Developments in digital radiography: cassette-based solutions

Manufacturers continue to find innovative ways of refining digital radiography systems to make them more adaptable to the different scenarios that present in clinical settings

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During the last two decades, digital radiography (DR) has replaced screen-film (SF) systems and is now the standard technology in most departments. The triumph of digital over analogue technique has been made feasible by improvements in technology in the last 20 years and is related to its undoubted advantages with regards to image quality, improved image handling and improvements in productivity that have occurred in general radiography.[1]

As the technique Despite the improvements, however, radiography facilities have been burdened with the positioning challenges that DR detectors often present. While the detached cassette detectors used in computed radiography (CR) systems can be positioned at any angle during examinations, the angle of fixed detectors in classic DR systems is restricted by the position of either a vertical wall stand or a table Bucky. This limitation made it necessary to keep CR detectors available in DR-equipped facilities units until portable DR detectors were introduced in the last few years.

Digital detectors

Today, manufacturers provide a variety of digital imaging solutions based on various detector and readout technologies. The two major detector systems widely applied for digital radiography are computed radiography based on storage phosphor plates and solid-state (flat panel) direct radiography systems. Solid-state, digital radiography detectors, designed specifically for standard projection radiography, emerged a few years ago. This new generation of digital image detector comprises a thin layer of X-ray absorptive material combined with an electronic active matrix array fabricated in a thin film of hydrogenated amorphous silicon (a-Si:H). DR detectors can offer both efficient (low-dose) X-ray image acquisition and online readout of the latent image as electronic data.[2,3] To date, solid-state, flat-panel DR detectors have been developed in two principal designs: the indirect-conversion (X-ray scintillator-based) and the direct-conversion (X-ray photoconductor-based)

types. In standard projection radiography indirect-conversion DR detectors currently offer superior image quality and dose efficiency compared with direct conversion DR and modern point-scan CR.[2]

Currently, the most successful design of an indirect-DR image detector combines a layer of X-ray fluorescent material with a hydrogenated amorphous silicon (a-Si:H) active matrix (AM) readout array and uses a layer of thallium-activated caesium iodide (Csi:Tl). In a direct-conversion DR detector a layer of X-ray photoconductor material is used to absorb the incident X-ray photons. Amorphous selenium (a-Se) has been the favoured photoconductor material superimposed upon a large-area AM array fabricated from a-Si:H.[4]

Cassette-based solutions

Portable DR detectors for use in, for example, emergency departments and intensive care units were introduced several years ago. Early designs of these detectors typically used a GdO2S2:Tb radiographic intensifying screen to absorb X-ray photons and convert their energy to light. Data were transferred via cable.

Nowadays, portable DR detectors are becoming an increasingly important topic in radiographic acquisition and meet the requirements of nearly all commonly encountered X-ray exams and environments. They have made cross-table and bedside DR examinations possible, as well as DR imaging in various trauma, paediatric and orthopaedic settings. An additional option for DR imaging of hospital patients with limited mobility has also become available since portable detectors can be transported with mobile X-ray units to

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Table 1. Features of cassette-based DR solutions from different companies

Products	Detector	Scintillator	Imaging area	Dimensions (WxLxH)	Weight	Data transfer
Canon						
CXDI-50G	a-Si	GOS	35 x 43cm	49.1 x 47.7 x 2.3cm	4.8kg	Cable
CXDI-50C	a-Si	CsI	35 x 43cm	49.1 x 47.7 x 2.3cm	4.8kg	Cable
CXDI-55G	a-Si	GOS	35 x 43cm	48.0 x 48.1 x 1.5cm	3.4kg	Cable
CXDI-55C	a-Si	CsI	35 x 43cm	48.0 x 48.1 x 1.5cm	3.4kg	Cable
CXDI-60G	a-Si	GOS	23 x 28cm	34.4 x 38.0 x 2.3cm	2.7kg	Cable
CXDI-60C	a-Si	CsI	23 x 28cm	34.4 x 38.0 x 2.3cm	2.5kg	Cable
Carestream Health						
DRX-1	a-Si	GOS	35 x 43cm	38.0 x 46.0 x 1.5cm	3.9kg	Wireless
GE Healthcare						
Optima XR640	a-Si	CsI				Cable
Siemens Medical Solutions						
Ysio	a-Si	CsI	35 x 43cm			Wireless

patients' rooms. The flexibility of portable detectors has provided great advantages in time-critical environments where an X-ray image can now be captured and viewed in less than 10 seconds.

Perhaps even more interesting are the lower costs of entry to DR that have been created by the additional upgrade options that some portable detectors provide, especially as some portable DR detectors are being designed to fit into the space where a film or cassette was inserted so that they can be integrated into an analogue or CR system. This option is helping facilities make the transition to DR easier and less expensive by eliminating the need for a complete replacement of their existing X-ray equipment.

The industry's first portable DR detector, the CXDI-31, was introduced by Canon Medical Systems in 2001. Canon has since launched three more generations of portable DR detectors. The latest is the CXDI-60C detector, which is more focused on neonatal and paediatric imaging, where smaller fields are more typical. The CXDI-55C and CXDI-55G detectors are used for imaging of larger anatomical sections.

Carestream Health launched its first portable DR detector, the DRX-1, in 2009. This also happens to be the industry's first detector featuring wireless image transmission. Since the DRX-1 is identical in size to a standard CR cassette, it can be inserted into an existing wall stand or table Bucky. As noted earlier, this presents an attractive option for modest-budget facilities wanting to improve productivity and image quality in existing film or CR rooms. A recent study in our department underlines the advantage of workflow efficiency regarding the novel DRX-1 detector compared with a CR system.

Several other market participants, including GE Healthcare (Optima XR640) and Siemens (Ysio) also offer portable detector-based DR systems. The Optima XR640 and the Ysio detectors are compact and lightweight and feature a handle for convenient carrying. While the Canon and GE Healthcare detectors transmit image data via a cable, the Carestream Health and Siemens detectors accomplish this task wirelessly (see Table 1).[5]

Summary

To date, DR detectors have followed two different technological paths: indirect and direct conversion. They offer superb image quality and excellent options for dose reduction based on their high dose efficiency.[3] Manufacturers of solid-state DR detectors continue to refine their products and explore new technological topics. Further advances in portable DR detectors promise the user greater operational freedom and an improved workflow. As a result, the proportion of portable detector-based DR systems in the market is expected to increase and further encroach on the CR systems market. ■

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