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Wearable MRI RTD 2013

FNSNF

Scalable, In-Bore Array Receiver Platform for MRI

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Wearable MRI

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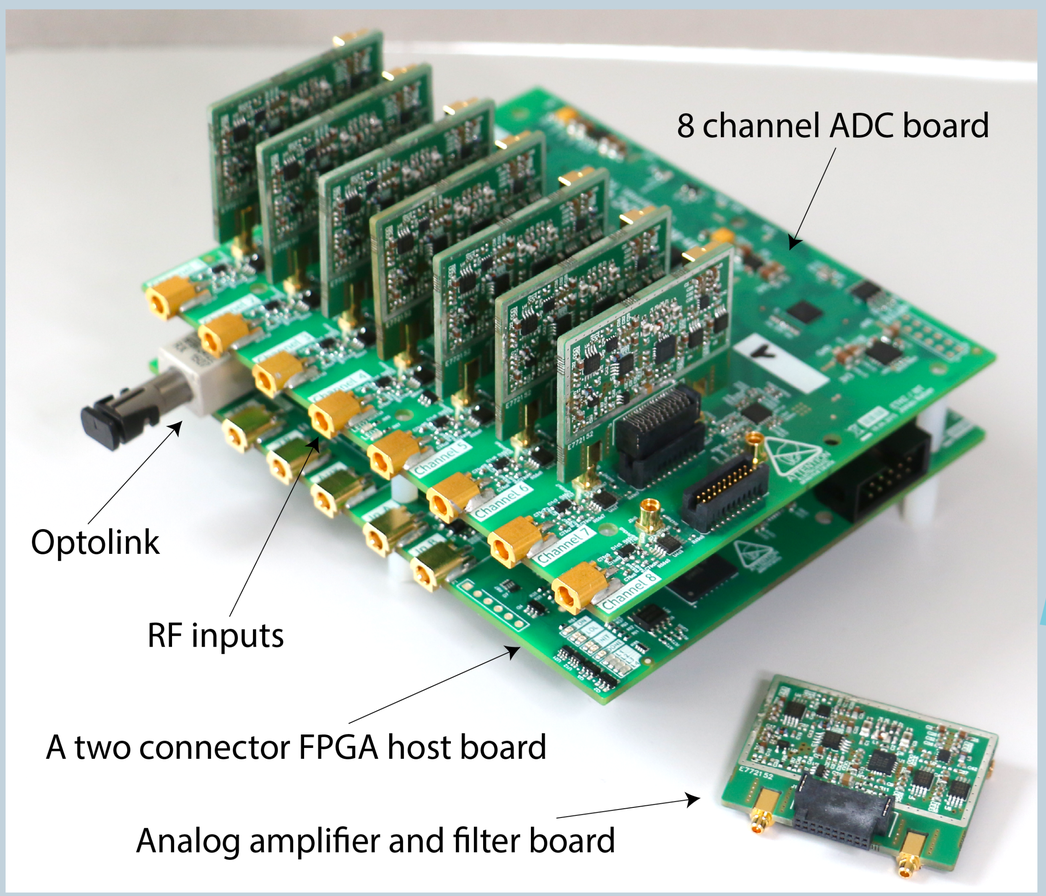
Motivation

