Claims

1. A portable magnetic particle imaging (MPI) device comprising:

a handheld probe comprising: a main housing housing a first sensor coil, a second sensor coil, a transmitter coil arranged between the first and second sensor coils, and an excitation priming frame housing magnetic components; and

a processing unit comprising: a transmitter communicatively connected to the transmitter coil and the excitation priming frame, and a receiver communicatively connected to the first and second sensor coils;

wherein the first sensor coil and the second sensor coil are two concentric sensor coils with windings in opposing directions, wherein the transmitter coil is surrounded by the first sensor coil, and wherein the second sensor coil is surrounded by the transmitter coil.

2. The portable magnetic particle imaging (MPI) device according to claim 1, wherein the excitation priming frame is in a shape of a circle and the magnetic components are evenly distributed around the excitation priming frame.

3. The portable magnetic particle imaging (MPI) device according to claim 1 ,wherein the excitation priming frame is a hexagonal shape and the magnetic components are evenly distributed around the excitation priming frame.

4. The portable magnetic particle imaging (MPI) device according to claim 1, wherein the magnetic components are neodymium magnets.

5. The portable magnetic particle imaging (MPI) device according to claim 1, wherein each of the magnetic components is being controlled by the processing unit such that the magnetic components are selectively activated.

6. The portable magnetic particle imaging (MPI) device according to claim 1, wherein the main housing has a convex probe surface.

7. The portable magnetic particle imaging (MPI) device according to claim 1, further comprising an apparatus with a thumb screw adapted for translation of one of the first and second sensor coils relative to the transmitter coil.

8. The portable magnetic particle imaging (MPI) device according to claim 1, wherein the processing unit further comprises a processor, memory and instructions stored on the memory and executable by the processor to:

receive signals from the receiver; and

apply spatial encoding to reconstruct the signals to generate a 3-dimensional field-of-view image.

9. The portable magnetic particle imaging (MPI) device according to claim 8, wherein the transmitter is configured to generate a fixed known magnetic field in beam shape for the transmitter coil.

10. The portable magnetic particle imaging (MPI) device according to claim 8, wherein the transmitter is configured to generate a patterned magnetic field for the excitation priming frame.

11. The portable magnetic particle imaging (MPI) device according to claim 9 or 10, further comprising gyroscopic and optical sensors to measure a beam position for image reconstruction.

12. The portable magnetic particle imaging (MPI) device according to claim 11, wherein the gyroscopic sensor is arranged along a vertical axis of the handheld probe and adapted to sense tilt when the handheld probe is conically tilted to interrogate a conic field-of-view.

13. The portable magnetic particle imaging (MPI) device according to claim 11, wherein the gyroscopic sensor is arranged at two points along a perimeter of the excitation priming frame.

14. The portable MPI according to claim 1 further comprising:
an ultrasound control and receiver adapted to provide an anatomic reference.

15. The portable MPI according to claim 14, wherein the ultrasound control and receiver is adjacently coupled to the handheld probe.

16. The portable MPI according to any one of claims 1-15, further comprising a mountable adapter for receiving the handheld probe.