MR Based Attenuation Correction Method for SPECT

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Introduction

- Advances in SPECT/MR hardware integration [1] necessitate an MR based SPECT attenuation correction.
- For PET/MR hybrid systems, several ways of generating an attenuation map from MR sequences exist [2] [3].
- Feasibility of these approaches for SPECT needs to be investigated.

Objective: Derive an attenuation map from MR sequences and investigate its accuracy for SPECT studies with patient CT as the reference.

Materials and Methods

Data Acquisition

- 5 patients (3 female, 2 male, average age 72 years) underwent SPECT/CT HMPAO brain and T1-MPRAGE and T2-TSE acquisitions.
- T2-TSE included to provide complementary information eg. ventricles.

MR derived CT

- MR to CT intensity mapping learnt via ε–insensitive Support Vector Regression [4] using a Radial Basis Kernel (RBF).
- Features: mean, median, maximum, minimum, variance across 3x3x3 voxel neighborhood.
- $SPECT_{MRAC}$ and $SPECT_{CTAC}$ reconstructed from MR derived CT and patient CT respectively.
- SPECT reconstructions used an Ordered Subset Expectation Maximization algorithm with 3D resolution recovery (OSEM-3D), attenuation and scatter correction in 4 subsets and 8 iterations.
- Relative difference (RD) computed from:

