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Portable MRI indoors, outdoors, at home and for major sporting events

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Magnetic resonance imaging (MRI) is an essential tool for the diagnosis and treatment of numerous health conditions. However, its use is limited to a small fraction of potential patients due to its high cost and lack of portability. Low-field (< 0.3 T), cheap and light MRI systems are now starting to become a valuable complement to standard MRI [1]. At the MRILab we have developed an extremity LF-MRI scanner based on a yokeless Halbach magnet of 72 mT, inspired on a previous system by LUMC [2]. We have mounted the complete system on a wheeled structure of width 70 cm, with an overall weight ≈ 250 kg and component cost < 50 k€. The scanner runs from a standard wall power outlet. The control electronics is based on MaRCoS, an open-source, high-performance Magnetic Resonance Control System [3,4], which we are currently working on adapting to clinical practice.

As a first result, we have demonstrated the true portability of the system and benchmarked its performance in various relevant scenarios, having acquired images of a volunteer's knee in different locations. These include: (a) an MRI physics laboratory; (b) in open air, powered from a small fuel-based generator; and (c) at the volunteer's home, (Fig. 1). Despite small differences in SNR value (Fig. 1 right), the main anatomical features and different tissues remain clearly identifiable across all acquisitions, demonstrating the system portability with the world-first MR images of patients inside their house [5].

Secondly, we studied the potential MR value of this system for use in major sporting events, specifically in the Motorcycle Grand Prix held in the Ricardo Tormo Racing Circuit in Valencia (Spain) between November 3rd and 6th, 2022 [6]. The system was transported in a small truck, installed in the main surgery room of the circuit medical facilities, and operational around 30 minutes after arrival. Our results demonstrate that LF-MRI scans can provide valuable information in the diagnosis and monitoring of injuries in sporting events. The highlight is we were able to detect a traumatic arthritis in a wrist that went otherwise unnoticed by the MotoGP medical staff (Fig. 2).

In conclusion, we have operated in scenarios where high-field MRI is unlikely to play a role but where a low-field system can lead to improved medical attention. Arguably, this can be extrapolated to numerous other environments and diverse circumstances.

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