ziehm imaging

Image processing redefined

QuantumStream sets new standards in fluoroscopic image quality

Ziehm Imaging continues to shape the future of mobile imaging, integrating sophisticated algorithms into mobile C-arms for optimal clinical performance.

With growing demands for precision in interventional procedures, imaging chains must evolve to meet these clinical requirements. Leveraging the latest advancements in detector and generator technologies becomes critical to ensure consistent image quality.

Image processing as a cornerstone

Fluoroscopic image processing has evolved into a key enabler of image quality in modern X-ray systems. Covering the entire imaging chain from acquisition to display, it combines dose management, noise reduction, contrast optimization, and artifact suppression to ensure high-quality images at minimal dose levels. This is particularly important in minimally invasive interventions, where image clarity and efficiency directly influence clinical outcomes.

The role of anatomical programs (APRs)

APRs are preset imaging programs tailored to specific body regions and clinical applications. By automatically adjusting imaging parameters to anatomical density and motion, they simplify operation and support consistent, high-quality imaging across various procedures.

The importance of Object Detected Dose Control (ODDC)

Compensating for patient movement is essential to keep dose levels low while maintaining image quality. ODDC analyzes anatomy in real time and adapts both image processing and pulse rates accordingly.

When the patient is still, the system applies maximum noise reduction and lowers pulse frequency to minimize dose without compromising clarity. During movement, however, ODDC increases pulse rates and reduces filtering to avoid blur. This intelligent adjustment ensures smooth fluoroscopy, consistent image quality, and optimized dose efficiency throughout the procedure.

The mechanical depth of the C-arm is defined as the distance from the base of the C to the midpoint of the free space between X-ray source and detector. For Ziehm Imaging's premium systems, this value is 68 cm. With our 31 cm × 31 cm detectors, half of the detector size extends beyond this axis. Thanks to advanced image processing such as ODDC, in combination with asymmetric collimators, a diagnostic image quality can be maintained across the full detector area, making this additional range fully usable. In practice, this results in an effective C-arm depth of up to 83 cm – providing clinicians with more working space and flexibility during procedures.

Additionally, Ziehm Imaging C-arms feature a compact vertical extension of 42 cm, compared to the 45–50 cm offered by conventional systems. This design incorporates an ultra-flat detector, integrated within the C-arm, which minimizes downward protrusion thus increasing the effective floor-to-detector height, which is similar to competitors' systems at maximum extension.

The technology behind QuantumStream

QuantumStream combines premium CMOS technology with a unique 100 µm pixel pitch and full 2k x 2k image processing – displayed in razor-sharp detail on a native 4k monitor. This delivers an unmatched spatial resolution of up to 5.0 lp/mm, setting a new standard for mobile fluoroscopy.

With advanced contrast optimization, QuantumStream excels in demanding applications: from cardiovascular imaging, where subtle vessel details must remain visible, to spine procedures with strong density variations, where contrast stabilization prevents loss of information. Supported by a unique, compact and powerful 30 kW generator, the system achieves these performance gains without increase in patient dose – combining precision with patient safety.

