4D MR iaging using internal respiratory gating

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Author(s) Martin von Siebenthal,; Philippe Cattin,; Urs Gamper,; Antony Lomax,; Gabor Szekely,
Author(s) at UniBasel Cattin, Philippe Claude ;
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Respiratory organ motion is a key problem in proton therapy and in many other treatments. This paper presents a novel retrospective gating method for 4D (dynamic 3D) MR imaging during free breathing to capture the full variability of respiratory organ deformation. In contrast to other imaging methods, a constant breathing depth or even strict periodicity are not assumed. 3D images of moving organs can be reconstructed for complete respiratory cycles by retrospective stacking of dynamic 2D images using internal image-based gating. Additional noise reduction by combining multiple images significantly increases the signal-to-noise ratio. The resulting image quality is comparable to breath-hold acquisitions. Although the method was developed for proton therapy planning, the new possibilities to study respiratory motion are valuable to improve other treatments and to assess gating techniques, which rely on stronger assumptions about the breathing pattern.

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