University of Sao Paulo - USP
Medicine School of Riberão Preto
Clinics Hospital of USP RP

Medical Image Registration Using Tsallis Entropy in Statistical Parametric Mapping (SPM)

- Henrique Tomaz do Amaral Silva
- Paulo Mazzoncini de Azevedo Marques
- Lauro Wichert-Ana / Luiz Otávio Murta Jr.

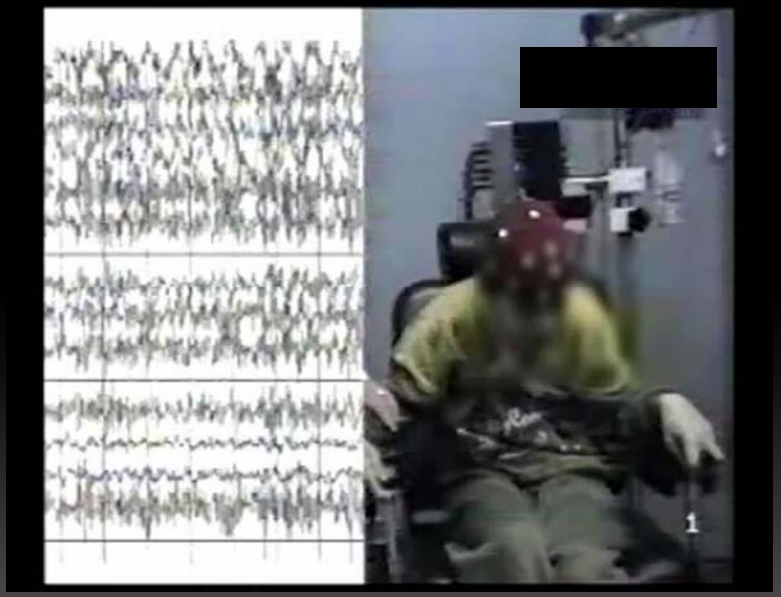
Support

Topics

- Introduction
  - Epilepsy
  - Statistical Parametric Mapping (SPM)
  - Co-registration
  - Tsallis Entropy
- Purpose
- Materials and Methods
- Results
- Conclusions

Epilepsy

- Epilepsy is a chronic neurological condition characterized by recurrent seizures.
- A seizure happens when abnormal electrical activity in brain causes an involuntary change in body movement or function, sensation, awareness or behavior.
- Epilepsy affects about 1% of world population
- Some patient are Refractory to DAES.



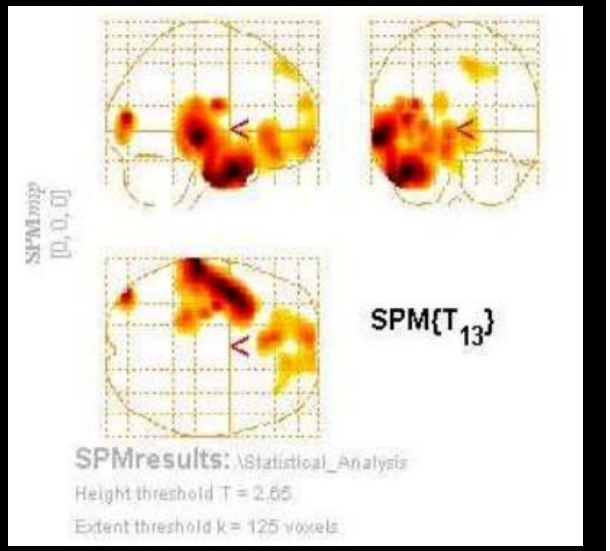
- Surgical Planning

- Medical Images to localize the EZ.
  - MRI.
  - Nuclear Medicine
    - SPECT
    - PET

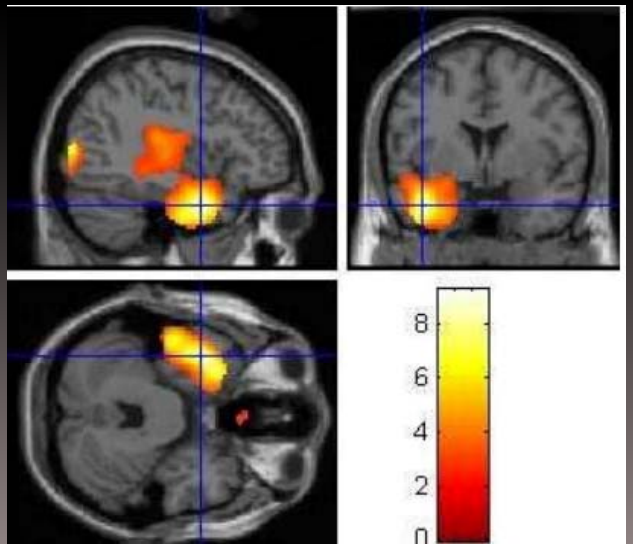
- SPECT and PET can evaluate the ictal and inter-ictal functional status of the brain assuming relevant role in EEG and MRI inconclusive [Wichert-Ana L, 2005].

