Magnetic resonance imaging (MRI) is widely used for both clinical and research purposes, and offers non-invasive imaging of tissues within the head and body of patients. Generation of the magnetic resonance (MR) signal relies on the presence of a large, static, main magnetic field, and temporally varying gradient and radio-frequency fields, that typically alternate at kilohertz and megahertz frequencies. During scanning, other signals than the MR signal are often of interest, e.g., biomedical signals from the imaged patient for multi-modal studies, and precise characterization of the scanner’s electromagnetic fields for improving image quality. The static magnetic field, however, prevents having typical measuring equipment in the vicinity of the scanner, and the oscillating fields induce unwanted currents in cabling and transducers, causing artefacts in acquired non-MR signals. Using the scanner to acquire both the MR and the non-MR signals partially alleviates these challenges, as the scanner’s fields are typically not alternating during MR acquisition periods. In addition, this yields a high degree of synchronization between the scanner and the acquisition of the non-MR signals, which for most applications is highly beneficial. Such acquisition is, however, challenged by filters of the scanner attenuating signals with frequencies far from those of the MR signal. This thesis evolves around solving the engineering challenges arising from using an MR scanner for acquisition of non-MR signals. Custom circuitry is presented, which facilitates this through real-time signal processing, and digital synthesis of scanner-recorded signals. The applicability of the circuitry is exemplified by emulation of a point-shaped MR source from real-time measurements of the scanner’s electromagnetic fields. For demanding sequences, reconstruction based on nominal gradient fields, and thereby nominal k-space trajectories, leads to degradation and artefacts in MR images, which can be avoided if the actual k-space trajectory is determined. In a second study, an inductively generated k-space trajectory measure is generated and acquired by an MR scanner concurrently with MRI. Initial results from a solely inductive measure are improved by regularization using a measure of the current driving the gradient field. Minimal artefacts are observed when reconstruction is based on the measured k-space trajectory, and improved image quality compared to reconstructions based on the nominal trajectory is obtained. Lorentz forces induced in generation of the gradient field lead to loud acoustic noises that challenge speech recording in the MR environment. In a third study, an induction-based transducer and amplitude modulation are used to facilitate concurrent MRI and audio sampling. The resulting synchronization between gradient field shifting and speech signal sampling facilitates simple removal of the scanner-induced noise, and audible speech recordings are obtained.