

# eXP

Esaote MRI,  
more than technology

“Every chain is as strong as its weakest link.”

## Esaote Dedicated MRI Image Quality.

On all occasions, tradeshows, demo etc, people remain positively surprised by the excellent Image Quality that we are able to generate with our MRI systems independently whether it is O-scan, S-scan or G-scan. Also in places where our systems are installed next to traditional large MRI systems, the positive Esaote image quality is evident as are other aspects like ease of use and reliability.

This impression is confirmed by some universities that use our MRI systems like the University of Pisa (Italy) and Freiburg (Germany).

Dr Lange from Freiburg in an interview on dedicated MRI: Before daily use of the O-scan at the Freiburg University, Prof. Langer and his team conducted investigations during a trial period comparing the O-scan with traditional whole body MRI in the appropriate patient population. After a short time it became clear that the dedicated MRI in almost all cases provided a secure and clear diagnostic answer. Prof. Langer: “If more details are necessary, we still have the opportunity to clarify this on the high-field MRI.” “The later however has hardly been necessary, so that duplicate examinations can almost always be avoided while maintaining maximum quality in Diagnostics.”

Prof Caramella from Pisa during a site visit: “The selection criteria we use for deciding where to send our patients for the MRI is very simple. We send the extremities to the O-scan and all the others to the large MRI”.

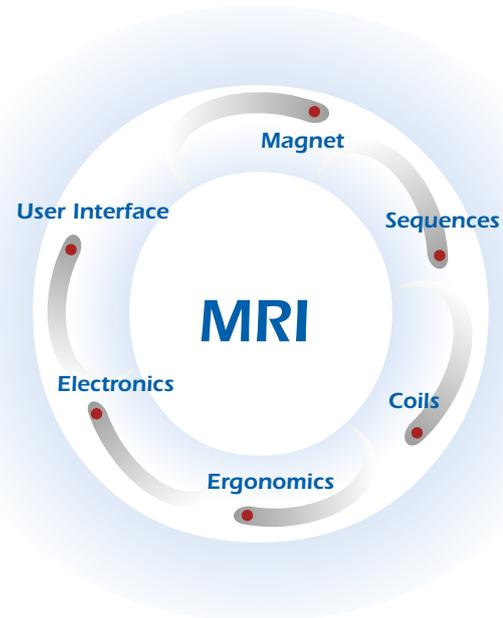
**So, what makes Esaote MRI systems perform so well - what is the key to success?**

As always in MRI, there is no such thing as a magic trick that does the job. Image Quality, Reliability, Ease of use come from a combination of things that comprises system hardware like coils and magnet, software and sequences and above all experience and focus.

## Dedicated MRI and eXP

The new eXP technology is the expression of the Esaote experience in a combination of hardware, software and sequence technology that gives a substantial overall quality improvement to the Esaote MRI systems. eXP will do this and more as the technologies introduced with eXP leave ample space for further improvements. Last but not least, eXP technology is available also for the installed base clients to prolong the life cycle of their MRI and therefore protecting the clients investment.

## eXP - Esaote Balanced Design Concept

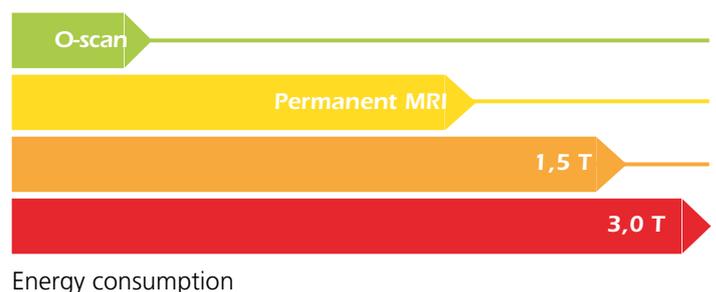


Balanced design means carefully design and select each single component in the chain to obtain the maximum result.