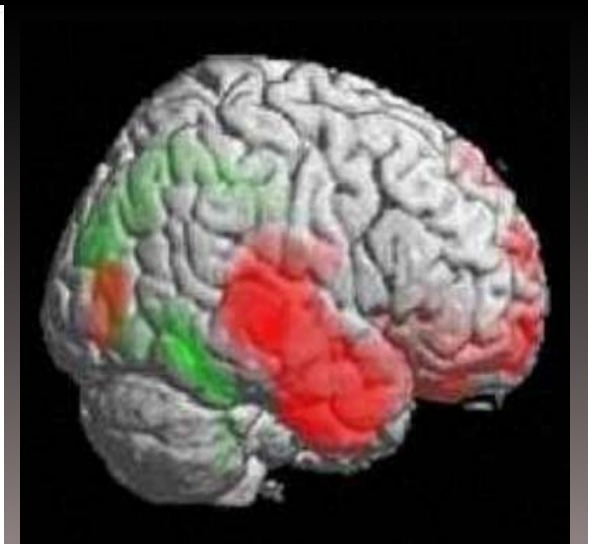
Statistical Parametric Mapping

- **Statistical Parametric Mapping** is a MatLab toolbox.
  - Medical Image Processing:
    - Filters
    - Masks
    - Normalization
    - Segmentation
    - **CO-REGISTRATION**.
  - **Analysis of neuroimages and mapping of ROIS**.



voxel-level					x,y,z {mm}		
p FWE-corr	p FDR-corr	T	(Z)	p uncorrected			
0.013	0.002	9.30	5.06	0.000	-40	2	-30
0.016	0.002	9.07	5.01	0.000	-60	-26	-6
0.037	0.002	8.19	4.78	0.000	-48	-8	-38
0.098	0.002	7.21	4.50	0.000	-40	-84	10
0.880	0.016	4.59	3.48	0.000	-36	-88	-2
0.660	0.009	5.15	3.74	0.000	-8	36	-16
0.696	0.010	5.07	3.70	0.000	-6	30	-4
0.706	0.010	5.05	3.69	0.000	-6	64	-14
0.995	0.038	3.82	3.07	0.001	12	48	48
1.000	0.071	3.28	2.75	0.003	30	40	46
1.000	0.076	3.22	2.71	0.003	20	46	46
0.997	0.042	3.73	3.02	0.001	-12	62	22





Co-registration

- The co-registration consists in the overleaping of two or more images, where the space of one them is used as reference to define the transformations that the other images must perform for that their space align to the reference one [J. Ashburner,2004].

