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Agfa DR 800:
New Concepts in
Dynamic Imaging

Optimal Image Quality at the Lowest Possible Dose

**White paper**

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Introduction

A number of improvements have been introduced in fluoroscopy imaging over the past decades, in order to address the challenges associated with non-static X-ray imaging. In addition to pulsed (instead of continuous) X-ray imaging, concepts such as Automated Brightness Control (ABS) and adaptive dose per frame rate (which keeps the dose rate constant and independent of the frame rate) have been established and become state-of-the-art. On the image processing side, advanced temporal filtering and noise suppression methods have been made available by manufacturers.

Challenges in dynamic imaging

> Noise reduction when lowering dose
> Optimal trade-off between lag and image noise
> Real-time imaging during complex multi-scale spatio-temporal filter operations in order to reduce noise while preserving edge details
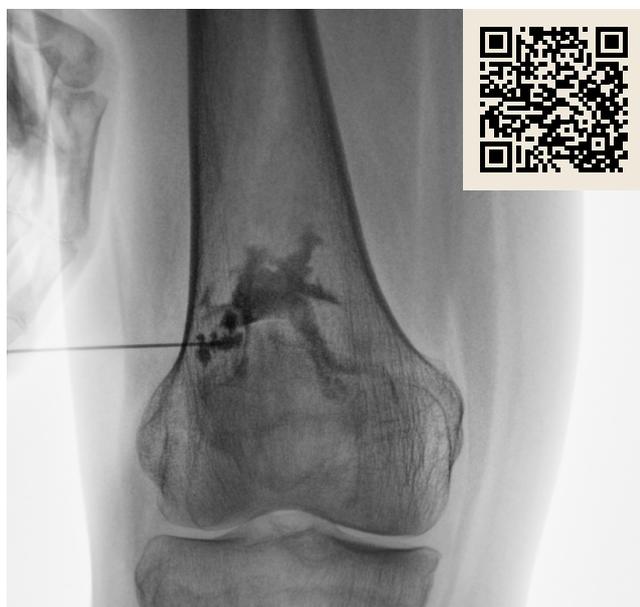
Arthroscopy at low dose (DIN standard)

Since radiation dose is of particular concern for both patients and clinicians, Agfa aimed to contribute to dose and image quality optimization by extending the established and well-known Musica® image processing platform with a dedicated concept for dynamic image processing. Together with the DR 800 multi-purpose X-ray system, a novel approach using Dynamic Multiscale Enhancement™ (DME) for optimal dynamic image quality at the lowest possible radiation dose was introduced.

While the DR 800 was already well-established in the DR market, customers have been very appreciative of the excellent dynamic image quality enabled by the newly introduced and patented DME processing algorithm.

This *Whitepaper* provides deeper insights into the new concept, which has been successfully introduced along with a number of other features and improvements for optimal fluoroscopy and Rapid Sequence imaging.

Dynamic image quality – More than just a single image ...

Elements of high-quality dynamic imaging

> Stability: both initial, and during exam and movement
> Generic image quality: optimal noise, lag and dose trade-off
> Rapid sequencing: high quality per image

Optimal quality in dynamic imaging incorporates a more complex pattern of features, building up the framework of a dynamic series (as compared to the one-shot acquisition of static processing). Due to the temporal nature of the imaging, specific care must be taken for both the beginning of the dynamic series, and for variations of basic image quality within the series. The latter can include differences in patient thickness and absorption, as well as the presence of diagnostic or interventional devices that move, such as catheters or needles.

Stability

Stability, especially initial stability, is important in order to use fluoroscopy sequences immediately and without noticeable delay. It is especially crucial for pediatric exams, where series are kept very short. To deliver a stable image appearance, closed-loops and ABS are typically used to keep contrast and brightness steady. Minimal brightness variation between frames ("flickering") during a sequence is desired within an exam.

