

Patch-based DTI grading: Application to Alzheimer's disease classification

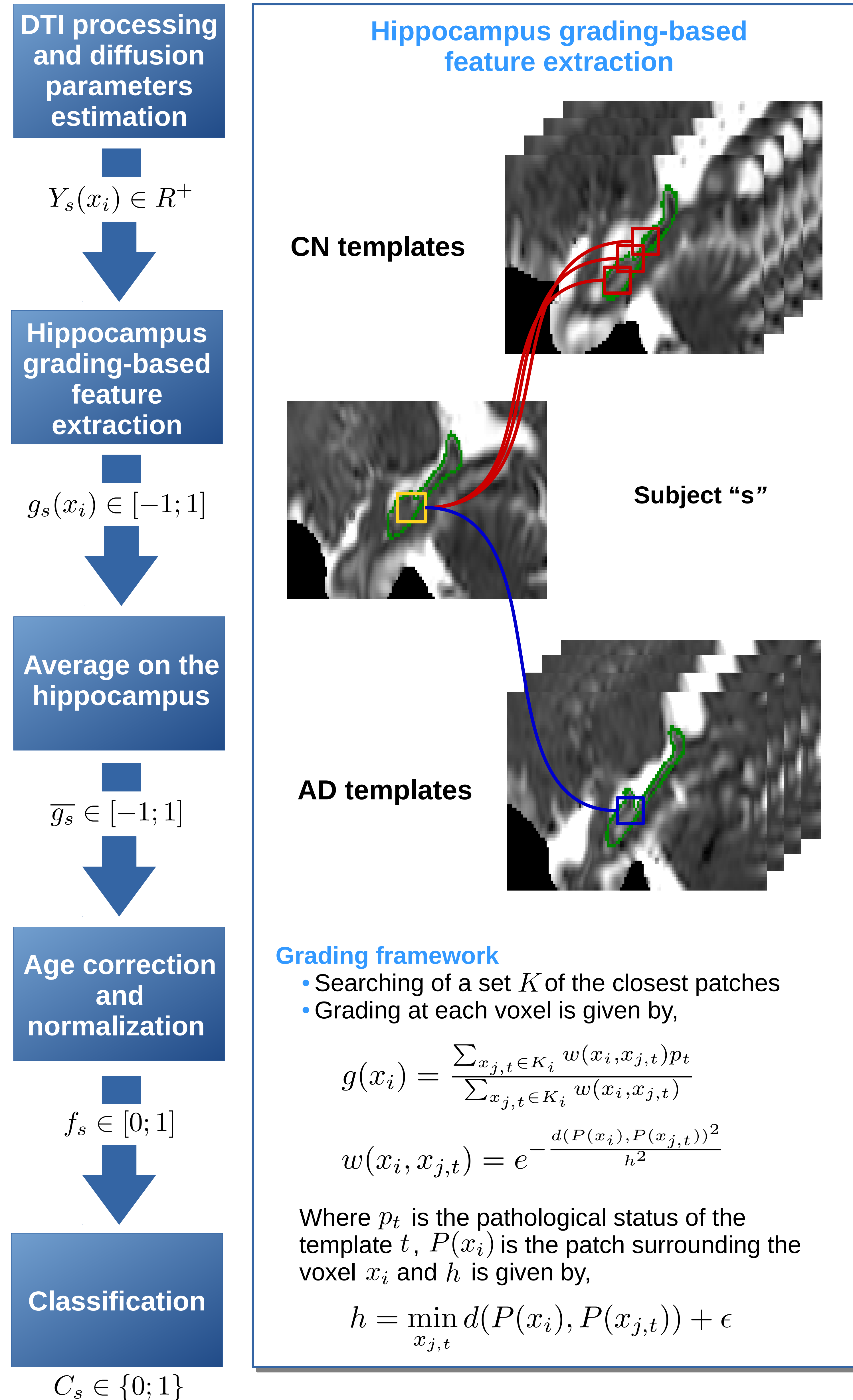
K. Hett^{1,2}, V.-T. Ta^{2,3}, R. Giraud^{1,2}, M. Mondino^{1,2}, J. V. Manjón⁵, P. Coupé^{1,2} and ADNI