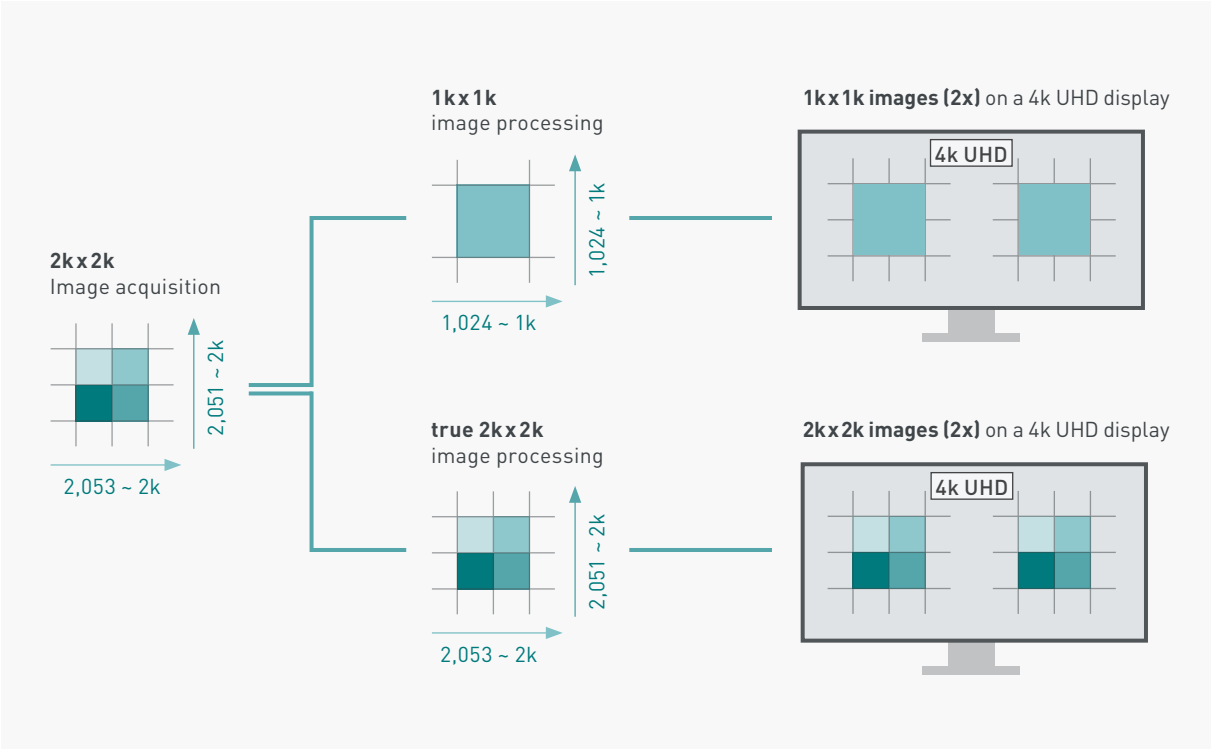

Figure 1: QuantumStream imaging chain

Ziehm Adaptive Image Processing (ZAIP)

ZAIP features advanced real-time algorithms designed to deliver optimal fluoroscopic image quality. A spatial, edge-preserving noise reduction filter suppresses background noise while maintaining fine anatomical detail. In parallel, an intelligent motion-sensitive temporal filter adapts to patient or instrument movement, reducing noise effectively without introducing blur.

Complementing these noise controls, frequency-based contrast stabilization selectively enhances clinically relevant structures while preventing oversaturation in areas of varying density.

Together, these technologies ensure consistently clear and detailed visualization – from guidewires and catheters to complex anatomical regions – even under low-dose conditions.

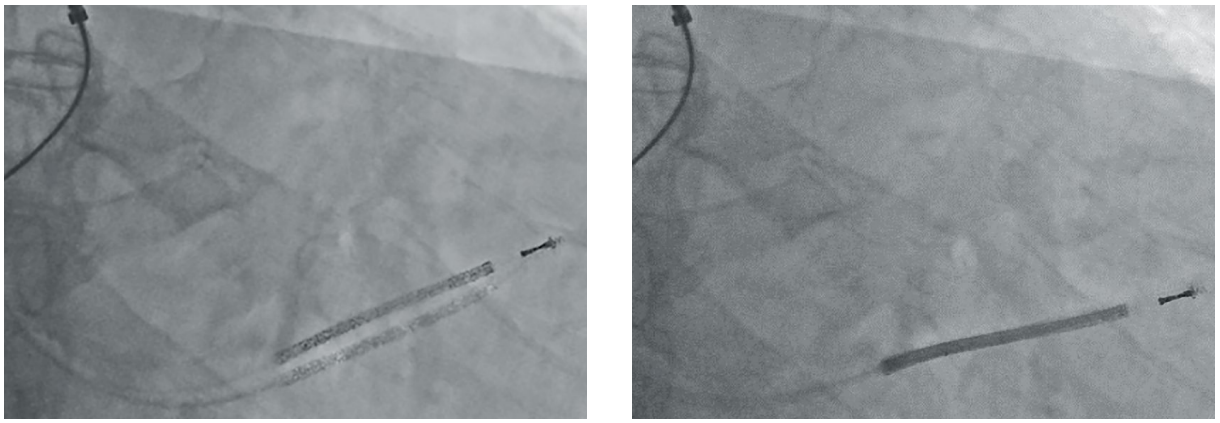

Figure 2: Example of recursive filtering.
Left: Without motion detection, with visible lag. Right: With optimized motion detection.

