

Automatic detection of perfusion abnormalities based on an Arterial Spin Labeling template

ISMRM Scientific Workshop: Perfusion MRI 2012

Camille Maumet, Pierre Maurel, Jean-Christophe Ferré,
Christian Barillot

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Outline

1 Context

2 Method

3 Results

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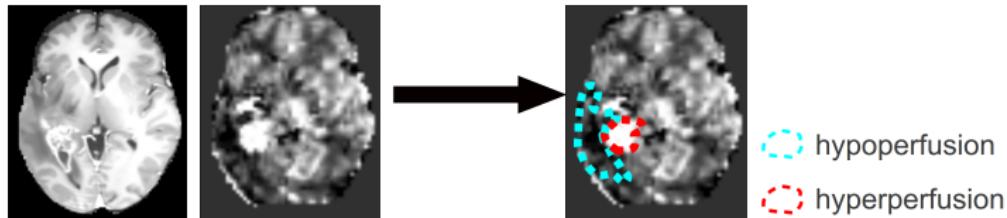
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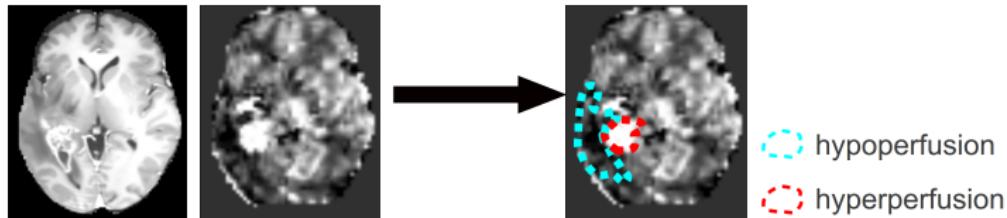
Objective

Quantitative identification of voxelwise patient-specific perfusion abnormalities.



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Challenges:

- Low signal-to-noise ratio of the Q2TIPS PASL sequence.
- Presence of artefacts.

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- Statistical analysis
- Ground Truth estimation

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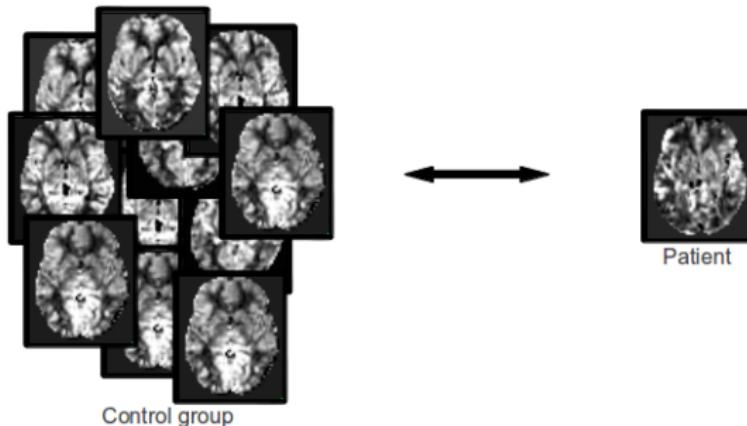
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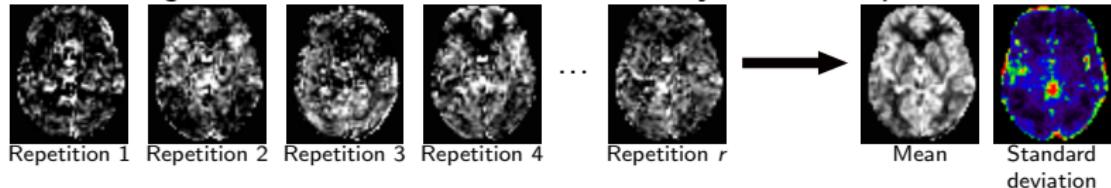
Method

Originality of our approach:

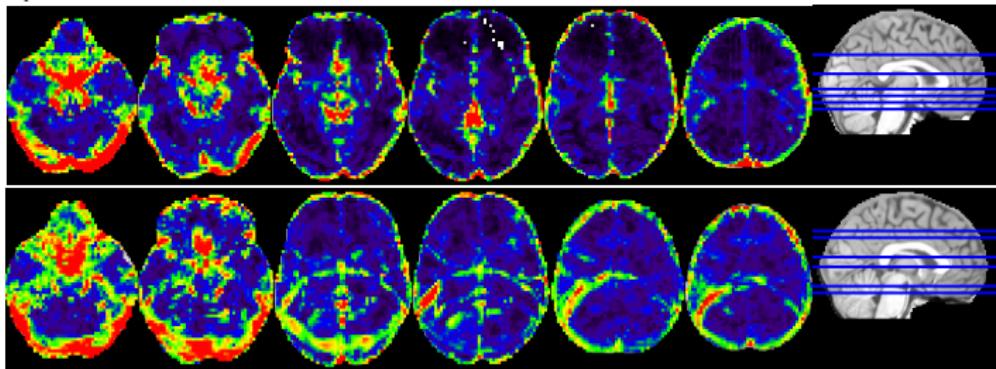
- *Explicit modelling of both intra-subject and inter-subject variances.*
- **No pre-smoothing of the data: a contrario approach.**