Stability

> Optimal parameter setting for good image quality within fewer than 3 frames
> ABS for minimal contrast and brightness variation during movement

Optimal parameter settings for immediate and stable image quality at the start of a sequence have been established by Agfa and optimized with several phantom studies and quantitative evaluations.
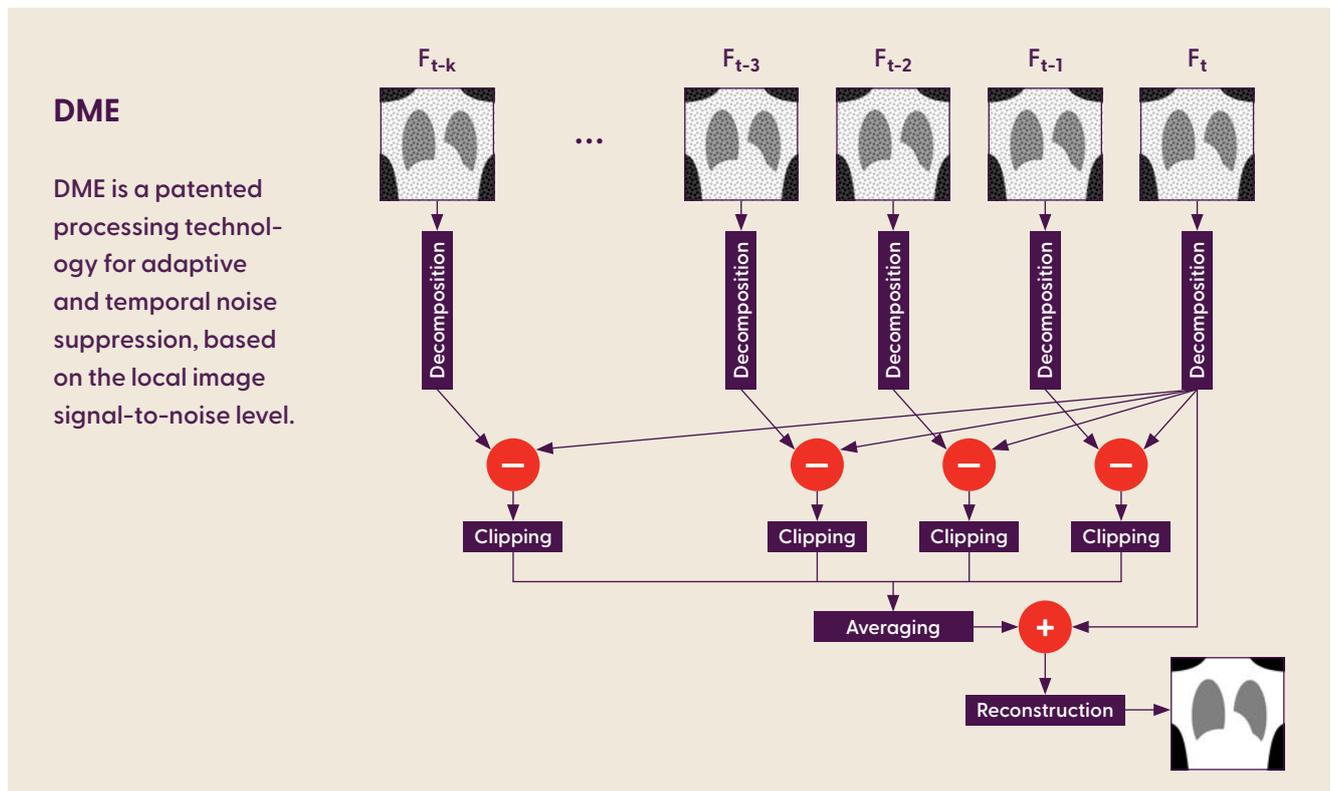
A signal-based, closed-loop steering concept (ABS) enables automatic contrast and noise optimization during object or patient movement, and an optimal steering curve has been implemented.