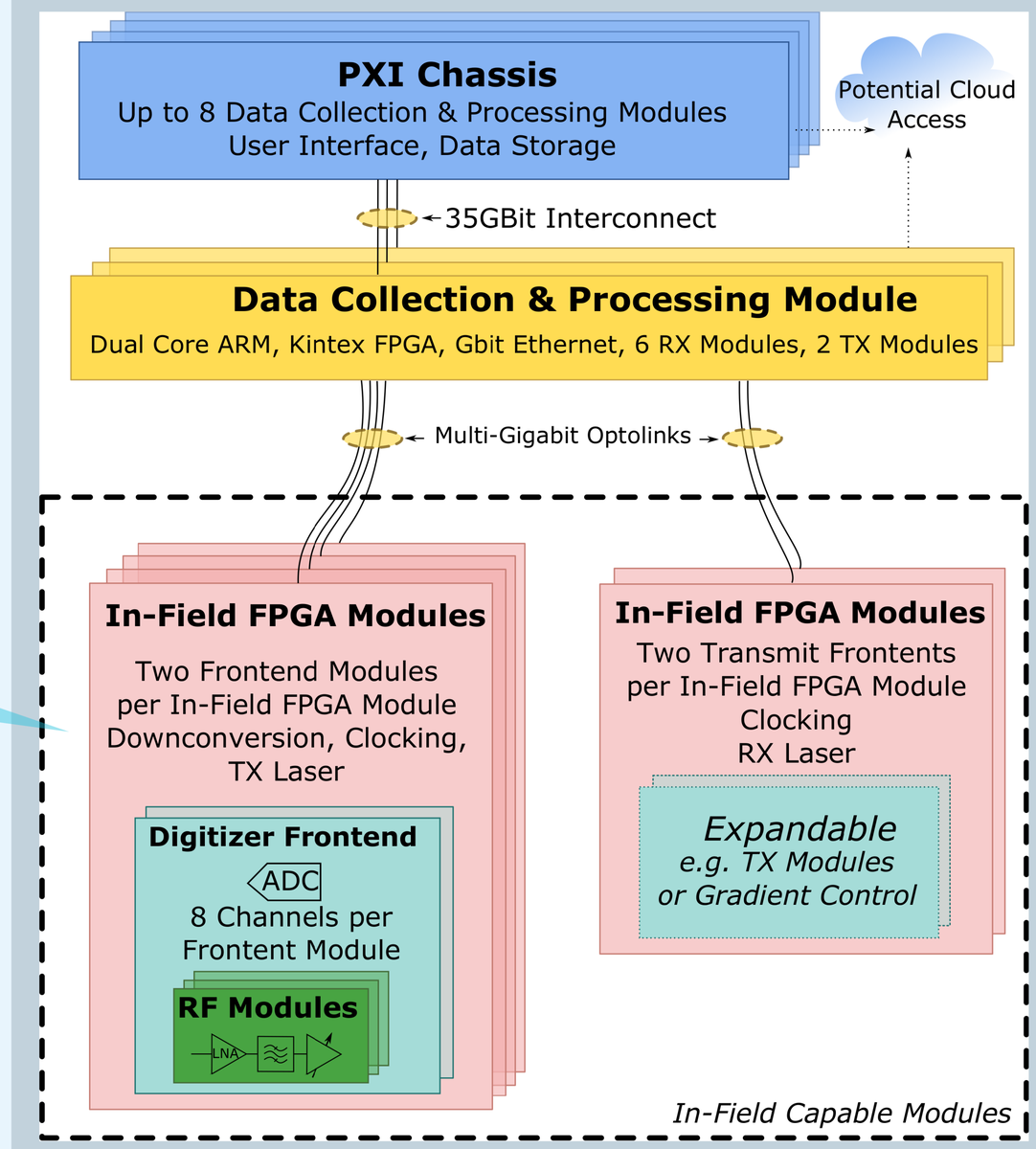
With growing numbers of RF receive channels in MRI cable routing and data handling becomes an increasing problem in particular for demanding applications requiring high acquisition duty cycles and bandwidths. To overcome this we present an MR acquisition platform that is capable of acquiring MR signals in-bore and scales its data handling ability with the number of incoming channels. Further, the system provides ample, configurable and distributed real-time computational power for advanced in-line data processing and low-latency applications.

Methods



Modular Hardware Components

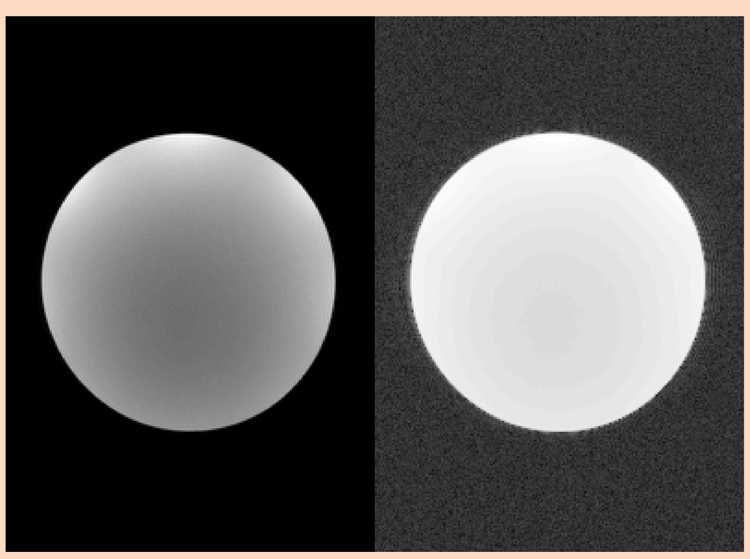
Maximum flexibility is achieved by a compact and modular hardware and processing design. Shown here: an 8-channel in-bore receiving hardware configuration of our scalable MR digitizer. The 8-channel ADC board (14bit, 125Msps) is mounted on the FPGA host board (Artix-7 200T FPGA). The analog input stages are hosted on mezzanine boards. This modularity allows the whole receiver to cover a large range of applications. The shown examples are RF gain stages for 3T proton imaging with programmable gain (-17..40dB) and anti-alias filter. All communication is optical and the hardware is designed for minimum interference with the sensitive MR environment.