¹ Univ. Bordeaux, LaBRI, UMR 5800, PICTURA, F-33400 Talence, France
² CNRS, LaBRI, UMR 5800, PICTURA, F-33400 Talence, France
³ Bordeaux INP, LaBRI, UMR 5800, PICTURA, F-33600 Pessac, France
⁴ Universitat Politècnica de València, ITACA, 46022 Valencia, Spain

Contributions

- Application of the grading-based framework on the different DTI parameters (FA, AD, RD, MD)
- Comparison of basic DTI-based hippocampal features and volume of hippocampus
- Comparison of the advanced DTI-based and anatomical MRI-based features in the hippocampus

Methods



Summary

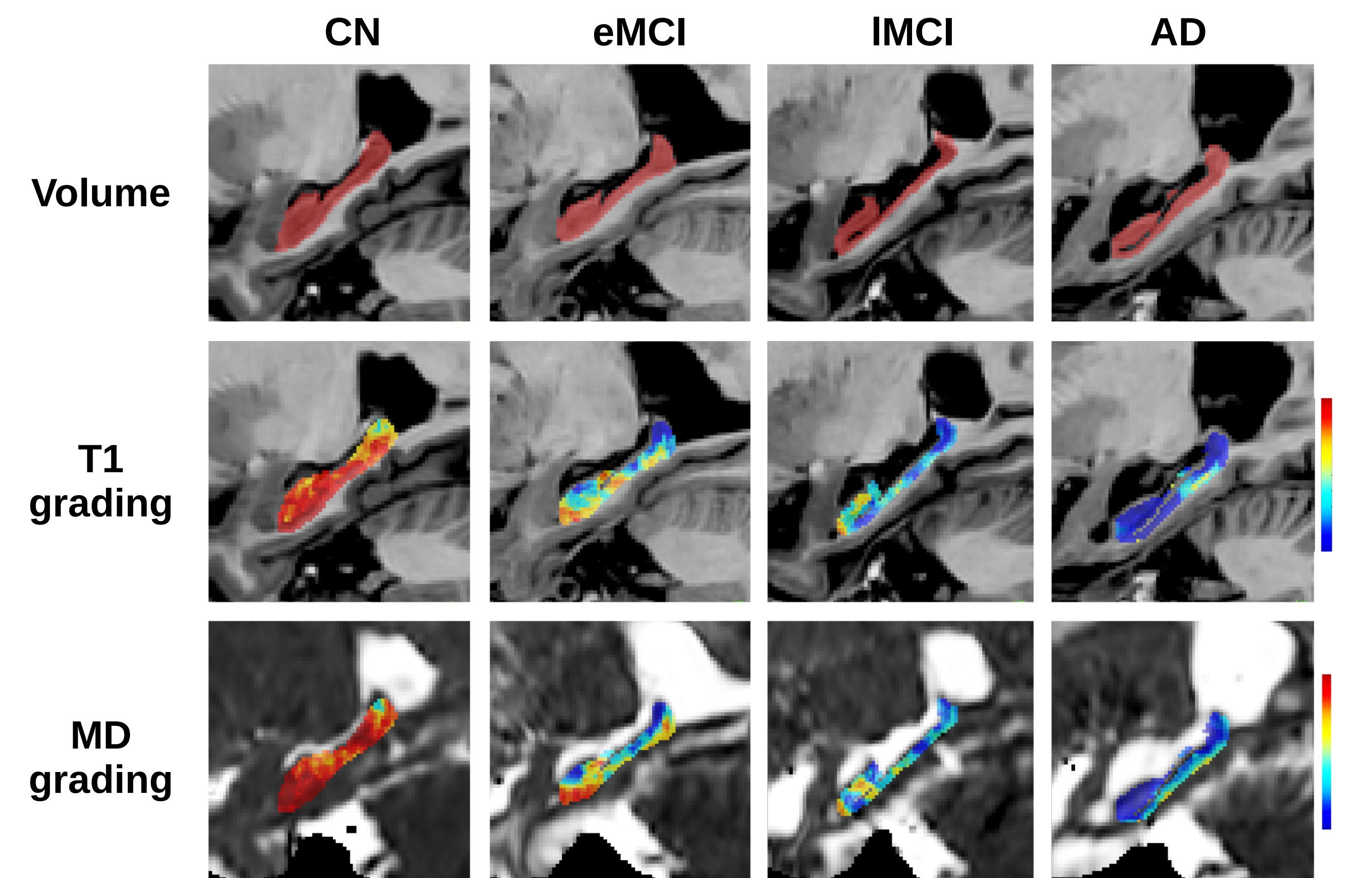
- Analysis on the hippocampus structure
- Capturing alterations of the micro-structures with DTI modality
- Application of the grading framework introduced in [1]
- Fast patch searching method with OPAL [2]
- Classification performed with LDA

