



# UCL

# STIR-GATE-Connection

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# What is GATE?

“GATE is an advanced opensource software developed by the international OpenGATE collaboration and dedicated to numerical simulations in medical imaging and radiotherapy.”\*

Based upon the GEANT4\*\* simulation toolkit’s well-validated high energy physics models.

Advanced emission tomography tools allow for the construction of scanners and insertion of positron emission sources and attenuation voxelised phantoms.



**Geant4 Application for Emission Tomography**  
a simulation toolkit for PET and SPECT\*

\*<http://www.opengatecollaboration.org/>

\*\*<https://geant4.web.cern.ch/>

# What is the STIR-GATE-Connection?

The purpose of this project is to provide a simple method to:

1. create a voxelised phantom from a parameter file using STIR functionality
2. setup and run GATE simulations in cluster array jobs
3. combine and unlist root files for reconstruction using STIR

<https://github.com/UCL/STIR-GATE-Connection>

<https://github.com/UCL/STIR-GATE-Connection/blob/master/VoxelisedSimulation/ExampleSTIR-GATE.sh>

# *SetupSimulation.sh*

## *PrepareScannerFiles.sh:*

Currently two example scanners

- Siemens mMR
- GE Discovery 690

## *GenerateSTIRGATEImages.sh:*

- Create using STIR and *\*.par* files
- Modifies attenuation to type int.

## *Gate SetupDmap.mac*

Creates density map

## *RunGATE.sh*

Runs a single simulation with a unique  $\${TASK\_ID}$

Computes many GATE variables from interfile headers

*Sets the center of the activity and attenuation voxels to the center of the scanner (x,y,z)*

*Sets correct voxel sizes (x,y,z)*

*Sets correct number of voxels (x,y,z)*

**AUTOMATICALLY FROM THE HEADERS**

## *UnlistRoot.sh*

Unlists root file into sinogram using template `.hroot` and `.par` files using STIR's *Im\_to\_projdata*

Two possible methods of unlisting for cluster array jobs

1. Combine *.root* files and unlist
- 2 . Unlist in job, sum sinograms

Users choice!

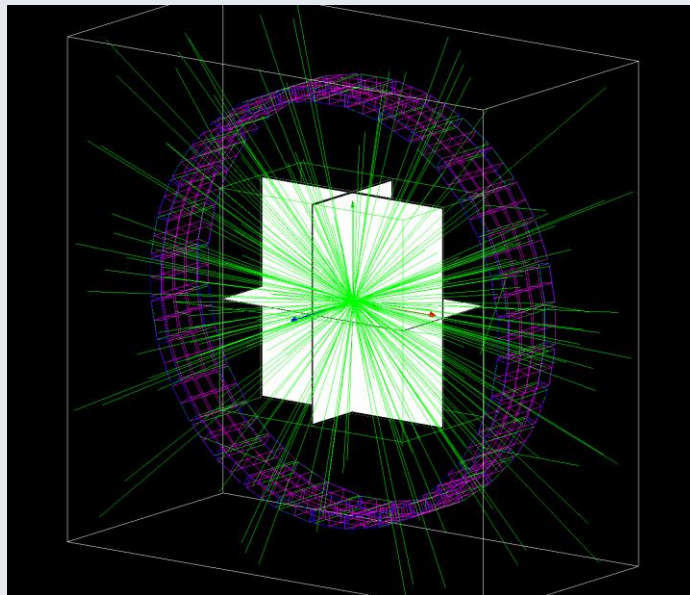
# CheckGeometry.sh

Utilises *Gate –qt* to visualize:

Scanner geometry (*crystals, blocks, buckets*)

Phantom (*check position*)

Emission photons



Emission profile of a point source at the center for the scanner

# Validation: Centring

## SourceSingleCentralVoxel.par

```

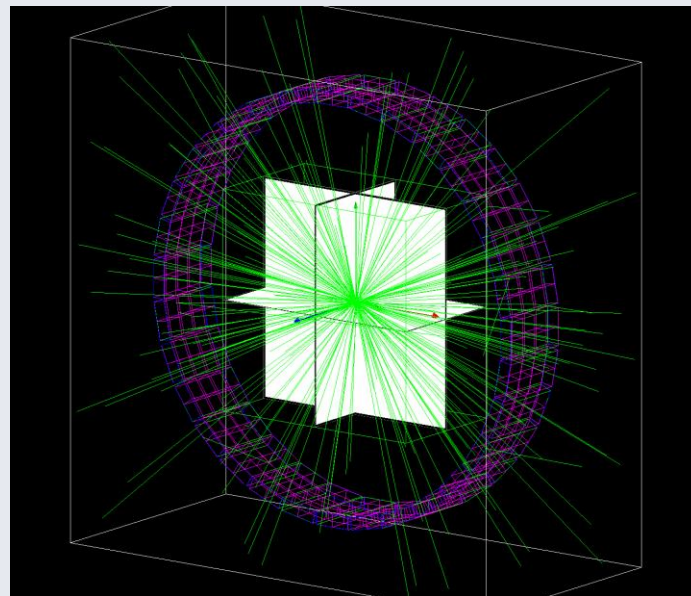
1 generate_image Parameters :=
2 output filename:=activity
3
4 X output image size (in pixels):=110
5 Y output image size (in pixels):=110
6 Z output image size (in pixels):=65
7 X voxel size (in mm):= 4
8 Y voxel size (in mm):= 4
9 Z voxel size (in mm):= 4.0625
10
11 Z number of samples to take per voxel := 1
12 Y number of samples to take per voxel := 1
13 X number of samples to take per voxel := 1
14
15 shape type:= ellipsoid
16 Ellipsoid Parameters:=
17 radius-x (in mm):=2
18 radius-y (in mm):=2
19 radius-z (in mm):=2
20 origin (in mm):={130,0,0}
21 END:=
22 value :=10000
23
24 END:=

```

sourcePosX.mean  
= -0.0015 mm

sourcePosY.mean  
= -0.057 mm

sourcePosZ.mean  
= -0.013 mm



Emission profile of a point source at the center for the scanner



## Future work

Validation methods

- Point source
- Oblique plane

Better script tests and errors

Create GATE scanner geometries from STIR interfile headers

More scanner geometry examples

Use the real mMR scanner geometry without extra crystal (*requires STIR mods*)

Improve documentation

# Contributions and Comments Welcome!

## Any Questions?

### Authors

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