Scalable Architecture

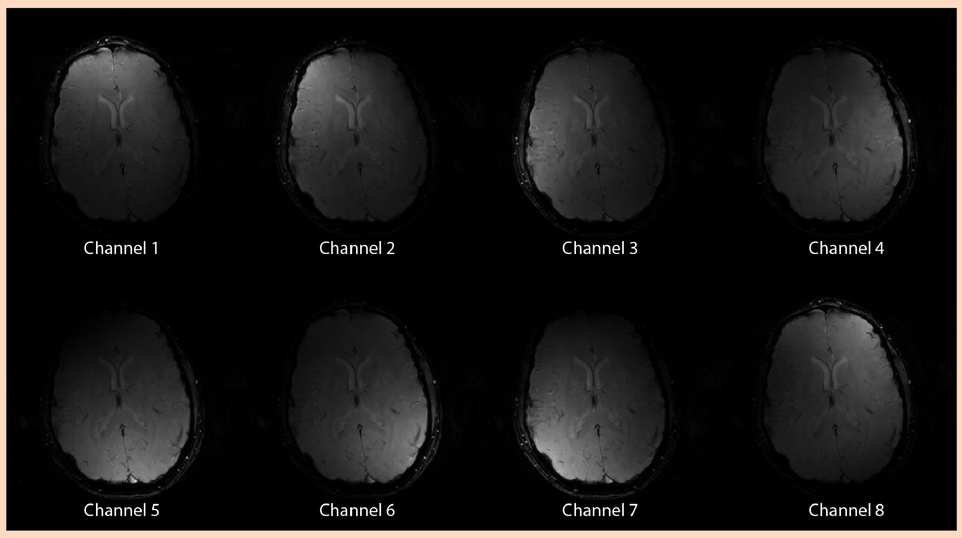
Parallelizable PXIe chassis are connected via high-speed busses to up to 8 custom data collection and processing modules. Each of these modules can host up to 4 in-field FPGA slaves connected via high-speed optical link (3-12Gbit/s) for galvanic isolation. Each of these in-field boards can carry two 8-channel ADC boards or boards covering further functionality (e.g. WearableMRI data collector, Gradient Control or RF-transmit Unit). Image reconstruction takes place on either the out-field processing modules, the PXIe controller or even in the cloud.

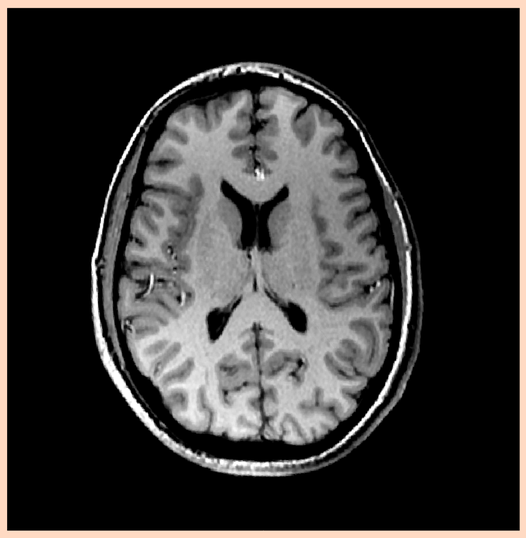
Results



In-bore Compatible, No Artifacts

Phantom images acquired with a standard clinical 3T 8-channel coil connected to one receiver module (left). The log plot of the same image (right) shows a clean signal background and low artifact levels despite the comparably strong signal power provided by this scan.





In-vivo Imaging

Left: single channel images of a T2*-weighted gradient echo sequence (TTR=29.9ms, R=50ms) illustrating coil sensitivity regions. Right: standard T1-weighted MPRAGE image (1mm inplane, 1.5mm slice thickness, TE=4.8ms, TR=50ms) acquired with an 8-channel clinical head coil at 3T connected to the new receiver system. Data was digitized and preprocessed in-bore. Preprocessing includes digital down conversion and filtering.