According to an aspect of the present invention, there is provided a method for performing magnetic resonance spectroscopic imaging comprising:

a) providing a magnetic resonance device including (i) a main magnet for providing a background magnetic field along a first direction, (ii) at least one radio-frequency coil, and (iii) at least one gradient coil that can be controlled to define a region of interest;

b) positioning a supplemental spin reservoir within a field of view of the at least one radio-frequency ~~resonant~~ coil, the supplemental spin reservoir (SSR) including a plurality of molecules;

c) introducing a sample or subject to be studied into the field of view;

d) introducing RF pulses into the sample or subject;

e) collecting three dimensional spatial data for a set of nuclei of interest from at least one of the (i) sample or subject, and (ii) the SSR; and

f) adjusting at least one of (i) the circuitry of the at least one radio frequency coil, and (ii) the contents of the SSR in order to induce electromagnetic feedback between the nuclear magnetization of the set of nuclei of interest and the at least one radio frequency coil to cause the vector direction of the nuclear magnetization of the set of nuclei of interest to rotate to a desired angle.

The method further can include employing additional RF pulses and RF pulse detection schemes to obtain signals from the sample or subject with the at least one radio-frequency coil with the purpose of making an image and/or obtaining spectroscopic data or images. The method can further include repeating the above steps in order to improve image intensity, spectral resolution and the like. The method can still further include obtaining proton MR image data, either concurrently or sequentially with the above steps, so that any images produced by the above method may be co registered with anatomical MR data. The method can still further include employing a feedback enabled coil (FEC) and a Supplementary Spin Reservoir (SSR), described more fully below, as techniques for permitting feedback of nuclear magnetism to occur even under clinical MRI conditions where it normally would not. The method further includes optionally obtaining proton MR image data, either concurrently or sequentially with the above steps, so that any images produced by the above method may be co registered with anatomical MR data.

According to another aspect of the present invention, there is provided a method for performing magnetic resonance spectroscopic imaging comprising:

a) providing a magnetic resonance device including (i) a main magnet for providing a background magnetic field along a first direction, (ii) at least one radio-frequency coil, and (iii) at least one gradient coil configured to be controlled to define a region of interest;

b) positioning a supplemental spin reservoir within a field of view of the at least one radio-frequency ~~resonant~~ coil, the supplemental spin reservoir (SSR) including a plurality of molecules;

c) introducing a sample or subject to be studied into the region of interest;

d) introducing RF pulses into the sample or subject;

e) adjusting at least one of (i) the circuitry of the at least one radio frequency coil, and (ii) the contents of the SSR in order to induce feedback between the nuclear magnetization of the set of nuclei of interest and the at least one radio frequency coil to cause the vector direction of the nuclear magnetization of the set of nuclei of interest to 90 degrees; and

f) collecting three dimensional spatial data for a set of nuclei of interest from at least one of the (i) sample or subject, and (ii) the SSR.

In some implementations, the above methods can further include processing information obtained from a plurality of pulses of RF magnetization to produce at least one of (i) an image, (ii) dynamic flow data, (iii) perfusion data, (iii) spectroscopic identity of chemical species, (iv) physiological data, or (v) metabolic data.

In further implementations, a coil designed to amplify feedback can be employed. The coil can additionally and optionally be made to permit manipulation of

CLAIMS

What is claimed is:

1. A method for performing magnetic resonance spectroscopic imaging comprising:

a) providing a magnetic resonance device including (i) a main magnet for providing a background magnetic field along a first direction, (ii) at least one radio-frequency coil, and (iii) at least one gradient coil configured to be controlled to define a region of interest;

b) positioning a supplemental spin reservoir within a field of view of the at least one radio-frequency ~~resonant~~ coil, the supplemental spin reservoir (SSR) including a plurality of molecules;

c) introducing a sample or subject to be studied into the field of view;

d) introducing RF pulses into the sample or subject;

e) collecting three dimensional spatial data for a set of nuclei of interest from at least one of the (i) sample or subject, and (ii) the SSR;

f) adjusting at least one of (i) the circuitry of the at least one radio frequency coil, and (ii) the contents of the SSR in order to induce feedback between the nuclear magnetization of the set of nuclei of interest and the at least one radio frequency coil to cause the vector direction of the nuclear magnetization of the set of nuclei of interest to rotate to a desired angle.

2. The method of Claim 1, wherein the vector direction of the nuclear magnetization of the set of nuclei of interest is rotated substantially to zero.

3. The method of Claim 1, further comprising repeating steps (d), (e) and (f) until sufficient three dimensional spatial data of the set of nuclei of interest has been obtained in order to produce a useful rendering of the spatial data.

4. The method of Claim 1, wherein a first radio frequency coil is used to introduce RF pulses into the sample or subject, and a second radio frequency coil is used to

frequency coil, and (iii) at least one gradient coil configured to be controlled to define a region of interest;

b) positioning a supplemental spin reservoir within a field of view of the at least one radio-frequency ~~resonant~~ coil, the supplemental spin reservoir (SSR) including a plurality of molecules;

c) introducing a sample or subject to be studied into the region of interest;

d) introducing RF pulses into the sample or subject;

e) adjusting at least one of (i) the circuitry of the at least one radio frequency coil, and (ii) the contents of the SSR in order to induce feedback between the nuclear magnetization of the set of nuclei of interest and the at least one radio frequency coil to cause the vector direction of the nuclear magnetization of the set of nuclei of interest to 90 degrees; and

f) collecting three dimensional spatial data for a set of nuclei of interest from at least one of the (i) sample or subject, and (ii) the SSR.

16. The method of Claim 15, further comprising collecting three dimensional spatial data for a set of nuclei of interest from at least one of the (i) sample or subject, and (ii) the SSR.

17. The method of Claim 15, further comprising repeating steps (d), (e) and (f) until sufficient three dimensional spatial data of the set of nuclei of interest has been obtained in order to produce a useful rendering of the spatial data.

18. The method of Claim 16, wherein a first radio frequency coil is used to introduce RF pulses into the sample or subject, and a second radio frequency coil is used to induce electromagnetic feedback between the nuclear magnetization of the set of nuclei of interest and the second radio frequency coil.

19. The method of Claim 16, further comprising collecting three dimensional spatial data of ^{1}H in the region of interest.

20. The method of Claim 16, further comprising combining and processing the ^{1}H spatial data with the spatial data of the set of nuclei of interest.