Patch-based super-resolution for arterial spin labeling MRI
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In clinical conditions, ASL images are often acquired at low resolutions (LR). This implies partial volume effects (PVE), limiting the validity of cerebral blood flow (CBF) quantifications.

We propose an adaptation of a super-resolution algorithm, taking advantage of a high resolution (HR) structural image to reconstruct CBF maps at a higher resolution, without increasing the acquisition time.

The images were processed using an inhouse processing pipeline based on Nipype\(^3\), SPM8 and Python functions. The ASL series were realigned on the first volume. The M0 and structural images were registered on the perfusion maps. The CBF maps were estimated using the general kinetic model\(^1\).

The proposed algorithm therefore consists in:
- a 3rd order spline interpolation to increase the image dimensions
- iterations between the non-local patch-based regularization and an original data fidelity term until convergence

\[
X_{t+1} = X_{t} + \text{arg min}_{x} \left( \| y - DHx \|^2 + \gamma \Psi_s(x) \right)
\]

with \( \gamma \) a scalar and \( \Psi_s \) a non-local patch-based regularization term, including information from the structural image \( S \).

In order to validate the ability of the algorithm to retrieve a HR image, we applied it to an original HR CBF map downsampled by a factor of 2 in each direction.

The CBF maps were also increased using nearest neighbor, trilinear and 3rd order spline interpolation as a matter of comparison.

The proposed algorithm enables the generation of HR CBF images, without increasing the actual acquisition time. It provides more reliable CBF values than traditional interpolation methods, especially in gray matter, which is of particular interest in clinical practice.