Influence of sequence protocol variations on MR image texture at 3.0 Tesla: Implications for texture-based pattern classification in a clinical setting

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ABSTRACT

The purpose of our study project was to (1) investigate the sensitivity of quantitative texture features of different categories to clinically feasible variations of NA (number of acquisitions), TR (repetition time), TE (echo time), and SBW (sampling bandwidth), and the dependence of such sensitivity on the spatial resolution; (2) determine whether MR image interpolation at the pixel or k-space level can enhance textural differences between tissues with physically different patterns; and (3) assess the feasibility of texture analysis for classification of liver cysts and hemangiomas on routine, non-enhanced T1- and T2-weighted MR images, respectively, at 3.0 Tesla. To determine the sensitivities of texture features, as well as the effects of MR image interpolation, we used PSAG (polystyrene spheres and agar gel) phantoms with different sphere sizes, ranging from 0.8 to 3.15 mm, as test objects, and a micro-imaging gradient insert for acquisition of high-resolution, T2-weighted MSME sequences. The results of these experiments clearly show that, although texture features of all categories are increasingly sensitive to acquisition parameter variations with increasing spatial resolution, variations of NA, TR, TE, and SBW have little effect on the results of pattern discrimination, as long as the resolution is sufficiently high. Co-occurrence matrix features are particularly useful for pattern discrimination if datasets are heterogeneous with regard to different acquisition parameters, including spatial resolution. MR image interpolation can improve the results of pattern classification, at least based on texture features derived from the co-occurrence matrix, run-length matrix, or absolute gradient. Unless spatial resolution is very poor, zero-filling is the interpolation technique of choice. For this reason, zero-fill interpolation was used to enhance texture-based pattern classification of liver cysts and hemangiomas using routine, zero-fill interpolated MR images. Our preliminary study results suggest that, using these resolution-enhanced images, texture-based pattern classification of liver cysts and hemangiomas is feasible. Thus, further studies are warranted to investigate the value of texture-based classification of other liver tumors, such as hepatocellular and cholangiocellular carcinoma, or metastases, on MRI.