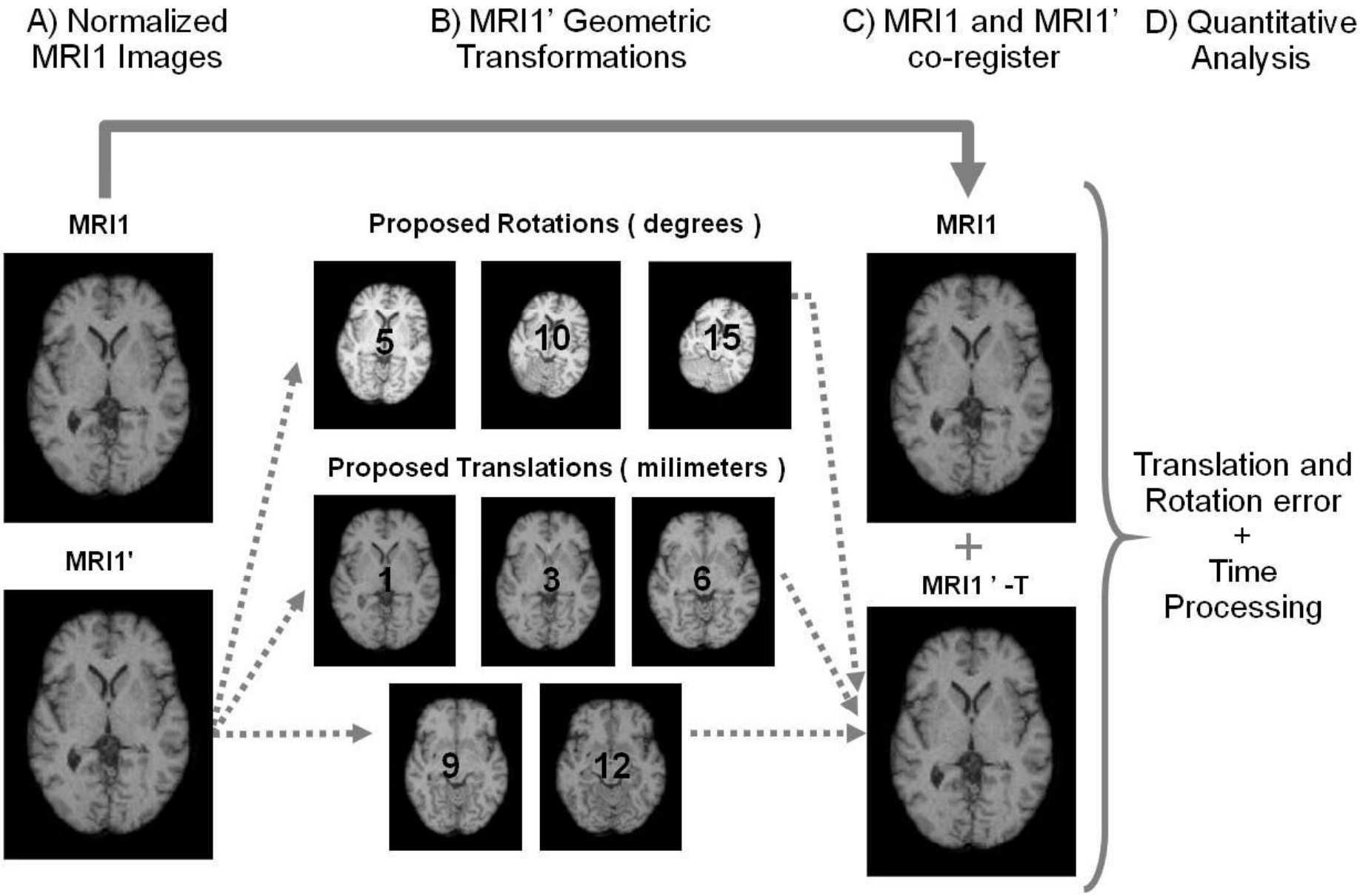
- The co-registration of medical images with complementary information can be a important tools to identify the EZ in the surgical planning [K.A. McNally,2005].