Materials

Database: ADNI2

Characteristic / Group	CN	eMCI	IMCI	AD
Number of subjects	60	74	36	48
Age (years)	73.3 ± 5.9	72.9 ± 8.0	73.5 ± 6.7	75.2 ± 8.6
Gender (male/female)	31/29	45/29	22/14	28/20

Results



Validation

- Leave-one-out cross validation procedure
- Binary classification of CN/AD, CN/MCI, AD/MCI, eMCI/IMCI groups

Results (AUC/ACC)

Features	CN vs. AD	CN vs. MCI	AD vs. MCI	eMCI vs. IMCI
Volume	88.4 / 83.1	69.5 / 63.9	71.1 / 67.2	67.2 / 63.7
Mean FA	64.2 / 59.2	57.7 / 56.1	54.0 / 52.7	38.2 / 43.1
Mean MD	85.7 / 80.3	66.0 / 62.6	75.0 / 72.5	67.6 / 62.8
Mean AxD	83.5 / 81.4	63.5 / 58.0	74.3 / 70.2	68.9 / 66.8
Mean RD	86.2 / 79.2	66.5 / 62.3	74.8 / 70.5	66.0 / 61.5
T1 grading	93.4 / 87.8	71.3 / 64.1	82.0 / 73.4	68.7 / 66.2
FA grading	85.0 / 80.1	63.5 / 60.1	74.9 / 70.3	63.0 / 60.7
MD grading	90.6 / 86.5	68.8 / 60.7	80.4 / 76.3	70.4 / 65.8
AxD grading	91.1 / 85.8	68.7 / 59.6	80.2 / 73.1	71.8 / 67.6
RD grading	90.3 / 85.1	68.9 / 61.0	80.0 / 76.5	69.3 / 65.4

Comparison (ACC)

Features	CN vs AD	eMCI vs IMCI
T1 grading	87.8	66.2
AxD grading	85.8	67.6
ODF-brain connectivity [3]	78.2	63.4

Conclusions

- Novel fast grading framework
- Application on different diffusion parameters extracted from DTI
- DTI grading-based features provide competitive results

Perspectives

- Study the complementarity of the grading based on T1w and DTI
- Multi-modality framework to use this complementarity

Fundings

IDEX Bordeaux (ANR-10-IDEX-03-02), CPU, TRAIL (HL-MRI ANR-10-LABX-57) and CNRS multidisciplinary project "Défi imag'In"

[1] P. Coupé et al. *NeuroImage: clinical* 1.1 (2012): 141-152. [2] R. Giraud et al. *NeuroImage* 124 (2016): 770-782. [3] G. Prasad et al. *Neurobiology of aging* 36 (2015): S121-S131.