The novell way to include the DICOM structures in the the Geant4-based medical linac application

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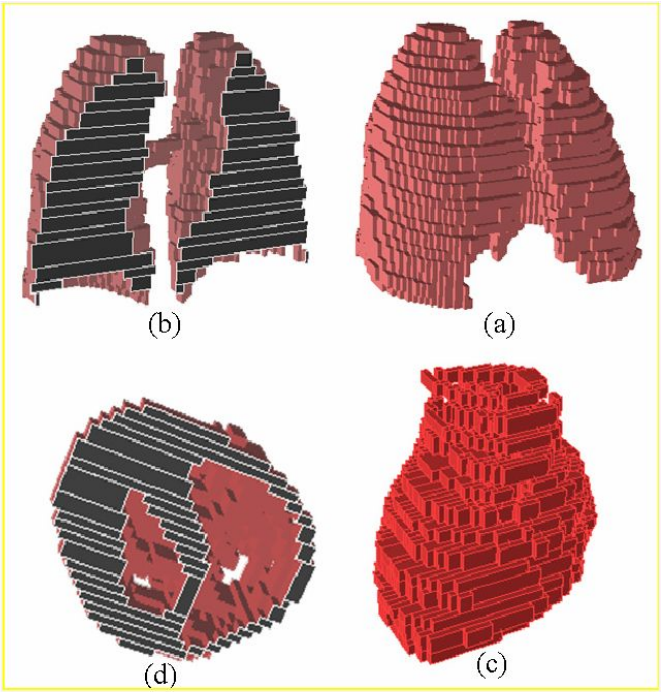
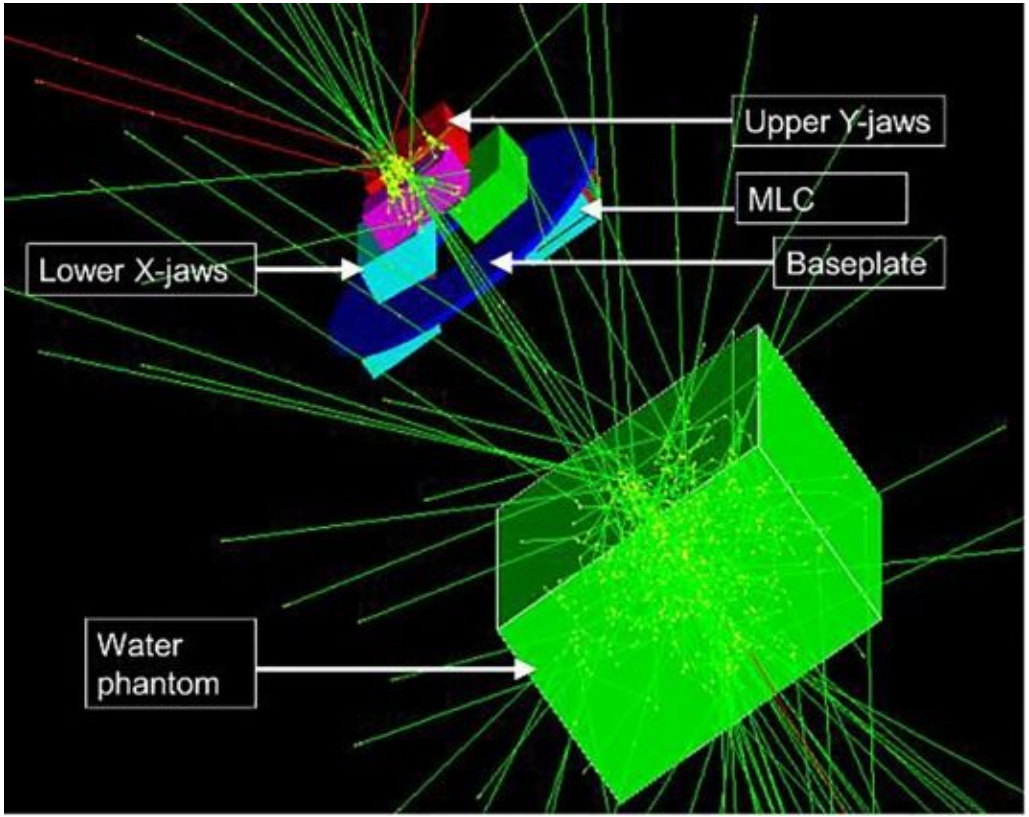
The role of geometry modelling in MC simulation.

