# A novel approach based on spatio-temporal features and Random Forest for scar detection using cine cardiac magnetic resonance images

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**Aim.**
The presence of ischemic scar tissue in left ventricle (LV) is usually assessed by cardiac magnetic resonance (CMR) with late Gadolinium (Gd) enhancement (LGE). However, CMR-LGE is highly contraindicated in patients with severe kidney disease and may represent a long-term risk factor also in subjects with normal renal function. As nonviable scar tissue modifies LV contractile properties, we aimed to identify scar tissue presence in the LV myocardium from CMR cine sequences, using a machine learning-based approach relying on spatio-temporal features.

**Methods.**
Spatial and temporal features were extracted using local binary patterns from cine end-diastolic frame (2D) and amplitude (A1/A0) and phase (φ) wall-motion parametric images, respectively. Parametric images allow computing a compact set of features relevant to pixel videointensity along the temporal dimension, fully exploiting the wall-motion temporal continuity encoded in cine dynamic images. This avoids extracting features from each cine frame, that could cause overfitting due to high feature dimension. The classification in scar/ no scar for American Heart Association (AHA) 6-sectors per slice was performed using Random Forest.

**Results.**
A total of 328 cine loops, each relevant to a CMR slice, were available from 40 patients. LGE was used for gold-standard definition only. The AHA sectors were balanced among scar/ no scar. The best results were achieved by using 2D+A1/A0+φ feature set, with a recall of 70% (inter-quartile range of 2%). Statistically significant differences were found with respect to 2D and A1/A0 only, processed separately.

**Conclusions.**
The 2D+A1/A0+φ feature set, as combination of both spatial and temporal features, showed the best results in terms of classification of sectors with scar. This supports the hypothesis that encoding spatio-temporal features from cine and parametric images may properly capture the LV contractile properties. The proposed approach showed promising results, paving the way for scar identification from Gd-free images.