$$RD = 100*(SPECT_{CTAC} - SPECT_{MRAC})/(SPECT_{CTAC})$$

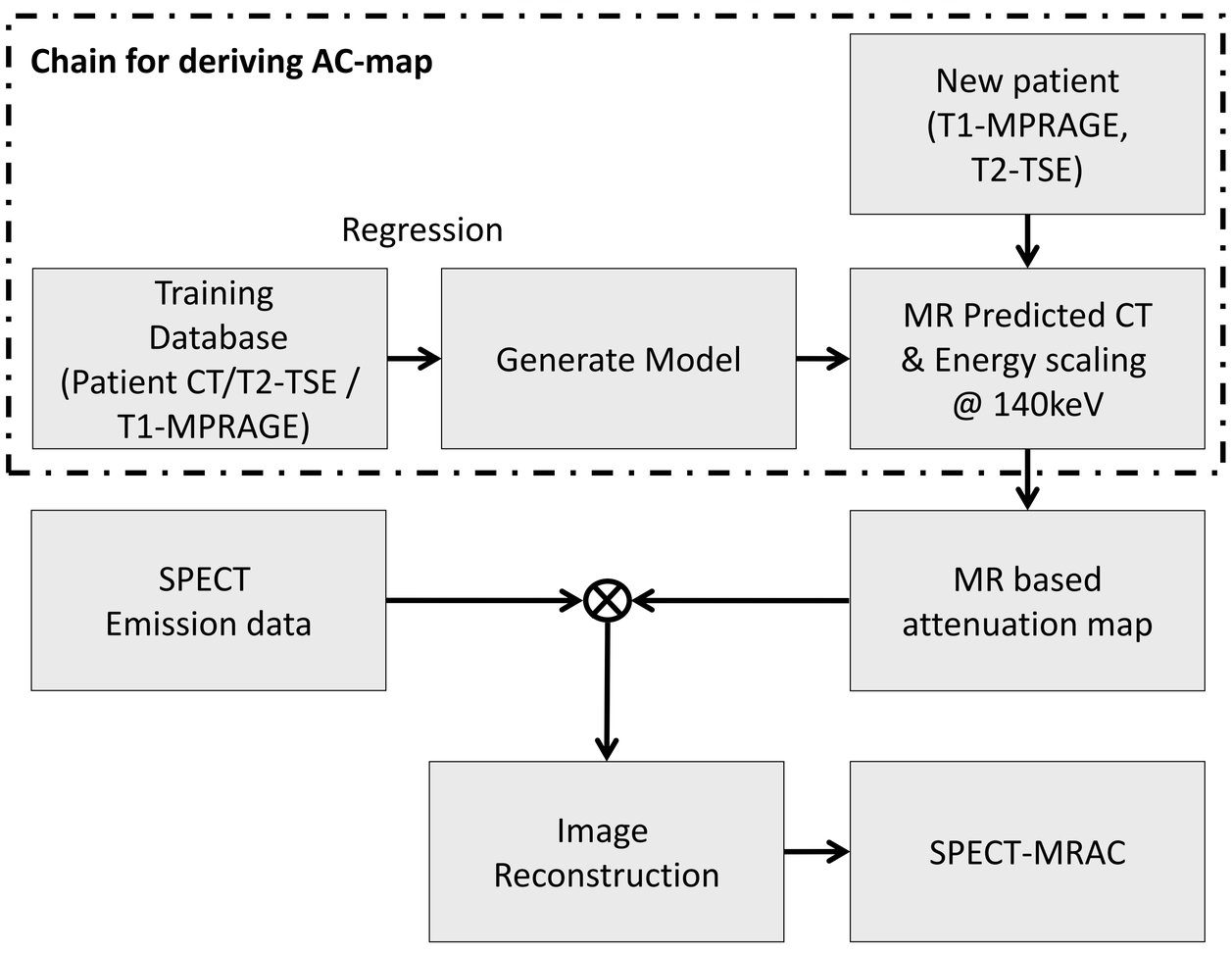

Figure 1: Flow chart illustration of an MR based SPECT attenuation correction.

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Results and Discussion

- **Figure 2:** Generation of Pseudo-CT from MR images.
- **Figure 3:** Efficacy of MR derived CT on SPECT.
- Visually $SPECT_{MRAC}$ and $SPECT_{CTAC}$ compare well.
- Average error below 5 % in the brain, less than 15% in the nasal and close to skull regions.

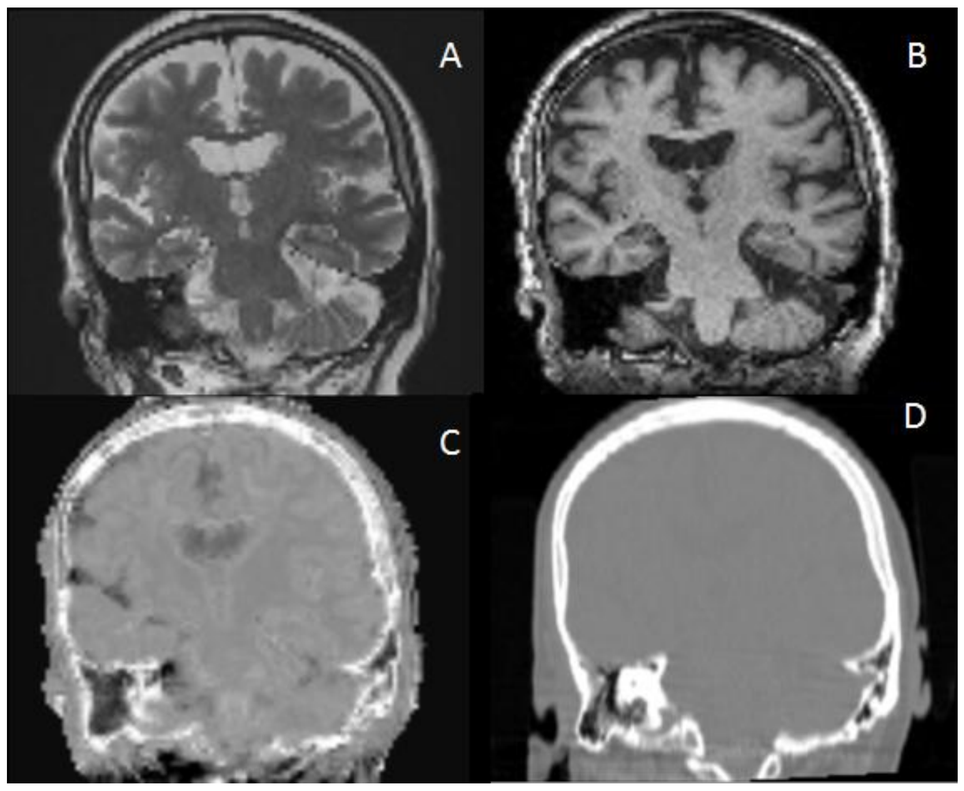

Figure 2: (A) T2-TSE , **(B)** T1-MPRAGE, **(C)** MR derived CT, **(D)** Patient CT.