Let's take e.g. gradient power, one of the parameters used to rate an MRI system. Typically gradient power is expressed in mT/m but it can also be expressed as Gradient-Factor which is the power related to the magnetic field. The Gradient-Factor provides a much better idea about the effective power of the gradients as it takes into consideration the gradient-magnet combination. Standard 1,5T systems with gradients of 100 mT/m have a Gradient-factor of 66,6 which actually is equivalent to the Gradient-factor of 65 (20mT/m on 0,31T) of the O-scan! (For example the Gradient-factor of the GE-Optima is only 41, this means that yes they have a 1,5T magnet but with clearly under-rated gradient system).

(GradientFactor = Gradientstrength/Fieldstrength)

Esaote has proven that with a truly balanced design it is possible to create a high-quality MRI and in the same time maintaining system costs and running costs to a minimum. That is why Esaote MRI systems also have the lowest energy consumption can be classified as truly **Green MRI systems**.



## Focus

Focused development team. Esaote is focused on Musculoskeletal MRI, all our effort goes into one single application which is MSK imaging. Being focused means that even with a relatively “small” group it is possible to obtain “big” results. You might have a large R&D group but when you need to develop many applications the end result will always be a compromise. Also large companies tend to put most of their focus and effort in the development of the latest new thing on the market like e.g. Nerve Tracking on a 3T paying less attention to the standard applications like MSK imaging.

Focused collaborations. Also in the collaboration with external centers we are very selective and for many years we have collaborated with a German university where one of the gurus in MRI sequence design is lecturing. Esaote has permanent staff and systems at this university with which we developed e.g. the 3DHYCE sequence. The 3DHYCE is an excellent sequence that depicts very well cartilage and as you know, good cartilage imaging is seen as the “measuring-stick” to evaluate the quality in MSK-MRI.

## Experience

After 20 years of dedicated MRI experience, the first Esaote dedicated system was presented at the RSNA of 1993, we can say that we do understand the business and know how to develop a good MSK-MRI. These aspects you find back not only in the Image Quality but also in small but important details in the system design like the monitor on the back of the O-scan to facilitate patient positioning, the ergonomic foot/ankle coil to image the ankle in the natural position and many other small but significant features that makes working with the system simple, easy and fast.

## Magnet Design

Experience also counts in the development of the system components like the magnet. Developing a magnet with a small bore like the O-scan with a high homogeneity is a major R&D effort. The smaller the magnet opening, the more difficult it becomes to create a large enough homogeneous area. Esaote, thanks to its’ long-term experience in the design of permanent magnets has created a magnet with a small and ergonomic form-factor and with a high homogeneity for high-quality imaging. The same long-term experience has played a crucial role in the design and development of the G-scan magnet. Creating a rotating magnet has been a major challenge for the R&D team as this was the first time that such a concept has been applied in MRI.



Rotating a heavy object in itself is not an issue. Rotating an MRI magnet with zero tolerance on homogeneity however is a complete different issue both because all common parts used for moving heavy objects are made from iron and because the mechanical requirements are very strict. Today’s image quality clearly proves that this challenge has been mastered with success by our R&D department.

## Sequence Development

Over the last 2 years some major steps have been performed in the area of sequence design thanks also to the close collaboration with university. Programming nice sequences in an environment where muscle-power is not on issue like with large MRI systems is one thing, creating the same quality on an eco-friendly and low power-consumption MRI is a complete different job. Thanks however to some innovative concepts and ideas, covered by Esaote patents, Esaote has managed to introduce many highly sophisticated sequences on the complete line of MRI systems.



