ABSTRACT

Very low field MRI

The aim of this thesis is to perform Magnetic Resonance Imaging at very low field (from 1 mT to 10 mT). A new kind of sensor called "mixed sensor" has been used to achieve a good detectivity at low frequencies. Combining a superconducting loop and a giant magnetoresistance, those detectors have a competitive equivalent field noise compared to existing devices (Tuned coils, SQUIDs and Atomic Magnetometers). They have been combined with flux transformers to increase the coupling between the sample and the sensor. A complete study has been performed to adapt it to mixed sensors and then maximize the gain. This set has been incorporated in an existing small MRI device to test its robustness in real conditions. In parallel, several MRI sequences (GE, SE, FLASH, EPI, ...) have been integrated and adapted to very low field requirements. They have been used to perform in-vivo three dimensional imaging and relaxometry studies on well known products to test their reliability. Finally, a larger setup adapted for full-head imaging has been designed and built to perform images on a larger working volume.