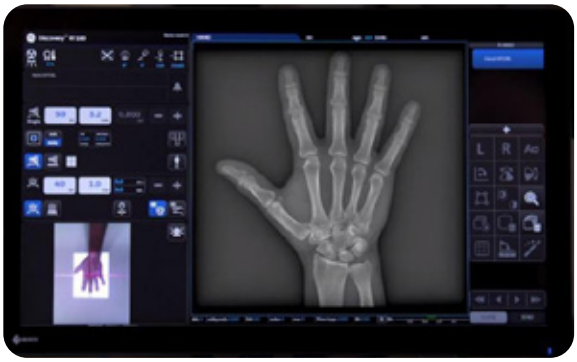
	Mode	Pulsed Fluoroscopy 15 fps	Pulsed Fluoroscopy 15 fps F1	Pulsed Fluoroscopy 15 fps F2
Field of View	**43x43**	Reference	-44%	-59%
	30x30	Reference	-44%	-59%
	20x20	Reference	-44%	-59%
	15x15	Reference	-44%	-59%

* Based on results from GE HealthCare dose comparison study. Theoretical dose reduction vs. reference of Pulsed Fluoroscopy 15 fps with medium dose level for each field of view. Spectral filtration dose reduction is estimated using Dosimetric Indication in appendix of Operator Manual (F1: 0.1 mm Cu + 0.5 mm Al; F2: 0.2 mm Cu+ 0.5 mm Al).

- **Removable, patented, autofocusing grid** – Grid with an exclusive autofocusing device that automatically set the correct grid focalization according to the selected SID. Easy grid removal allows dose reduction where appropriate.

- **Shot Positioning** – A recent exam at Lund University Hospital assessed the impact of Single Shot Positioning[3]:
  - 44% DAP reduction of **total** fluoroscopy DAP
  - 95% DAP reduction of **positioning** fluoroscopy DAP

- **Video camera (option)** – See your position and collimation live from the tube head.

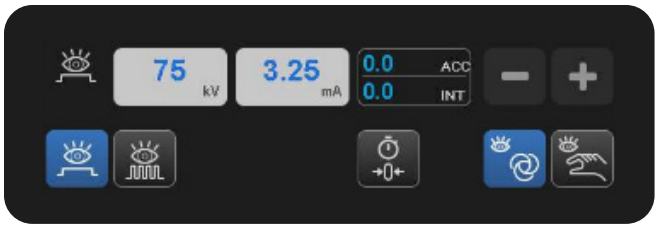


- **Virtual collimation** – Virtual collimation allows the operator to preview collimation changes on the last displayed fluoroscopic image rather than using live fluoroscopy, thereby conserving dose.

- **Virtual scanning (option)** – This function allows patient centering without X-ray emission (this function uses the Last Image Hold (LIH) in fluoroscopy or pulsed fluoroscopy that can be shifted on the monitor without X-rays emission).

- **Automatic exposure** – Precision 180 is designed to automatically determine the optimal X-ray technique parameters (kVp, mAs, focal spot size, and spectral filtration) for a variety of operational modes. The technique parameters are chosen to yield the targeted benefit of improved image quality at the lowest cost in terms of patient dose. In step one, an equivalent patient thickness is determined based on the average dose to the detector and the technique values used for that exposure. In step two, the technique parameters are determined for the next exposure using the patient thickness value and predetermined look-up tables. Three dominant exposure meters are present which are selectable independently by the operator or during anatomical programming. Ability to link a predefined dose value between 0.5 uGy and 5.0 uGy (at the detector level) at each single anatomical program in function of the patient size (seven sizes).

- **Range and steps of kV and mA** – Range of kV and mA and step-wise increments that allows small dose adjustments.



Radiography	
kVp range/steps	40 – 150 kV in 1 kV increments
High voltage ripple	<1 kV at 110 kV
mA range (1 mA/0.1 mA optional steps)	10 – 1000 mAs/R'10† (80kV generator only)
Time range	1.0 to 6300 ms
mAs range (no AEC)	0.1 – 1000 mAs/ R'10†

(†Rénard)

Continuous Fluoroscopy	
kVp range/steps	40 – 125 kV in 1 kV increments
High voltage ripple	<1 kV at 110 kV 5mA
mA range/steps	0.5 – 10 mA in 0.1 mA steps

Pulsed Fluoroscopy	
kVp range/steps	40 – 125 kV in 1 kV increments
mA range/steps	5 – 10 mA in 0.1 kV steps 10 – 99 mA in 1 mA steps

References:

1. "Fluoroscopy." (n.d.). U.S. Food and Drug Administration. Retrieved from https://www.fda.gov/radiation-emitting-products/medical- X-ray-imaging fluoroscopy
2. Stueve, D. (2006). Management of pediatric radiation dose using Philips fluoroscopy systems DoseWise: perfect image, perfect sense. Pediatric Radiology, 36 (Suppl 2), 216-220.
3. Based on a dose comparison study performed at Lund University Hospital in Sweden, going from 15 fps to 1 frame only for positioning (1 fps + virtual scanning).

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