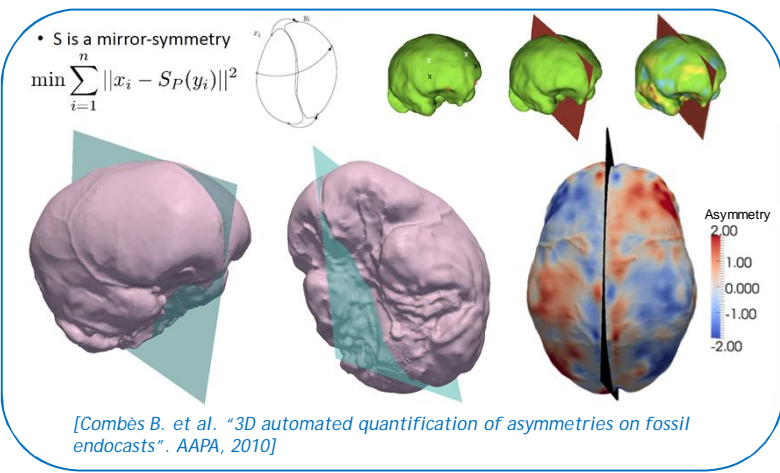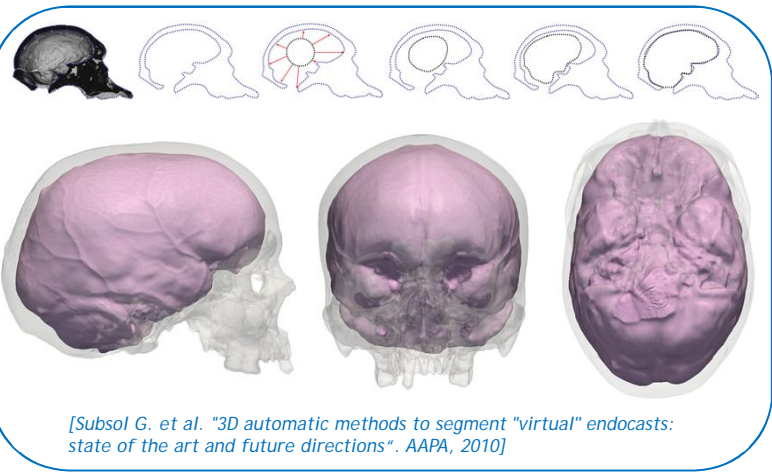# New 3D automatic methods for the analysis of the endocranial shape and its relationship with ectocranial structures: assessment and preliminary experiments

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1. 3D automatic endocast segmentation and 3D asymmetry map computation

- S is a mirror-symmetry

$$\min \sum_{i=1}^{n} ||x_i - S_P(y_i)||^2$$

Asymmetry
2.00
1.00
0.000
-1.00
-2.00

[Subsol G. et al. "3D automatic methods to segment "virtual" endocasts: state of the art and future directions". AAPA, 2010]

[Combès B. et al. "3D automated quantification of asymmetries on fossil endocasts". AAPA, 2010]
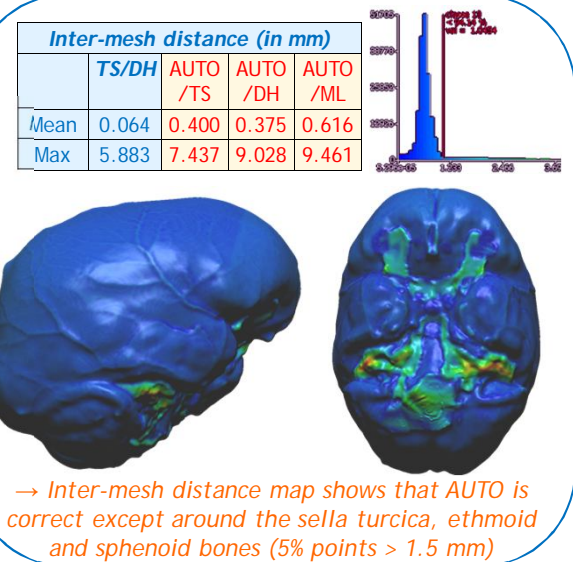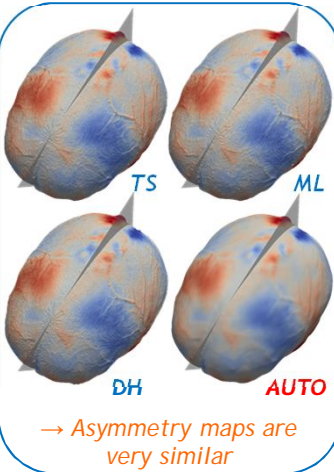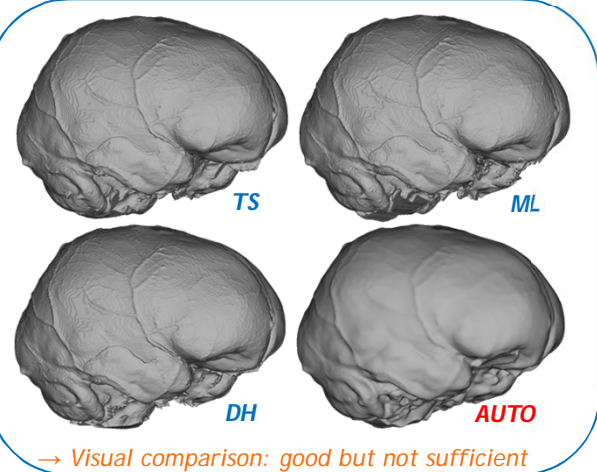
2. Assessment of the automatic results

- 5 samples of the Morton Collection (ex. Morton 0550)
- 3D CT images from the ORSA 3D digital database
- Manual segmentations by 3 experts (TS, ML , DH)

Volume (in cm³)			
TS	DH	ML	AUTO
1,198.4	1,196.3	1,206.2	1,181.1
Mean = 1,200.3			

[Schoenemann P.T. et al. "Validation of Plaster Endocast Morphology Through 3D CT Image Analysis". AJPA, 2007]

Inter-mesh distance (in mm)				
	TS/DH	AUTO /TS	AUTO /DH	AUTO /ML
Mean	0.064	0.400	0.375	0.616
Max	5.883	7.437	9.028	9.461

TS · ML · DH · AUTO

→ Visual comparison: good but not sufficient

→ Asymmetry maps are very similar

→ Inter-mesh distance map shows that AUTO is correct except around the sella turcica, ethmoid and sphenoid bones (5% points > 1.5 mm)

3. Analysis of the endocranial shape and its relationship with ectocranial structures

[Schoenemann P.T. et al., "The open research CT scan archive". British Institute of Radiology Newsletter, 2008. http://plum.museum.upenn.edu/~orsa/]

[Renschler E. & Monge J. "The Samuel George Morton Cranial Collection". Expedition, 2008]

Morton 1451: sagittal keel and occipital bun

Morton 0094: many depressions all over the cranial vault

→ Endocranial symmetry plane follows the keel
→ Endocranial shape correlates with the bun shape

→ No effect on the endocranial shape