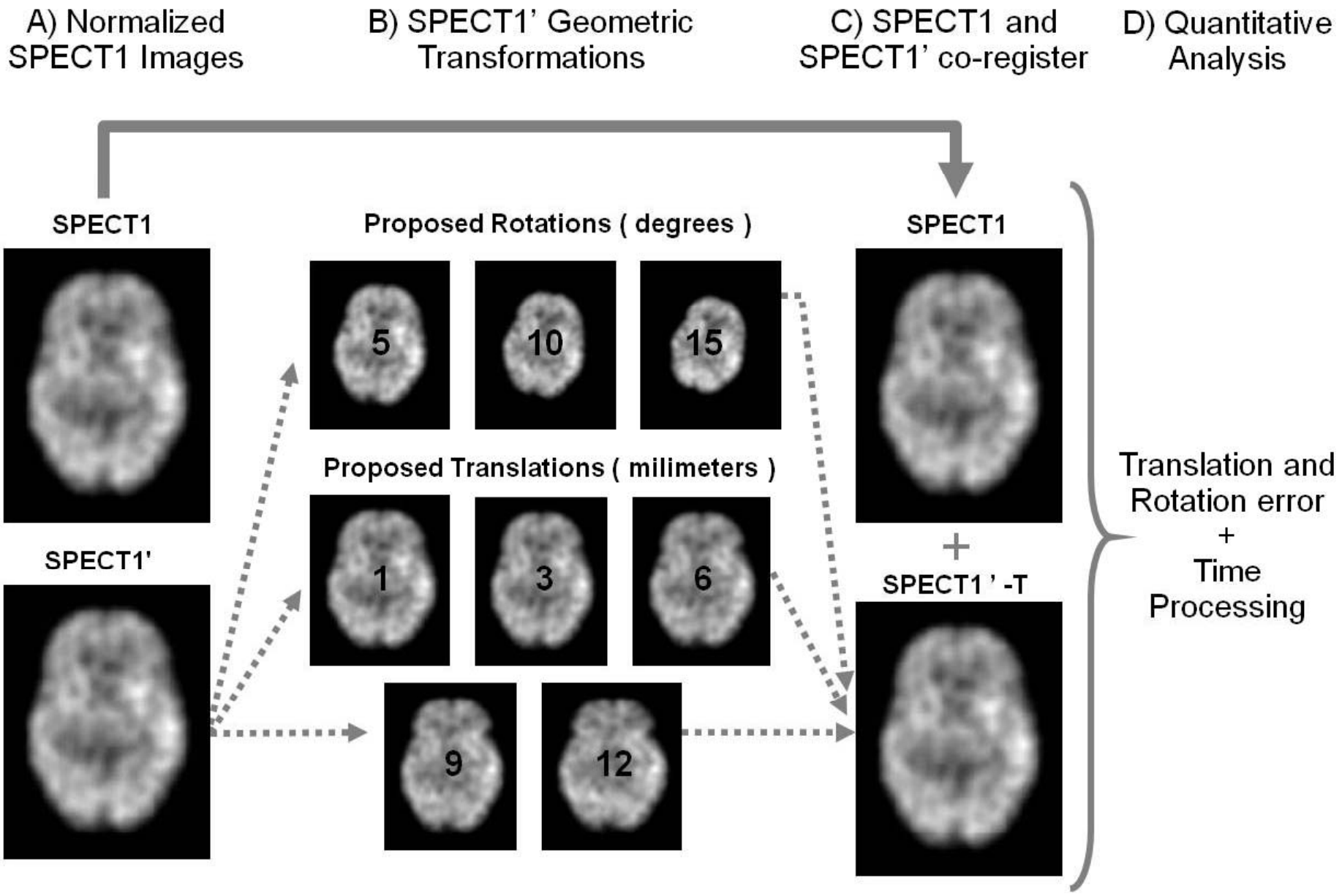
- The co-registration can be:
  - Manual (gold standard) ,
  - Semi-Automatic (landmarks),
  - Automatic.
    - Based in Voxel Value Intensity >>> Cost Function.
      - Entropy Correlation Coefficient (ECC).
      - Normalized Mutual Information (NMI).
      - Normalized Cross Correlation (NCC).
      - Mutual Information (MI-Shannon).
      - Mutual Information – **Tsallis Entropy ?**

Purpose

Describe a study focused on to find a reliable new cost function for neuroimage co-registration in the EZ localization through of the comparative performance analyses of the TSallis Entropy (MI-Tsallis) and of the traditional cost functions in the SPM package.

Material and Methods


A) Normalized MRI1 Images
B) MRI1' Geometric Transformations
C) MRI1 and MRI1' co-register
D) Quantitative Analysis
MRI1
MRI1'
Proposed Rotations (degrees)
5
10
15
Proposed Translations (milimeters)
1
3
6
9
12
MRI1
+
MRI1 ' -T
Translation and Rotation error + Time Processing


