Image processing can make or break digital X-ray images

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In recent years, new technologies in medical imaging, in particular computed radiography (CR) and direct radiography (DR), have become both more compact and more affordable, making them increasingly appealing alternatives to conventional film and development. In this article, we consider the important role of image processing software for these digital radiography solutions.

In effect, when you are preparing to make the change to digital radiography, it is important to consider not only the quality of the detector itself, but also the image processing software that is delivered with the solution. Here’s why, and what to consider.

Image processing: an absolute necessity

Some people claim that digital images cannot offer the same image quality as conventional film, but this is only partially true. Classic film/cassette/screen systems do intrinsically offer a very simple sort of image processing, which results, for example, in images in which soft tissue and bone are often not visible at the same time. But with computers, we have many more possibilities; in principle, all information from a raw image can potentially be provided in a balanced and easy-to-interpret way.

Digital detectors capture almost all of the information from X-ray images. However, the radiation range is so large that raw, unprocessed images are unclear. Without image processing, they become more or less impossible to interpret for the human eye, and consequently cannot be used for diagnosis.
To enhance the visibility of the details, CR and DR systems always include image processing. This function is usually integrated within the workstation used for making the images. However, the possibilities and the quality of the software can vary a lot, so be alert.

The systems currently available on the market can be broadly classified into three groups:

- a) basic image processing systems;
- b) conventional systems with multi-resolution image enhancement;
- c) sophisticated, automated systems with multi-resolution image enhancement.

**Basic image processing systems**

The most basic systems for image enhancement offer a limited set of basic functions. With such a system, the veterinarian can perform a number of general processing tasks, such as adjusting the grey tones for the anatomical part he wishes to examine; using a filter to make the image sharper; adjusting the contrast by equalizing the histogram; optimizing the image noise; etc.

This type of software first emerged from 1985-1990; it is still supplied today in combination with CR and DR systems by a number of, mostly local, veterinarian suppliers.

But to get a good result with these elementary software systems, you will usually need to do quite a lot of manual post-processing for each individual image. Not only is this time-consuming, but it isn’t always easy to visualize all the relevant information that is potentially available in the image in an optimal way. In other words, the image quality may not always be satisfactory.

**Conventional systems for image processing**

When CR systems were introduced for human healthcare in the beginning of the 1990s, they stimulated the need for a more powerful and convenient image processing. This led to the development of a new generation of software based on multi-resolution technology. Essentially, these software systems split the image into different frequency components, each of which is processed separately. The image is then recomposed, resulting in an image with enhanced contrast and more visible information.

When the veterinarian selects an exam type on the workstation, an image processing algorithm is applied automatically, based on an extensive range of values that have been predefined for that specific exam type. So it is important to configure the correct image processing for each exam, including factors such as the body part, exposure dose, patient position, patient weight, possible use of contrast media, etc.

This is rather labor-intensive, but when done properly, the images are easy to interpret, and require only limited manual post-processing by the veterinarian. In practice, the configuration is not always carried out perfectly, so more post-processing is required.

An example of this type of technology is Agfa HealthCare’s first-generation MUSICA image processing software, which was released in 1993. The acronym MUSICA stands for *Multi Scale Image Contrast Amplification*. 
**Advanced, automated image processing**

Second-generation multi-resolution image enhancement software has been available since 2007. This software analyzes the incoming raw image and then independently applies a very extensive set of parameters for image optimization. All the parameters needed to generate an optimal image are automatically derived or calculated based on the raw image.

With this software, the image is first split into its different frequency components (the multi-resolution decomposition). Next, a number of adjustments take place: details with too-high contrast are attenuated; details with subtle contrast are enhanced; edges are sharpened when relevant; noise in lower contrast areas is minimized. The image is then recomposed (the multi-resolution reconstruction). All of this takes only a fraction of a second, and is completed automatically.

After the image acquisition, the user receives a turnkey image on the screen, which visualizes all clinical information from the raw image in a balanced way. This almost always allows the user to make a diagnosis at a glance.

So as we see, the newest generation of software for image processing delivers images with a consistently high quality, while making manual post-processing almost redundant. Very little pre-configuration of the system is necessary, allowing an easier and quicker installation.

Another important advantage is that both soft and bone tissue are visible simultaneously in the same image, which was unthinkable with conventional X-ray images. This can be interesting in cases such as, for example, a tiny fracture that is hardly visible in the bone, but with a clearly visible injury of the surrounding tissue.

Agfa HealthCare’s MUSICA² is an example of this type of more recent technology.
Specific modules for veterinarians

Vendors of these sophisticated systems offer both universal versions for veterinary radiology and specialized packages that are optimized for either small or large animals. This allows the same digital radiography system to deliver excellent images for every sized animal from cats to horses, and more.

Conclusion

Veterinarians who are considering making the change to digital radiography are well advised to extensively evaluate the quality of the CR or DR detector. But just as important is the quality of the image enhancement software that comes with the solution. The basic systems don’t always deliver images that meet your expectations, while the first generation of the more advanced multi-resolution still requires quite a bit of manual configuration. If you want your images to appear on screen automatically and with optimal quality, a second-generation advanced image processing system may be the best choice for you.