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NMR velocimetry with 13-interval stimulated echo multi slice imaging in natural porous media under small flow rates

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Understanding root water uptake in soils is of high importance for securing nutrition in the context of climate change and linked phenomena like stronger varying weather conditions (draught, strong rain). One step to understand how root water uptake occurs is the knowledge of the water flow in soil towards plant roots. Magnetic Resonance Imaging (MRI) is potentially the most powerful analytical tool for non-invasive three dimensional visualization of flow and transport in porous media [1]. Numerous attempts have been made to measure local velocity in porous media by combining phase encoding of the velocity with fast imaging methods [2–4], where flow velocities in the vascular bundles of plant stems were investigated. Since their cells impose almost no limitation to flow, their MR signal is hardly inferred by internal field gradients. The situation in the surrounding soil, a natural porous medium, is different, since there internal magnetic field gradients are not negligible. In this work we account for the existence of these gradients by employing bipolar pulsed field magnetic gradients [5] for velocity encoding. This enables one to study flow through sand (as a model system for soil) at flow rates relevant for the water uptake of plant roots.

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