Dynamic image quality

While many of the elements mentioned (such as ABS) are state-of-the-art, there is still room for improvement to enable an optimal trade-off between dose, image lag and noise level. Agfa has introduced the novel DME method to answer this need.
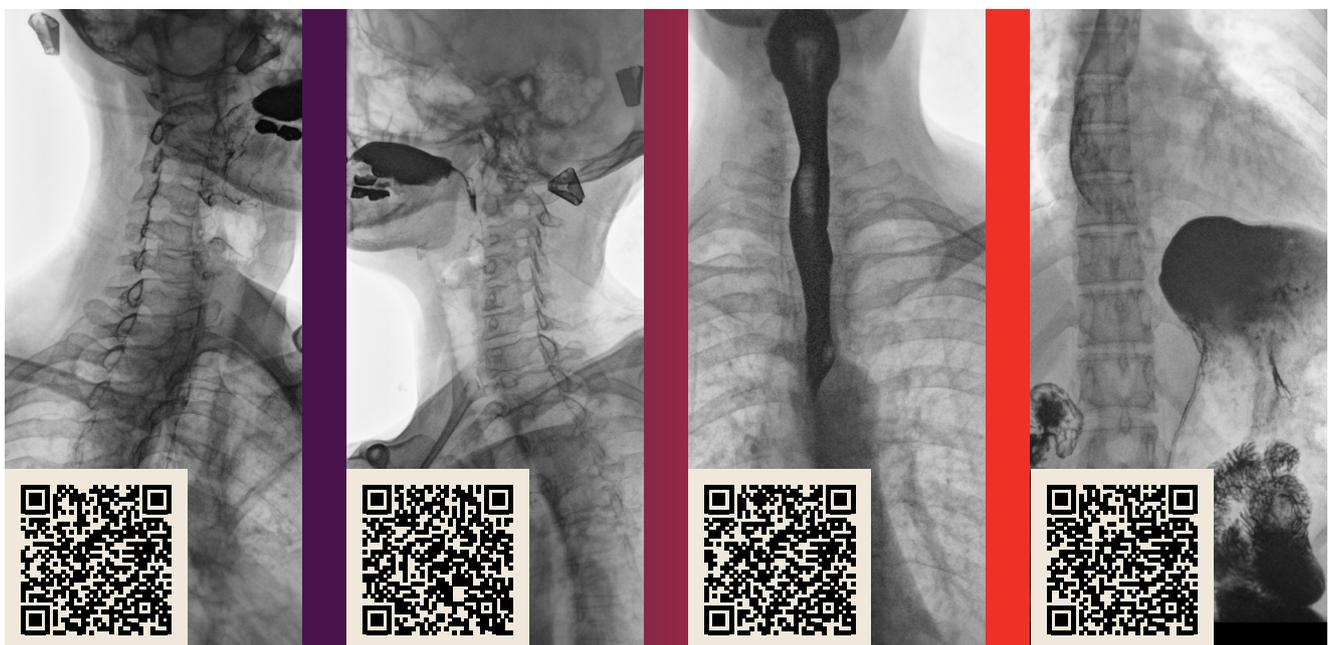

Suboptimal brightness (left) vs. optimal processing with Musica Dynamic (right)

DME

DME is a patented processing technology for adaptive and temporal noise suppression, based on the local image signal-to-noise level.

ABS is used to maintain a target signal-to-noise, in order to support low dose levels or dose variations, and is applicable for all frame rates for pulsed and continuous fluoroscopy. The Dynamic Multiscale Enhancement (DME) technology first decomposes a frame in different scales, and then corrects each corresponding scale based on the decomposition of a selection of other frames. Using the images with the corrected details, a noise-suppressed frame is reconstructed.

DME is adaptive and configurable, which allows to achieve an optimal trade-off between noise, lag and dose. Thus, stable dynamic image quality at the lowest dose and the best noise/image lag compromise is obtained.

Optimal trade-off between dose, lag and noise-level with DME

Lag artefacts (left) vs. optimal processing with Musica Dynamic (right)

Rapid Sequencing

Rapid Sequencing is often done for diagnostic dynamic exams when better image quality is desired. The challenges include, amongst others, achieving real-time imaging at optimal high-resolution, without pixel binning.

Musica image processing for Rapid Sequencing

> Musica 2 or
> Musica 3 for best quality in dynamic series
> Agfa's patented Fractional Multiscale Processing (FMP), optimized for Rapid Sequencing, ensures well-balanced and sharp rendering of the diagnostically relevant image regions

Musica (the proven multiscale technology for non-temporal imaging in static imaging) uses the most powerful tool and processing framework for Rapid Sequencing. Patented FMP technology and the latest body part optimizations are embedded in the two commercial packages currently available.

Musica 2 (left) vs. Musica 3 – variant (right): best image quality for Rapid Sequencing with Musica technology (including FMP)

Conclusion

With the new DR 800 multi-purpose system, Agfa takes care of *every* aspect of dynamic imaging and image quality.

Agfa's state-of-the-art dynamic processing – the adaptive noise suppression DME concept – guarantees low noise level and minimal lag at the lowest possible radiation dose throughout common fluoroscopy exams. Moreover, Agfa has taken care to ensure immediate and stable image quality at the beginning and during dynamic sequences. Finally, Rapid Sequencing delivers the finest Musica image quality for state-of-the-art diagnostic imaging.

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References

Agfa Patent: Bertens, T., 2014, Method for noise reduction in an image sequence, WO 2015/049103A1

Appendix / Authors

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