Spherical navigator echoes can measure the translation and rotation of a rigid object in three dimensions in MRI.[1] Although there are many sampling strategies capable of acquiring data on the surface of a sphere in k-space, a trajectory that follows a spiral path with even sampling density is promising. A uniform distribution of samples along a spherical spiral k-space trajectory can lead to changes in magnetic field gradient over time that exceed the maximum slew rate of the MRI scanner. The desired radius of the k-space sphere and the time spacing of gradient-waveform updates affect the slew rate of the gradient waveform. To avoid exceeding the hardware limitations of the scanner, the desired k-space trajectory can be stretched over time if the maximum slew rate is exceeded. The stretched portions of the trajectory are associated with more gradual changes in gradient. To achieve this, the sphere is divided into segments of linearly-increasing sampling density; the extra data in these segments can be interpolated to achieve the same spacing as the desired trajectory. With this approach, an hemispherical shell in k-space with the equivalent of 1200 samples and radius 0.4 cm^{-1} can be collected in under 6 ms of readout time on a scanner with a maximum slew rate of 150 mT/m/s.

[1]Welch, et al. Magn. Reson. Med., 47:32-41 (2002).

Supported by the Canadian Institutes of Health Research.