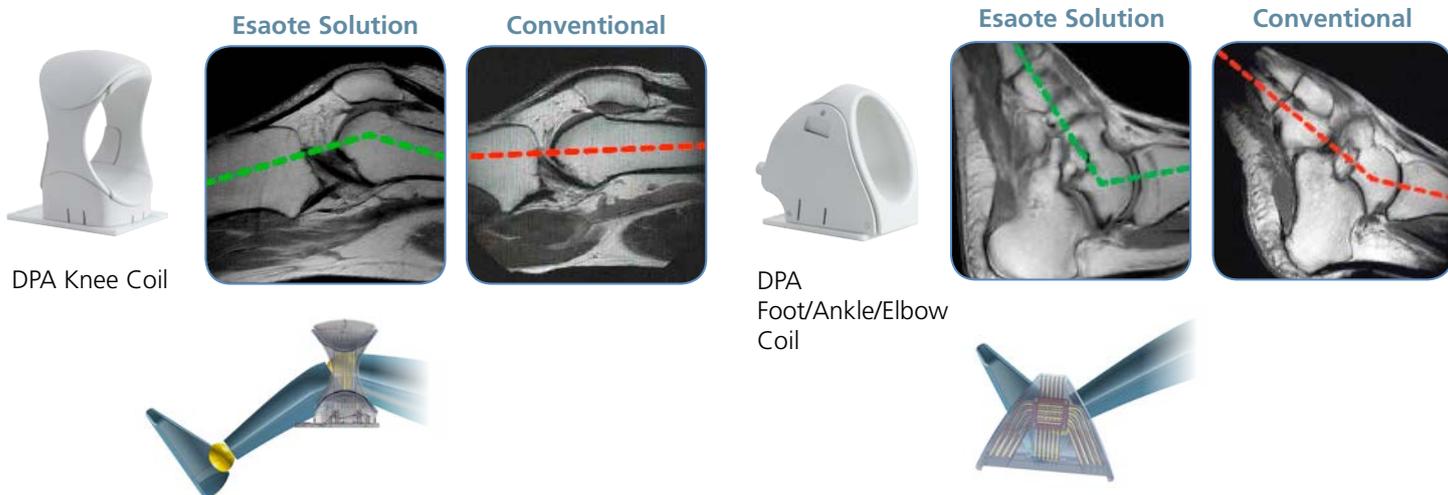
1,6 mm Slice-thickness

## Coil design and technology

Coils are an important element in the MRI chain as they receive the very small MRI signal emitted by the human body. Next to the pure technical issue of receiving the MRI signal, coil design has to take into consideration aspects like patient comfort, ease of use for the operator e.g. fast coil exchange and positioning and robustness in daily use. Esaote coils use Dual Phased Array and Multi Channel coil technology for a high Signal to Noise Ratio (SNR) and there is an ample choice of organ specific coils to assure optimal coverage of the joint under investigation. All coils are self-centering meaning that the area of interest is always in the magnet iso-center that is why e.g. shoulder images have such a high quality (in traditional MRI the shoulder is on the edge of the area of homogeneity). An example of patient friendly and ergonomic coil design is the foot/ankle coil. The shape of the coil assures that the foot is examined in the natural angled position facilitating correct evaluation of the joint and tendons (no stress condition). The same holds for the knee coil that puts the knee in a slightly angled position improving imaging of the ACL and PCI tendons.

## High-tech under the hood

Esaote delivers High-Tech in a small form factor. Esaote R&D closely follows the latest developments in hardware and software technology and carefully selects the right combination in line with the Esaote MRI Balanced Design concept. A suitable example is computing power; a bigger box is getting you more computational power that is needed to run the sophisticated sequences. A bigger box however means more power consumption, more space and more components that can breakdown. The Esaote solution, use GPU hardware and parallel processing from the gaming industry. Every PC has a GPU which is a piece of very powerful hardware dedicated to perform one simple task like handling the user interface and screen. In case of an MRI system this piece of very powerful computing hardware is underused as the screen handling task is relatively simple. By changing the architecture of the data-handling into a sophisticated parallel process it is possible to route highly intensive calculation tasks like image reconstruction to a GPU. The end result is a substantial gain in computing power while the form-factor and power consumption remain the same. That this is a more than viable solution is proven by the fact that the top 5 world's most powerful computers use exactly this technology; parallel processing and data-handling on GPU based hardware.



## Conclusion

Esaote developed its first MRI unit at the beginning of the eighties, more than 30 years ago and started concentrating its R&D effort in dedicated MRI from 1993. By concentrating all the effort, R&D as well as commercial, on dedicated MRI Esaote has become a reference point in musculoskeletal for MRI and Dedicated MRI has become an official recognized segment in the market.

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