

METHOD FOR MOTION SENSING IN MRI USING PREAMPLIFIER RF INTERMODULATION

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OTHER INFORMATION

KEYWORDS

magnetic resonance imaging, radio
frequency, motion, motion sensing,
intermodulation

CATEGORIZED AS

- » [Engineering](#)
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- » [Medical](#)
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RELATED CASES

2021-109-0

PATENT STATUS

Country	Type	Number	Dated	Case
Patent Cooperation Treaty	Reference for National Filings	WO 2022/178050	08/25/2022	2021-109

Patent Pending

BRIEF DESCRIPTION

The inventors have developed a new flexible motion sensing method that exploits nonlinear intermodulation of MRI receiver coil preamplifiers to sense the motion of a subject in an MRI scanner without on-subject hardware.

The method transmits two tones at two different frequencies, f1 and f2, designed to be received at frequency f_BPT by the receiver via intermodulation, where f1 and f2 are much greater than the MRI center frequency. These signals are picked up by the receiver coils, mixed at the pre-amplification stage by intermodulation, then digitized by the receiver chain. The method is 20 times more sensitive to motion than the state-of-the-art Pilot Tone (PT) method of motion sensing.

The inventors have demonstrated the method with second order intermodulation.

Additionally, more transmitters can be used, each with a different set of frequencies. Higher frequency tones enable greater sensitivity to subject motion. This method enables the detection of motion at multiple temporal and spatial scales, for example, breathing and rigid motion of the head.

The method is used simultaneously with conventional MR imaging and does not adversely impact the signal-to-noise ratio (SNR) of the acquired MR image.

The method has been demonstrated using inexpensive consumer grade hardware for the 2.4GHz ISM band as a proof-of-concept. Since the MR signal is small (< -30dBm), little transmit power is necessary to induce an intermodulation signal similar in amplitude to the MR signal.

SUGGESTED USES

This method can be used by clinicians and researchers for monitoring subject motion with an MRI scanner. This is particularly useful for scans with scan times on the order of minutes, where there may be multiple simultaneous motion types (e.g., respiratory and cardiac motion).

ADVANTAGES

The advantages of this method include:

Increases patient comfortHas the potential to reduce setup time (because of no on-subject hardware)

Can be used for any MRI acquisition without changing the acquisition or degrading image SNR

Can be implemented flexibly with low transmit power and low-cost hardware

Achieves greater (20x demonstrated) sensitivity to motion than PT because it uses higher frequencies

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- [Method and Device for Designing Smooth Sequences of Spoke Endpoints in MRI](#)



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