A) Normalized SPECT1 Images
B) SPECT1' Geometric Transformations
C) SPECT1 and SPECT1' co-register
D) Quantitative Analysis
SPECT1
SPECT1'
Proposed Rotations (degrees)
5
10
15
Proposed Translations (milimeters)
1
3
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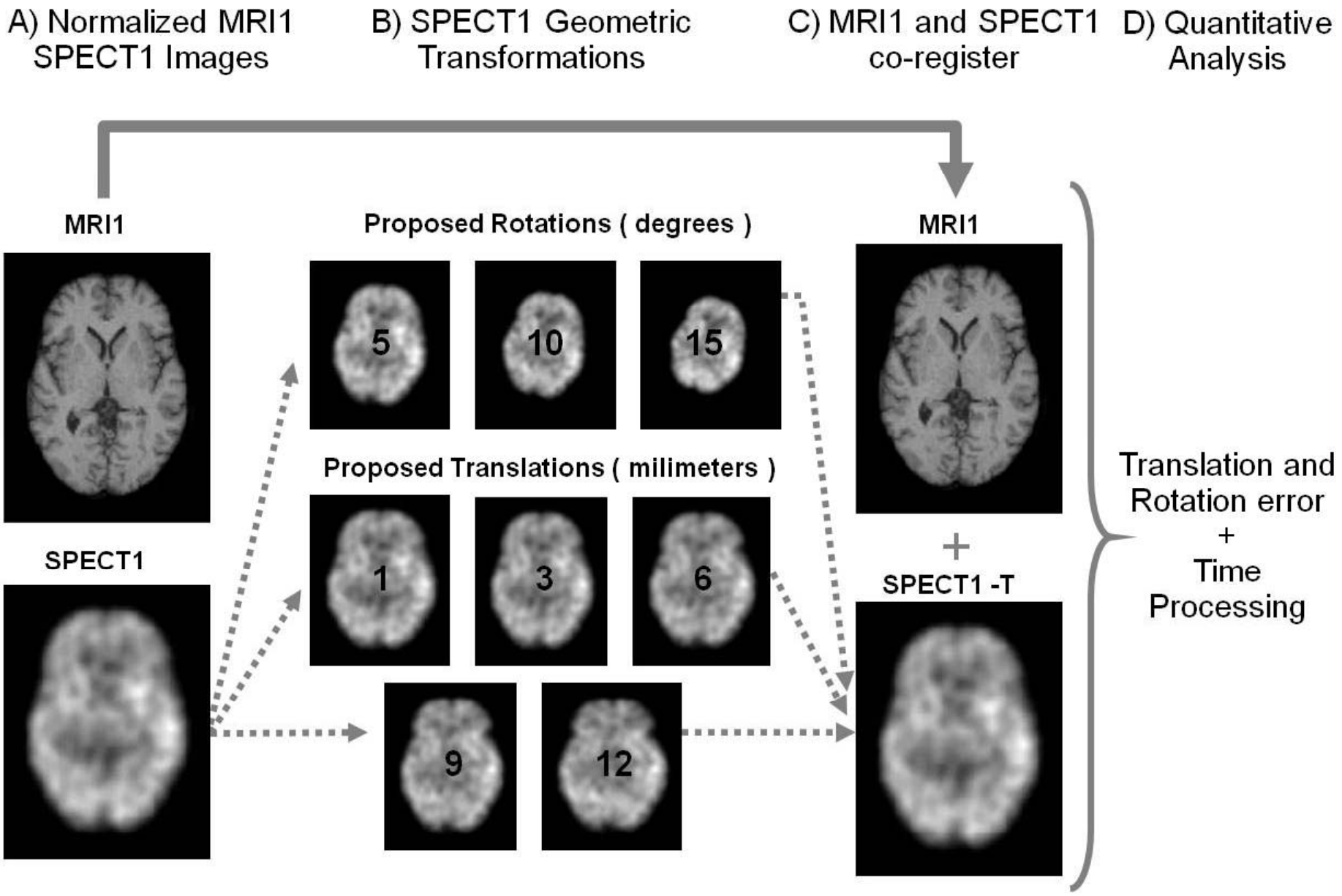
9
12
SPECT1
+
SPECT1 ' -T
Translation and Rotation error + Time Processing


