



Detection of QRS Complex from an MRI Patient

Principal Inventor:

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Description of Technology:

This automated method uses a matched filter to detect the initiation of a heartbeat as a patient undergoes magnetic resonance imaging. The filter synchronizes the initiation of the readings of the MRI machine with the readings of the detected QRS complex in the matched filter.

The QRS complex is a set of three waves associated with the initiation of a heartbeat. Detection of the QRS complex in electrocardiogram (ECG) is essential for the synchronization of the cardiac cycle with cardiac imaging using MRI devices.

Detection of the QRS complex in an ECG system can be frustrated by several factors including:

- The strong field in the MRI magnet causing voltages known as flow artifacts, induced by the movement of a patient's blood.
- Each patient has a unique ECG signal with corresponding QRS complex.
- Weak ECG signals from patients with weak hearts (e.g., those with scar tissue from a heart attack).
- Other conditions such as fluid around the lungs or heart (pleural or pericardial effusion) and over inflation of the lungs.

Once the hurdle of detecting a clear ECG signal is overcome, the next hurdle to overcome for the technician is to identify the QRS complex in the ECG signal. Several methods exist but each has difficulties. These methods include: (1) threshold measurement via voltage detectors; (2) slope measurement; (3) interference filtering using time sequences; (4) physically restraining the patient; (5) wavelet analysis; and (6) vectorcardiogram method. Methods (1) to (3) may result in false triggering of the MRI reading due to unfiltered interference as well as premature or belated timing of patient QRS complex while method (4) requires breath hold and methods (5) and (6) are slow or computationally complex.

This method has the following important advantages over these conventional methods:

- Minimally affected by interfering voltages which cause false triggering.
- Computationally simple, thereby resulting in minimal MRI trigger delay.
- Minimizes patient inconvenience as it does not require breath hold.

Patent Status:

U.S. patent pending.

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