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An Aristotelian view on MR-based attenuation correction (ARISTOMRAC): combining the four elements

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The ancient Greeks believed that matter was made of a weighted combination of four elements: earth, water, air and fire. Using a similar simplified assumption, we formulated a multi-component MR fingerprinting framework, where every voxel was considered a weighted combination of four base tissues: bone, water, air and fat. We named our approach Aristotelian MR based attenuation correction (ARISTOMRAC). We used a 3D radial acquisition scheme at 1.5T, using a transient-state spoiled acquisition with variable flip angles and TEs, with the shortest TEs being ultra-short echo times (UTE). We simulated a multi-tissue MR signal model using the Bloch equations and used dictionary matching to extract tissue fraction maps. Compared to previous methods for MRAC, our approach takes advantage of the intrinsic multicomponent nature of MR Fingerprinting. For this reason, rather than reconstructing high resolutions images, we could acquire MR data more efficiently, directly at the resolution needed for PET attenuation maps. We could accurately estimate water, bone, fat and air fractions in a phantom containing combinations of these.

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