A) Normalized MRI1
SPECT1 Images
B) SPECT1 Geometric
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MRI1
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Proposed Rotations (degrees)
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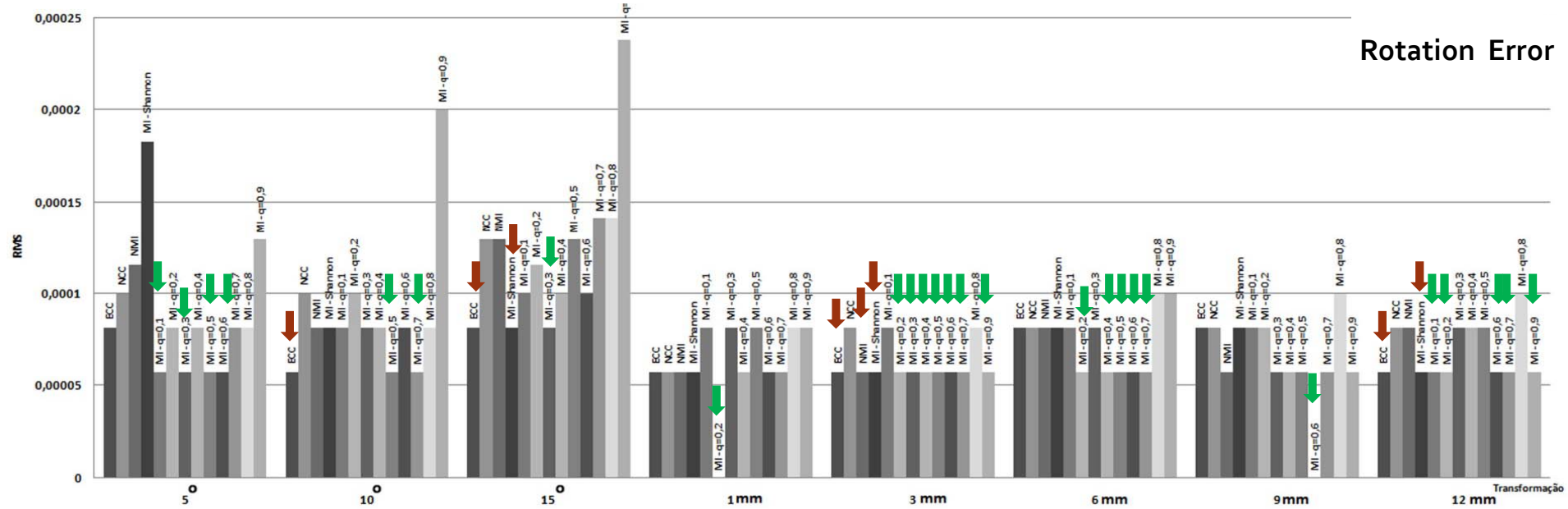
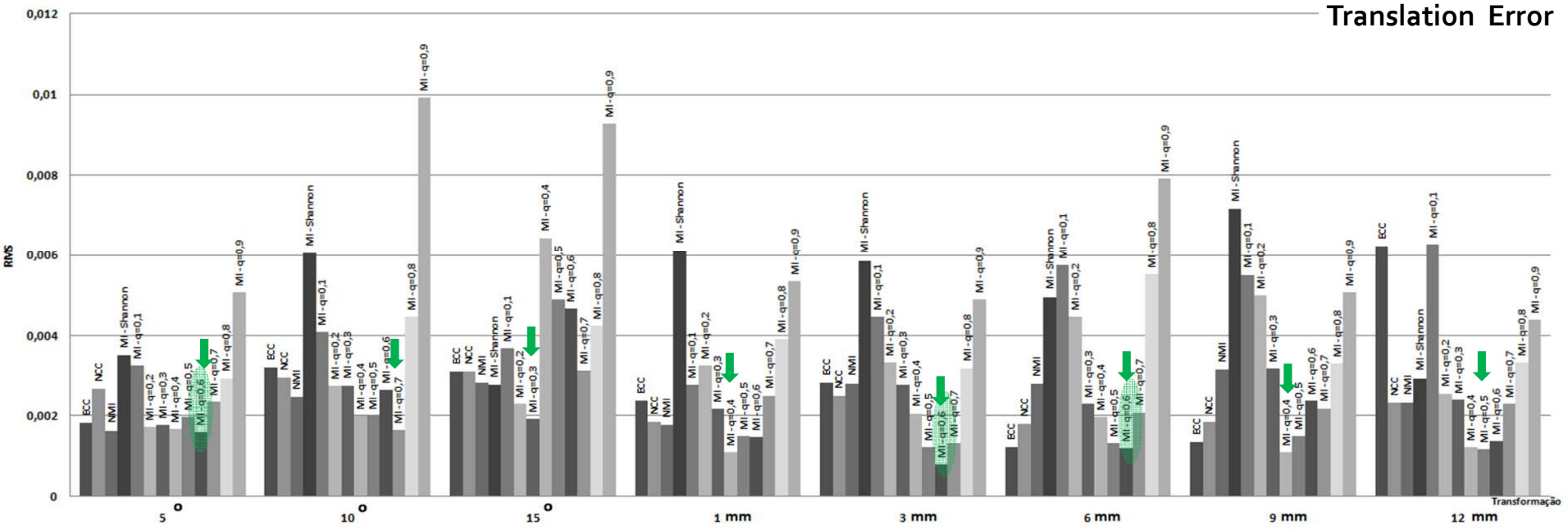
Processing

