Abstract:
Rapid imaging techniques have attracted increased interest for relaxometry, but none are perfect: they are prone to static ($B_0$) and transmit ($B_1$) field heterogeneities, and commonly biased by $T_2/T_1$. The purpose of this study is the development of a rapid $T_1$ and $T_2$ relaxometry method that is completely ($T_2$) or partly ($T_1$) bias-free. A new method is introduced to simultaneously quantify $T_1$ and $T_2$ within one single scan based on a triple echo steady-state (TESS) approach in combination with an iterative golden section search. TESS relaxometry is optimized and evaluated from simulations, in vitro studies, and in vivo experiments. It is found that relaxometry with TESS is not biased by $T_2/T_1$, insensitive to $B_0$ heterogeneities, and, surprisingly, that TESS-$T_2$ is not affected by $B_1$ field errors. Consequently, excellent correspondence between TESS and reference spin echo data is observed for $T_2$ in vitro at 1.5 T and in vivo at 3 T. TESS offers rapid $T_1$ and $T_2$ quantification within one single scan, and in particular $B_1$-insensitive $T_2$ estimation. As a result, the new proposed method is of high interest for fast and reliable high-resolution $T_2$ mapping, especially of the musculoskeletal system at high to ultra-high fields.