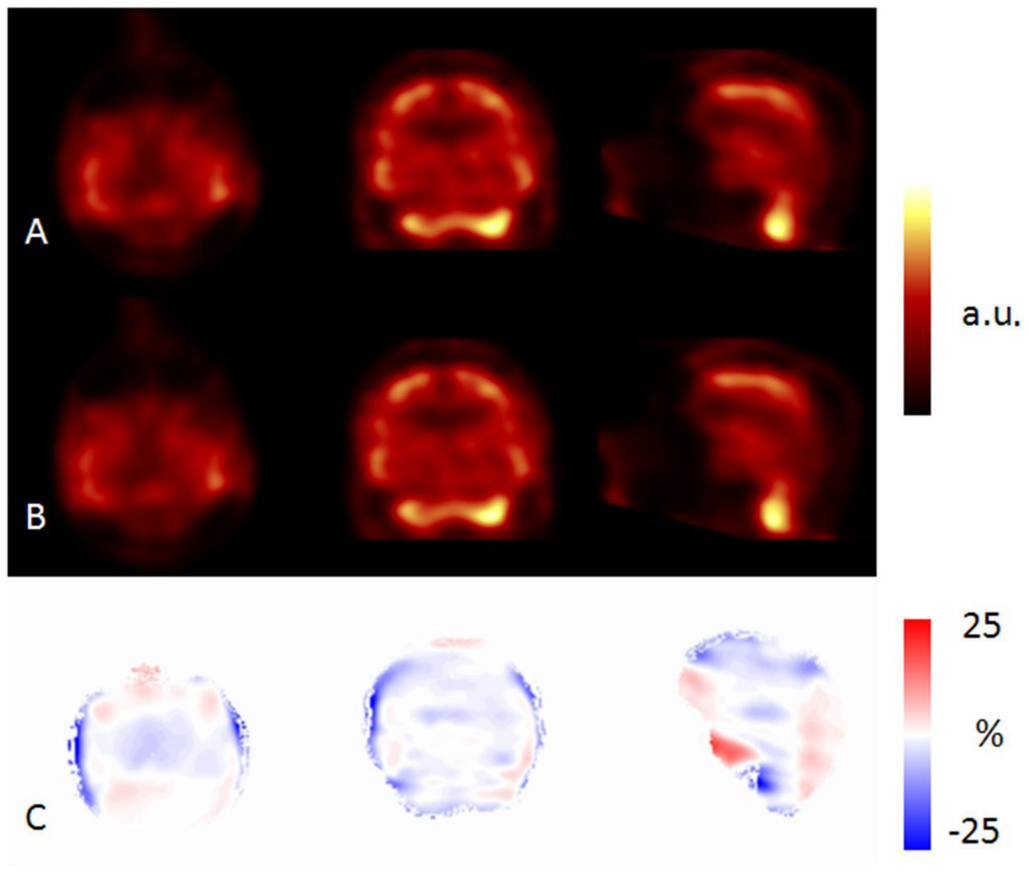

Figure 3: (A) $SPECT_{MRAC}$ **(B)** $SPECT_{CTAC}$ **(C)** Brain RD map.

Conclusions

- MR based AC in SPECT using pattern recognition techniques.
- Quantitatively equivalent SPECT reconstruction results.
- Misclassifications in skull and nasal regions could be improved using Ultra Short Echo Time sequences.

References

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