Technology Offer

Dynamic Parallel Imaging: New Method for Accelerated MR Imaging

Ref.-No.: 0107-5654-BC

The invention relates to a new method to reduce acquisition time in MR imaging. It is based on the variation of the sensitivity profile of the RF coils and allows an easy access to an additional source of spatial information to further improve imaging.

MR imaging is among the most important tools for modern medical diagnostics with a unique range of applications. The imaging duration however limits the applicability for situations with movements within the volume of interest. Therefore, many efforts are made towards accelerated MR imaging.

The problem was solved by an inventive enhancement of proven parallel imaging techniques. Besides having access to spatial information from the use of multiple RF receive or transmit coils, their sensitivity in magnitude and phase is varied over the MR acquisition time. This will offer additional spatial information that can be used for accelerated imaging with improved resolution.

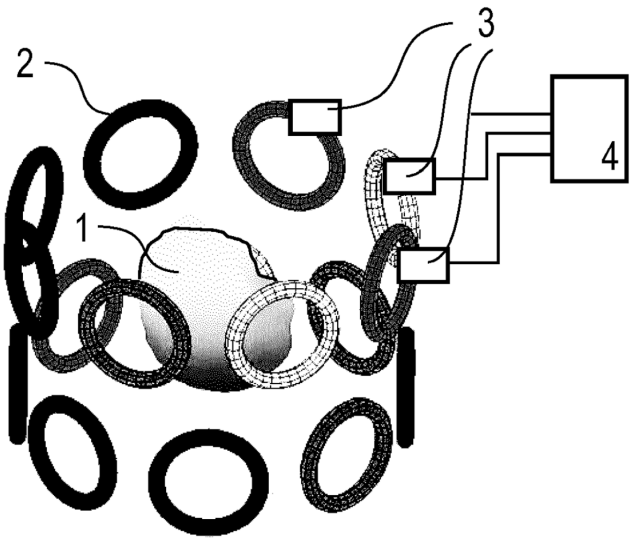

Fig. 1: As in common parallel MR imaging, the sample (1) is placed inside an arrangement of multiple RF receive coils (2) to detect the MR signal with additional spatial information. According to the invention each coil can additionally be equipped with an individual modulation device (3) to dynamically change the coils sensitivity profile. These profiles can be adjusted and monitored by a central modulation control unit (4).

Advantages

- Reliable and robust
- Many different implementations possible
- Uncomplicated integration process
- Cheap components usable

Applications

- Accelerated MR imaging
- MR imaging of dynamic samples

Background

For spatially resolved MR signal detection linear magnetic field gradients are used to locate the origin of a signal. To further increase spatial resolution and processing time, modern MR scanners are additionally using multiple RF coils at different positions, with each of them having its individual sensitivity profile within the sample. For many applications typical imaging durations are still too long and further improvement of the spatial information is desired.

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A new detection technique based on varying sensitivity profiles has been developed to overcome the aforementioned shortcomings and to further improve acquisition durations MR imaging. This approach represents an extension of the known parallel imaging method, where the individual sensitivity profiles of multiple RF coils are local and static. The use of dynamic instead of static sensitivity profiles offers additional spatial information that can be used for accelerated imaging.

The variation of the sensitivity profile can be achieved in various ways. One implementation of the invention is the use of adjustable capacitors, namely varactor diodes, as shown in the example schematic in figure 2a. The capacity of the diodes is adjusted by application of different voltages U1 to U6 to the diodes. With this arrangement the resulting sensitivity profiles of this coil can be modified dynamically.

Another possibility for varying sensitivity profiles is given using tunable metamaterials, as they have an adjustable dielectric permittivity and magnetic permeability. A possible arrangement using a separated profile modulation control unit (3) can be seen in figure 2b, where the metamaterial (4) is placed in between the sample (1) and the receive or transmit coil (2). As a third option (Fig. 2c), an auxiliary coil (5) arranged as a field shaping component with electro-magnetic coupling to one or more of the RF coils can be used.

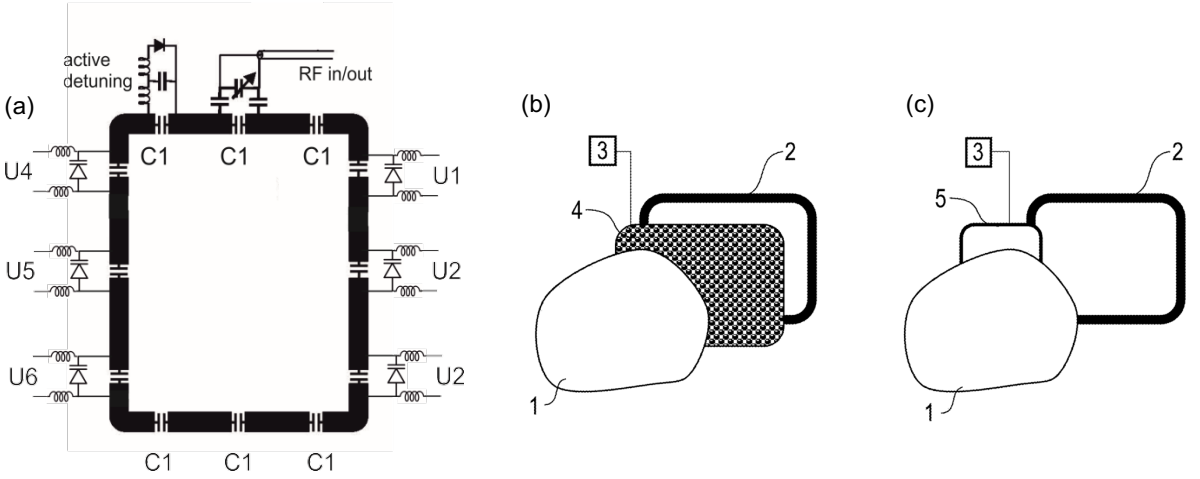

Fig. 2: Different implementations of the invention involving a sensitivity profile variation over time can be considered. The capacities in the RF coil can be varied quickly and independently when varactor diodes are used (a). Alternatively, metamaterials (b) or an auxiliary modulation coil (c) can be inserted between the sample and the RF coil to vary the sensitivity profile.

Patent Information

EPO *(EP2019191682)*, USPTO *(US20210048493)*

Publications

K. Scheffler*, et al.*, "Spread-spectrum magnetic resonance imaging" *Magn Reson Med. 2019,* 877–885 (2019)

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