Simplified Collimators: Thinking Outside The Box Yields Long Term Reliability and Serviceability

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This paper will discuss historical X-ray collimator design and performance parameters in comparison to new simplified engineering and product features that provide increased reliability and serviceability.

Traditionally known for their mechanical complexity, collimators are enjoying a new revival in simplified construction. Rigidly designed, overly complicated systems have given way to free-form design simplicity. This new wave of engineering strives for simplification in order to provide long-term reliability.

An integral component to successful X-ray performance, the collimator touches all aspects of radiology imaging. Basic collimator operation consists of controlling the shape of an X-ray beam through a series of fixed and variable barriers. These barriers are designed to provide a limited focus and project a useful beam onto a specific diagnostic area. Fixed barrier position, along with shape and operation of variable barriers or "shutters," determine the performance, ease of use and ultimate reliability of the particular collimator design.

A look at the past

The first commercially available collimator was introduced in the early 1960s. Although several revisions have improved collimator accuracy and performance since then, most are still comprised of nearly 300 components. Overly complex, traditional designs are inherently prone to maintenance and accuracy problems due to the sheer volume of interrelated parts. In particular, many mechanical tolerances can become loose over time. Rigidly structured to meet historically accepted design parameters, most current collimator designs have not changed in more than 15 years.

Imaging specialists have always expected accurate performance from their X-ray equipment. However, most administrators realize that reliability and serviceability are the key to maintaining that performance over time.

To control accuracy problems historically encountered with collimators, the FDA mandated stringent Positive Beam Limitation (PBL) guidelines. Achieving only limited acceptance, PBL was eventually dropped due to a unified objection from the radiology community. Common complaints stemmed from the complexity, reliability and service expenses related to maintaining the PBL collimator system.

With the demise of PBL, many collimator users must depend on cumbersome and time-consuming manual operation to provide a level of accuracy necessary to ensure good diagnostic quality. Most collimator manufacturers, whether original equipment manufacturers (OEMS) or independent, now offer complex manual collimators originally designed to be PBL automatic.

When less is more

Anything that simplifies the complexities of imaging equipment will ultimately reduce the probability of mechanical breakdowns and associated costs of repair and downtime. Often, it's what's not inside that counts.

One solution currently offered by Huestis Medical is a simplified, modular core assembly. Combined with component redundancy, this assembly eliminates more than 88 percent of the discrete parts found in other collimator designs. This significant reduction in parts also translates into considerable weight savings, requiring less counterweight for better performance.

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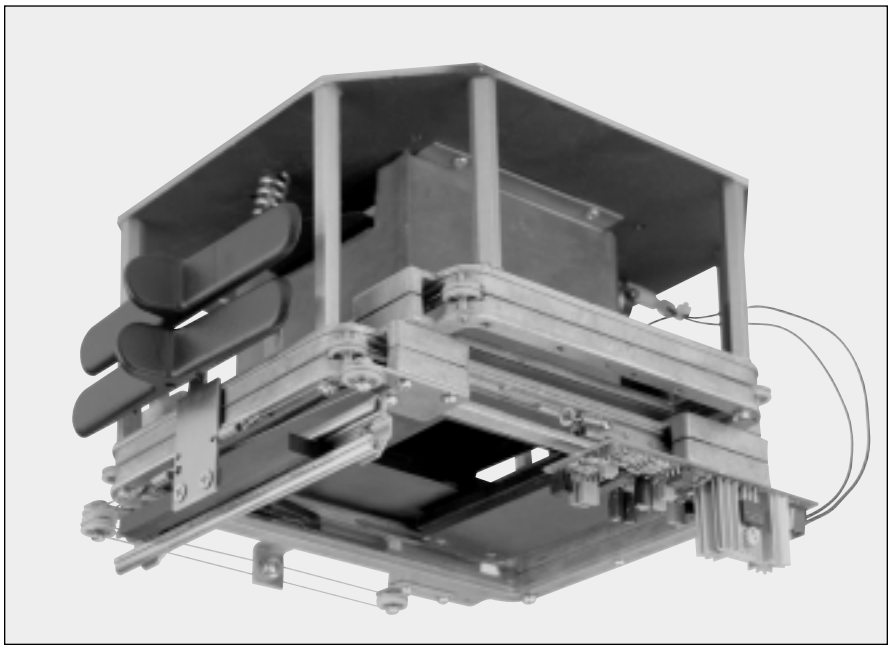

FIgure 1.

Another useful feature is directly coupled shutter drives, which eliminate mechanism and gear backlash common to rotary knob designs to improve accuracy and ease of use. By eliminating rotary adjustments, the collimator controls can be directly linked to the shutters in a direct "push-pull" motion. Going direct means less pieces, less motion and less wear and tear. This direct coupling eventually contributes to overall accuracy and reliability of collimator blade positioning. In addition, the use of thumb slides in manual models vs. rotary knobs in other designs allows true one-handed operation. Both thumb slides can be manipulated simultaneously between the thumb and forefinger for quick, easy adjustments. Perpendicular, flat collimator blades can also increase reliability and facilitate quick servicing with simple, modular construction. (Figure 1)

Easy serviceability

Unfortunately, required maintenance items are often overlooked in collimator design. For instance, many models require the entire cover to be removed for routine mirror adjustments. Designs that allow for quick light field adjustment with an integrated access port for mirror adjustment can make repair easier. Lightbulb adjustment is also easily handled with a removable access panel.

Another helpful solution offered by Huestis Medical is the Selectable™ collimator that provides automatic sizing without the complexity of traditional PBL systems. It allows technicians to easily select film size and source-image distance (SID) directly from the front panel of the collimator. It provides the accuracy, convenience and throughput of an automatic PBL collimator at a fraction of the total cost of a PBL system.

Uniquely simple, this new type of selectable automatic collimator alleviates complex systems traditionally required to accept, size and feed information from the Bucky to the collimator. It features modular, flat collimator blades, controlled with a direct-coupled motor drive. The state-of-the-art microcontroller electronics are fully integrated and self-contained in the collimator head, eliminating the historical problems associated with complex remote electronic logic and cabling.

Common goals

Radiology administrators share common goals in implementing effective radiology programs. Maintaining X-ray accuracy, reliability and ease of use are all key to effective patient throughput, and collimators are an important component in this process. New choices in simplified collimator designs allow administrators worldwide to help reach these goals by lowering costs associated with imaging system maintenance and downtime. Both existing and planned radiology systems can benefit from this new, simplified technology to offset the often hidden factors associated with radiology cost savings, long-term reliability and serviceability. ■

John O'Flaherty has served as Advertising/Communications Manager for Huestis Medical, Bristol, RI, USA since joining the company in 1997. He is responsible for the marketing and advertising of Huestis Medical products for the radiotherapy and diagnostic imaging markets. He holds a degree in marketing from the University of Rhode Island.