Ziehm Iterative Reconstruction (ZIR) for 3D systems

ZIR brings iterative reconstruction techniques – previously limited to CT scanners – to Ziehm Imaging's mobile 3D C-arms, automatically decreasing fan-beam and metal artifacts, resulting in a more distinguishable anatomy and easily defined bone crests. This, in turn, enhances volume rendering greatly, without increasing dose, which is especially important for complex orthopedic and vascular procedures.

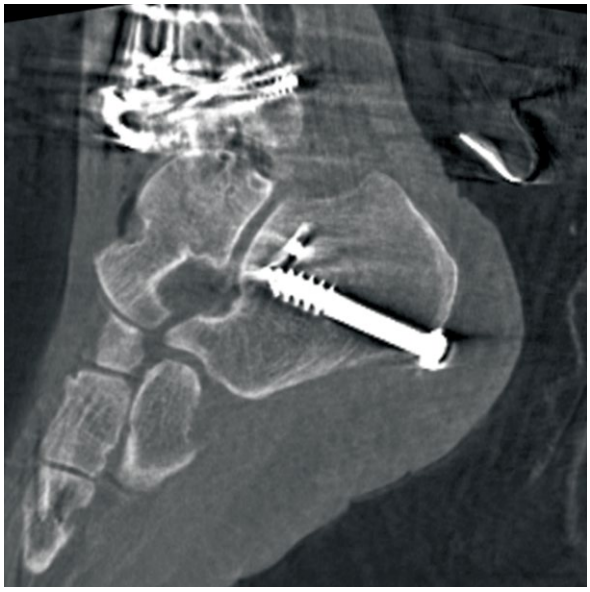

Figure 3: without ZIR

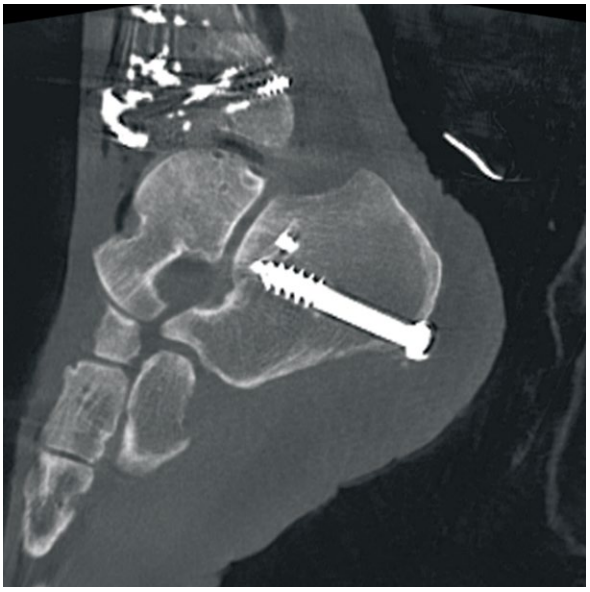

Figure 4: with ZIR

Conclusion

With technologies such as QuantumStream, ODDC, tailored APRs, ZAIP and ZIR, Ziehm Imaging brings premium image processing to mobile C-arms. This advanced imaging chain unlocks the full potential of high-resolution CMOS detectors while maintaining a clear focus on patient safety.

Authors:
Jens Glasbrenner
Senior Product Manager
Image Quality & System Settings
Ziehm Imaging GmbH

Robert Eidner
Marketing Manager
Competitive Intelligence & Technology
Ziehm Imaging GmbH

References
1. Konst B., Zaucha M., Buls N., et al.: Novel method to determine recursive filtration and noise reduction in fluoroscopic imaging – a comparison of four different vendors. In: Physica Medica/AAPM abstract/PMC preprint; 2020/2021