

# PVElab: Software for correction of functional images for partial volume errors

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**PVEOut**

A EU 5th Framework program



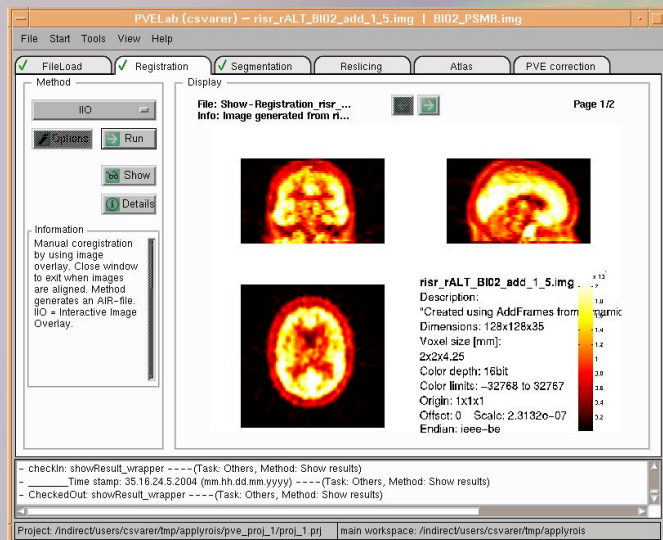
Contact for SW download: [pvelab@nru.dk](mailto:pvelab@nru.dk)  
PVEOut homepage: <http://pveout.area.na.cnr.it>

## Introduction:

A major problem using functional SPECT and PET images is the relatively low resolution in the images – the so-called partial volume effect. In this abstract a common software framework for controlling the process of correcting the functional images using structural information derived from structural MR images, is presented. The software is implemented in Matlab (Mathworks Inc.) and includes tools for controlling the process, logging the results, presenting the results, and it is easily extensible to include own methods for each step in the process.

## Methods:

The interface to the PVElab software tool is illustrated below



The partial volume correction process includes interfaces to standard software that can handle the following steps in the partial volume correction process:

- **FileLoad:** Imports and converts functional and structural images so it can be used by the routines in the process:
  - Analyze and dicom image files can be imported
- **Registration:** Identify alignment parameters between functional and structural images:
  - Interactive Image Overlay (manual method, IIO<sup>9</sup>, NRU)
  - Interactive Point Selection (manual method, IPS<sup>9</sup>, NRU)
  - Interface to SPM co-registration (Statistical Parametric Mapping<sup>1</sup>, SPM2)
  - Interface to AIR (Automatic Image Registration<sup>10</sup>, AIR 5)
  - Load AIR file (registration done otherwise)
- **Segmentation:** Segments structural images into gray and white matter classes:
  - QMCI segmentation (uses T1, T2, and PD, IBB)
  - Interface to SPM segmentation (Statistical Parametric Mapping, SPM2)
  - Interface to BrainSeg (KIMHS)
  - Load segmented volume (segmentation done otherwise)
- **Reslicing:** Reslices structural images to match functional images:
  - Interface to ResliceWarp (using Brain Warp toolbox<sup>2</sup>, Kjems, DTU)
  - Interface to AIR reslicing (Automatic Image Registration<sup>10</sup>, AIR 5)
  - Reslice (pure matlab, only trilnear)
- **Atlas:** Applies template atlases on the functional images:
  - Talairach based (16 VOI's, IBB)
  - MNI based (23 VOI's, IBB)
  - applyrois<sup>8</sup> (37 VOI's, NRU)
- **PVE correction:** Conducts partial volume correction:
  - PVE correction (IBB)<sup>5</sup>, includes Meltzer<sup>3</sup>, Müller-Gartner<sup>4</sup>, Rousset<sup>7</sup> and modified Müller-Gartner (WM value estimated using Rousset method) approaches

## Methods:

### Further:

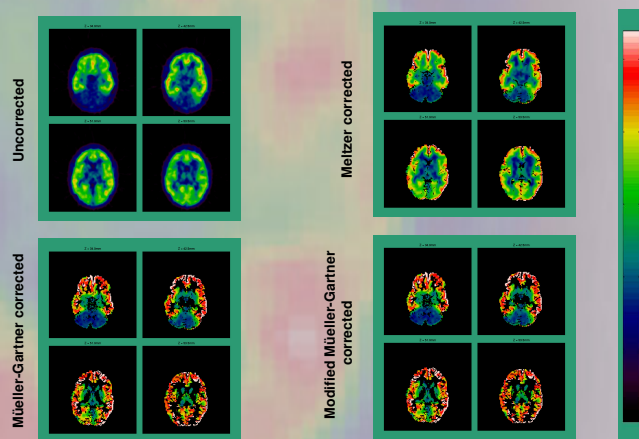
- The toolbox includes software for visualization of the outcome from any steps of the PVE correction process.
- The toolbox creates a log file so it is easy to follow execution steps and the project structure allows for loading old projects and redo some of the tasks using other methods or parameters
- The toolbox allows very easy incorporation of external methods at any stage along the process.
- Interface to AIR and SPM methods for co-registration, segmentation and reslicing included in pvelab (actual software have to be downloaded from their respective homepages)

## Discussion:

As a results of the partial volume correction the program generates PVE corrected values for the ROIs/VOIs defined in the Atlas step as shown below:

ROI NAME	PET	Meltzer	MullGart	ROUSSET	Modified MG
CTL	9550.13	12014.8	13674.2	12071.4	12759.2
LR_FPO	16179	18724.6	24161.3	22439.6	22008
MR_FPO	13249.6	16890.3	23052.6	20607.7	20197
LCTEM	14972.5	18830.7	22789.8	22534.3	21224.6
MR_TEM	11515.4	13277	17938.9	16018.9	15409.5
R_OCC	14720.1	17198	24569.8	22653.2	21634.1
LR_PAR	14871.5	21390.3	27007.7	26313.1	25108.7
MR_PAR	14153.1	19402.5	27309.4	25069.3	24415.2
ML_FPO	13883.4	17259.5	22916.1	20832.2	20299.2
LR_FPO	14263.7	18627.7	24537.1	22089.3	22214.8
ML_TEM	11867.9	13598.9	17730.8	15988.6	15411.4
LCTEM	15400.7	19033.6	23529.1	22087.9	21604.3
L_OCC	14935.3	17536.4	24664.6	22855.6	21890.7
ML_PAR	13509.2	19455.4	24621.1	22823	22696
LR_PAR	15038.6	21357.1	27209.8	25954.8	25331.7
CSP	10634.7	0	0	0	0
WM	10619.3	11372.3	0	6300.12	6300.12

Also image files with corrected gray matter values are generated. In the following figure 5-HT<sub>2A</sub> PET altanserin receptor images are shown uncorrected and corrected:



## Conclusion:

PVElab is available as a research tool for correction of functional SPECT and PET images. It can be downloaded from <http://nru.dk/downloads/pveout> for free (password requested by sending an email to [pvelab@nru.dk](mailto:pvelab@nru.dk)). The software facilitates an automatic partial volume correction of functional images and new or in-house methods can easily be incorporated in the toolbox for performing any stage in the process.

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