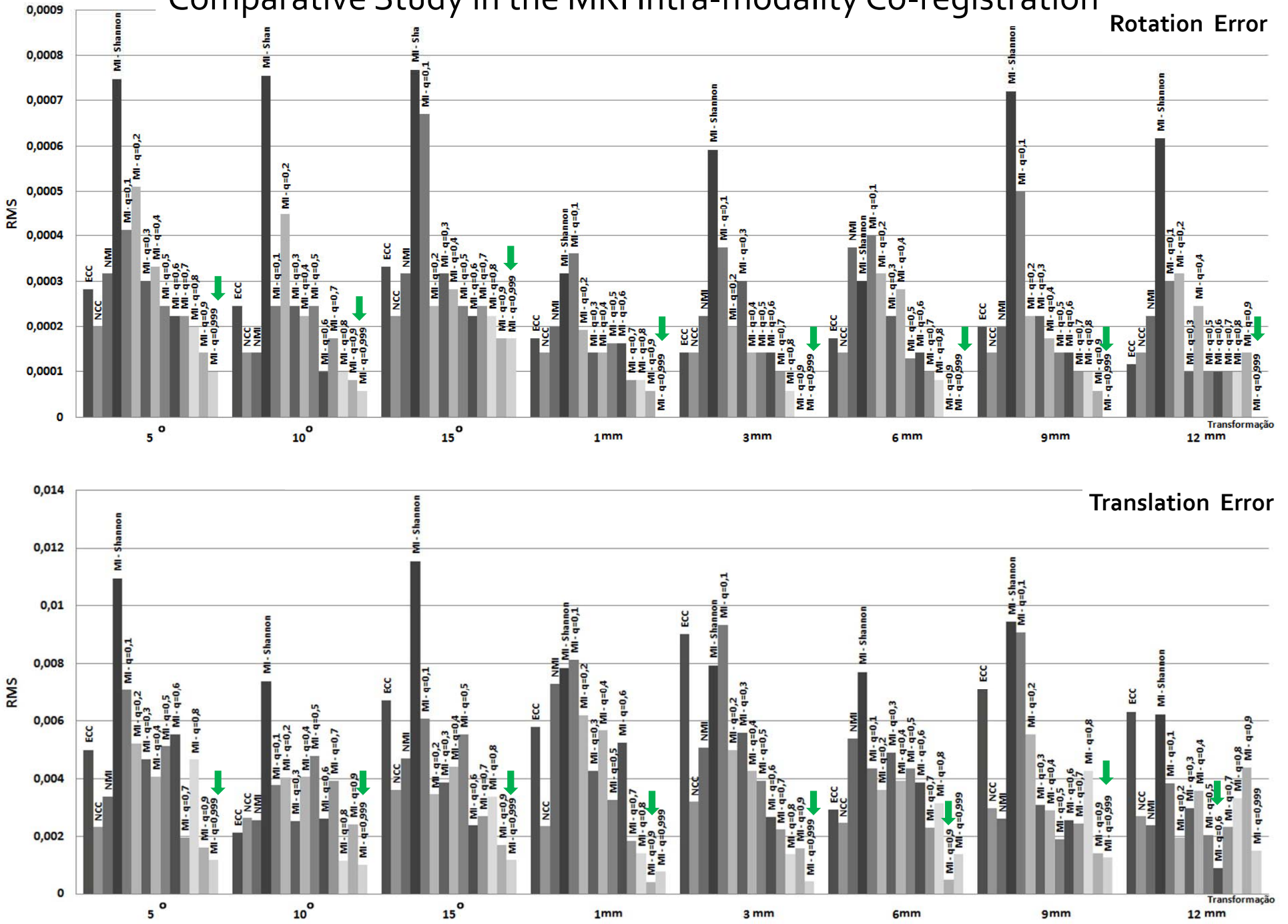
Results

Comparative Study in the MRI Intra-modality Co-registration

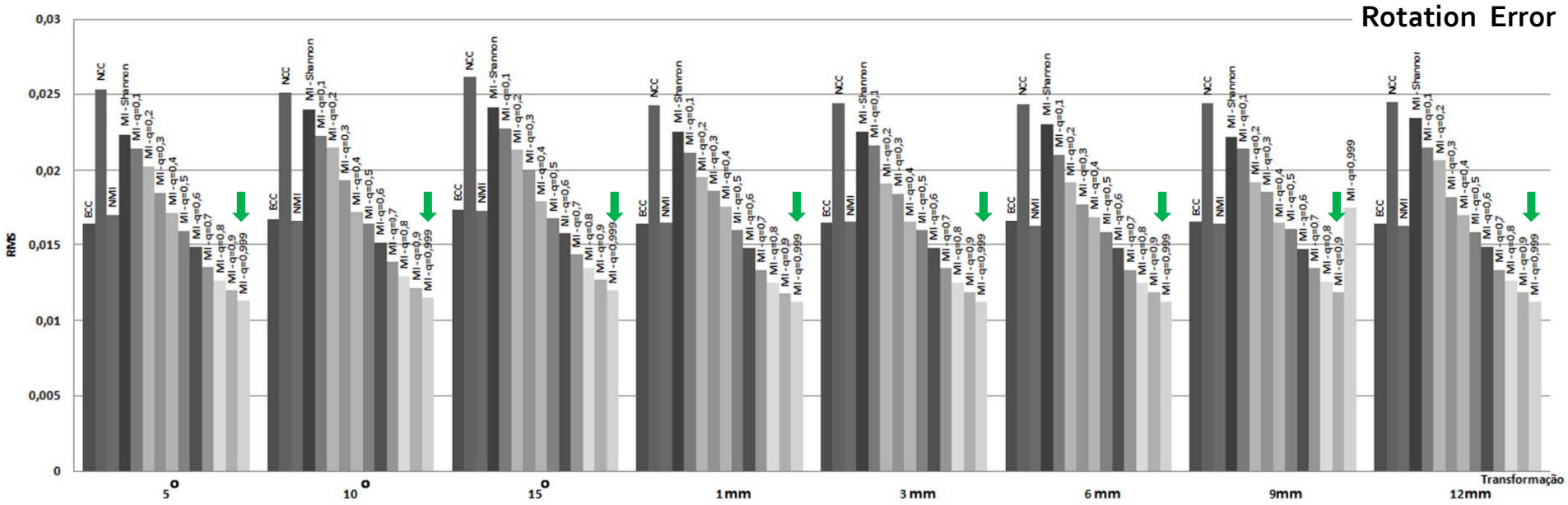


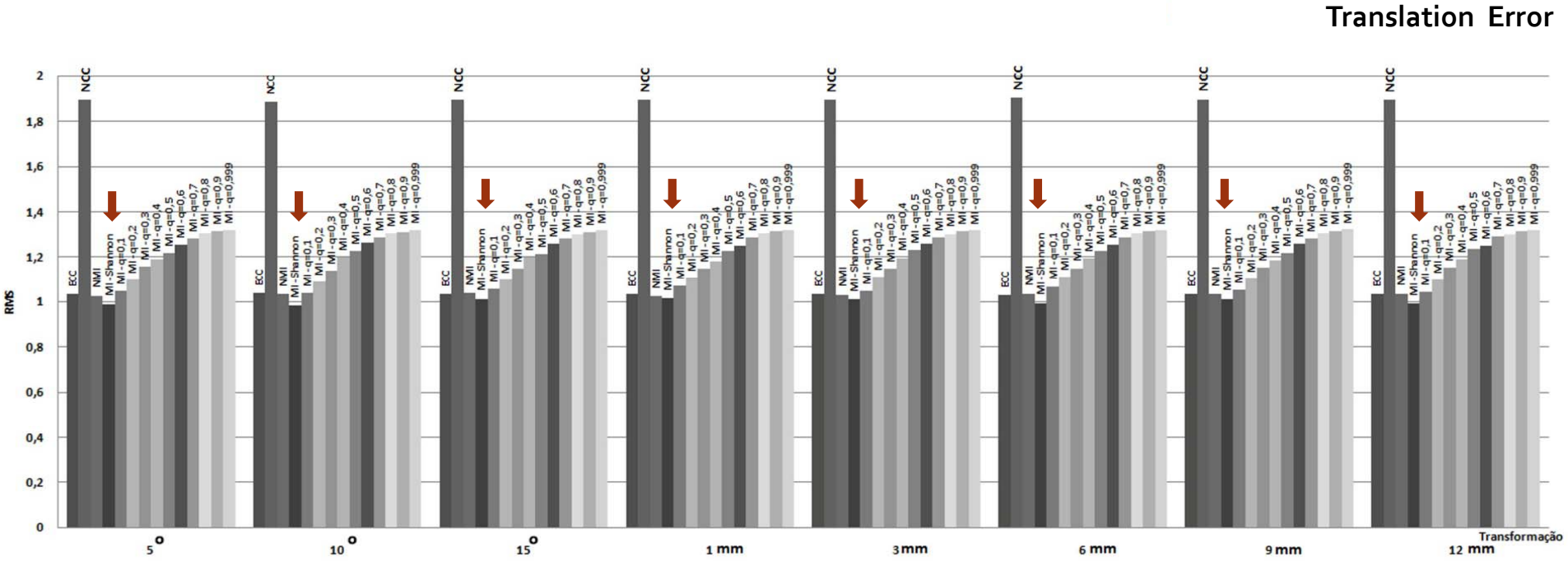


Comparative Study in the MRI Intra-modality Co-registration



Comparative Study in the MRI-SPECT Inter-modality Co-registration





Conclusion

- This study showed evidences that the Tsallis Entropy when used as cost function for the Mutual Information determination in the medical images co-registration can be considered a reliable Method for the automatic intra and inter-modalities alignment.

- Actually we are applying the method as a CAD system in the clinical routine using Tsallis Entropy in SPM analysis and on the our software SISCOM BRAZIL for subtraction.

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Thank you for the attention