Intra-subject variance

Intra-subject variance models variability across repetitions

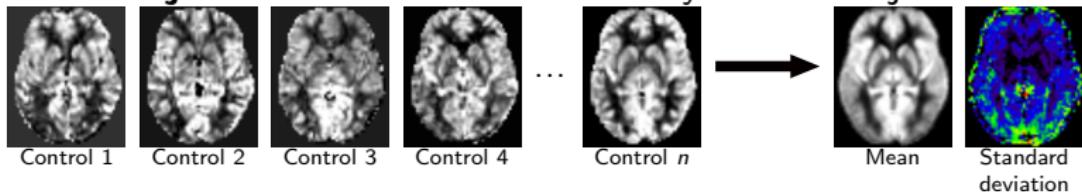


Examples

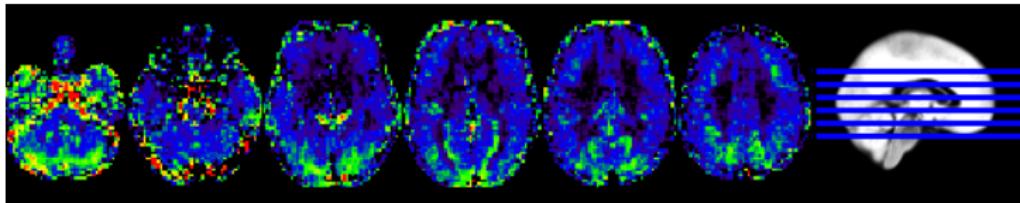


Inter-subject variance

Inter-subject variance models variability across subjects



Inter-subject standard deviation (35 healthy subjects)

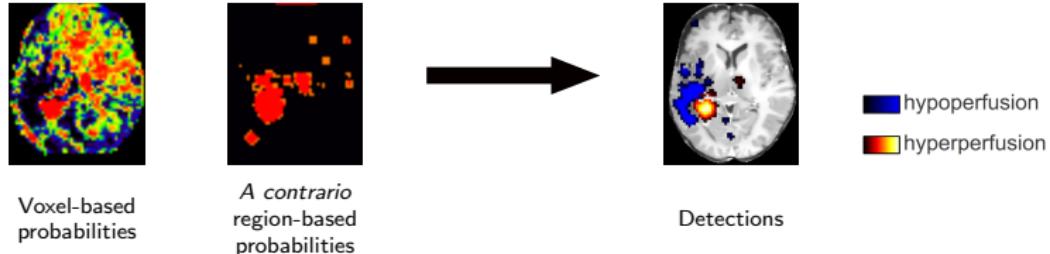


Detection of perfusion abnormalities

Model of normal perfusion:

$$\text{Patient map} \sim \mathcal{N}(\text{Mean across subjects}, \text{Inter-subject variance}^2 + \text{Intra-subject variance}^2)$$

Detection of hypoperfusions and hyperperfusions:



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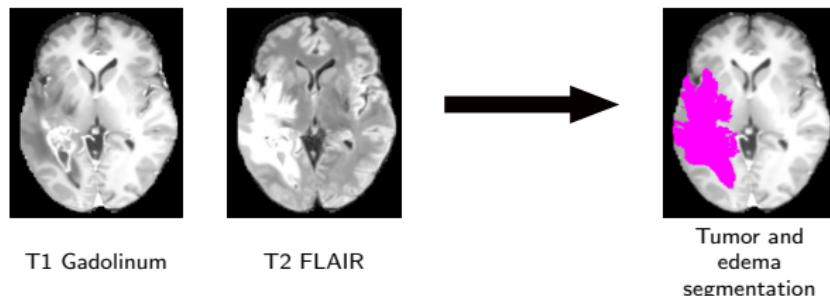
2 Method

- Statistical analysis
- Ground Truth estimation

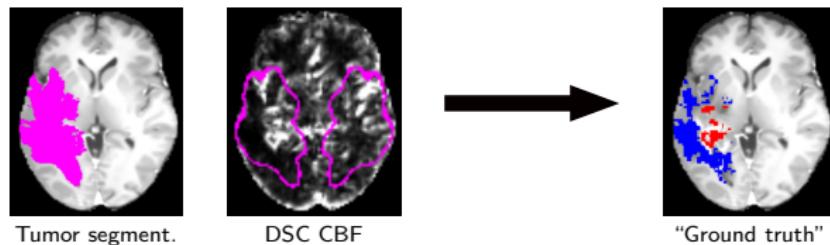
3 Results

Ground Truth estimation

Step 1 – Segmentation of the tumor:



Step 2 – Combination with T2 perfusion information:



Step 3 – Visual assessment and manual corrections by a clinician

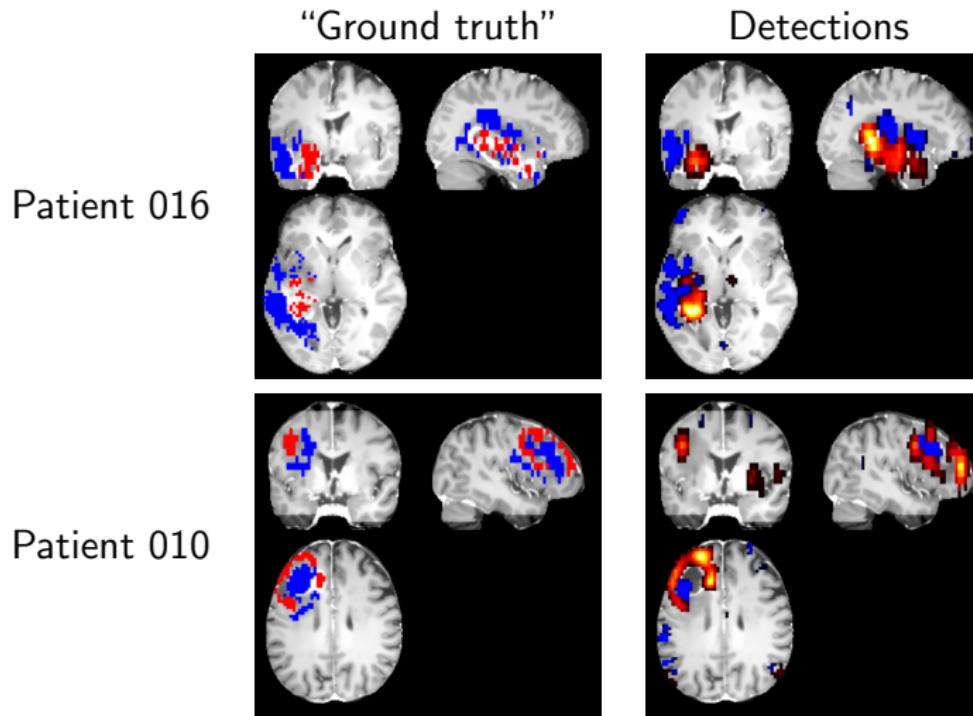
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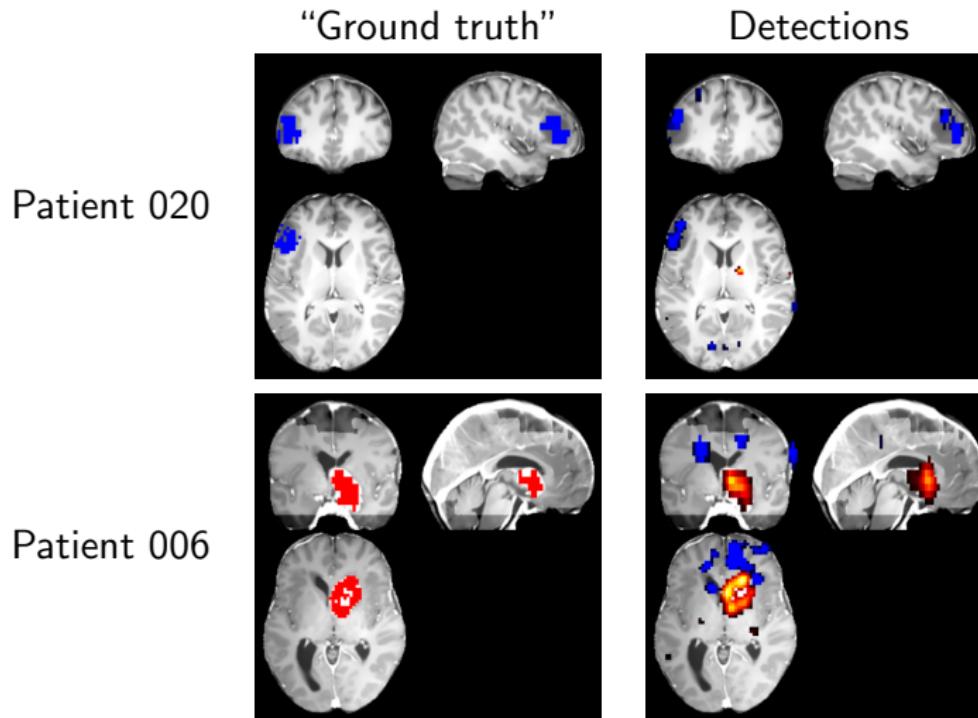
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Results



Results



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Quantitative results on a dataset including 22 patients and 35 controls:

Specificity (controls)	0.99
Specificity (patients)	0.93
Sensitivity (hyper)	0.82

Conclusion

Conclusions:

- Importance of intra-subject variance in the detection of patient-specific perfusion abnormalities.
- Good sensitivity and specificity of the proposed approach.

Future work:

- Relationship between the level of CBF in identified abnormalities and the grade of the tumor.
- Application in other pathological contexts.

More details on the *a contrario* approach: C. Maumet, P. Maurel, J.-C. Ferré, and C. Barillot, "A comprehensive framework for the detection of individual brain perfusion abnormalities using arterial spin labeling" MICCAI 2012, pp. 542–549.

Q & A