Methods based on MC, due to their specification, can even take complex geometric structures.



The MC code provides a set of random numbers used to determine both the track of the particle and the distance it will travel by comparing the physics models used for a given geometrical regions.



How to configure simulation parameters.

Beam modulation: DICOM-RT & DICOM-CT

In DICOM libraries we can find all necessary data about the patient, his physical structure (DICOM-CT & DICOM-RT-Structure) that we can use to build a patient model.

From the DICOM-RT-plan file we can extract such information as:
- Number of beams
- Number of control points
- MLC positioning
- Angle
- Dose

Available tools for read DICOM files:

geant4::dicomReader:

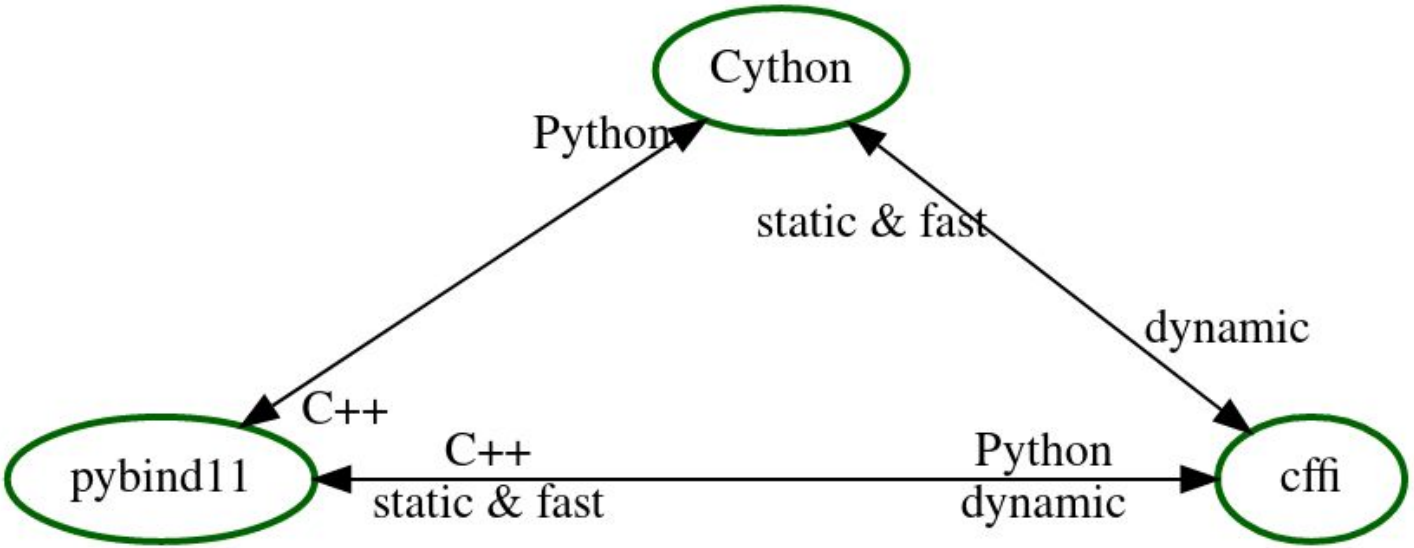
The old Geant4 based app were based on the so called dicomReader (and DCMTK) library. It is a very powerful but heavy construction which is also not the most comfortable to use.

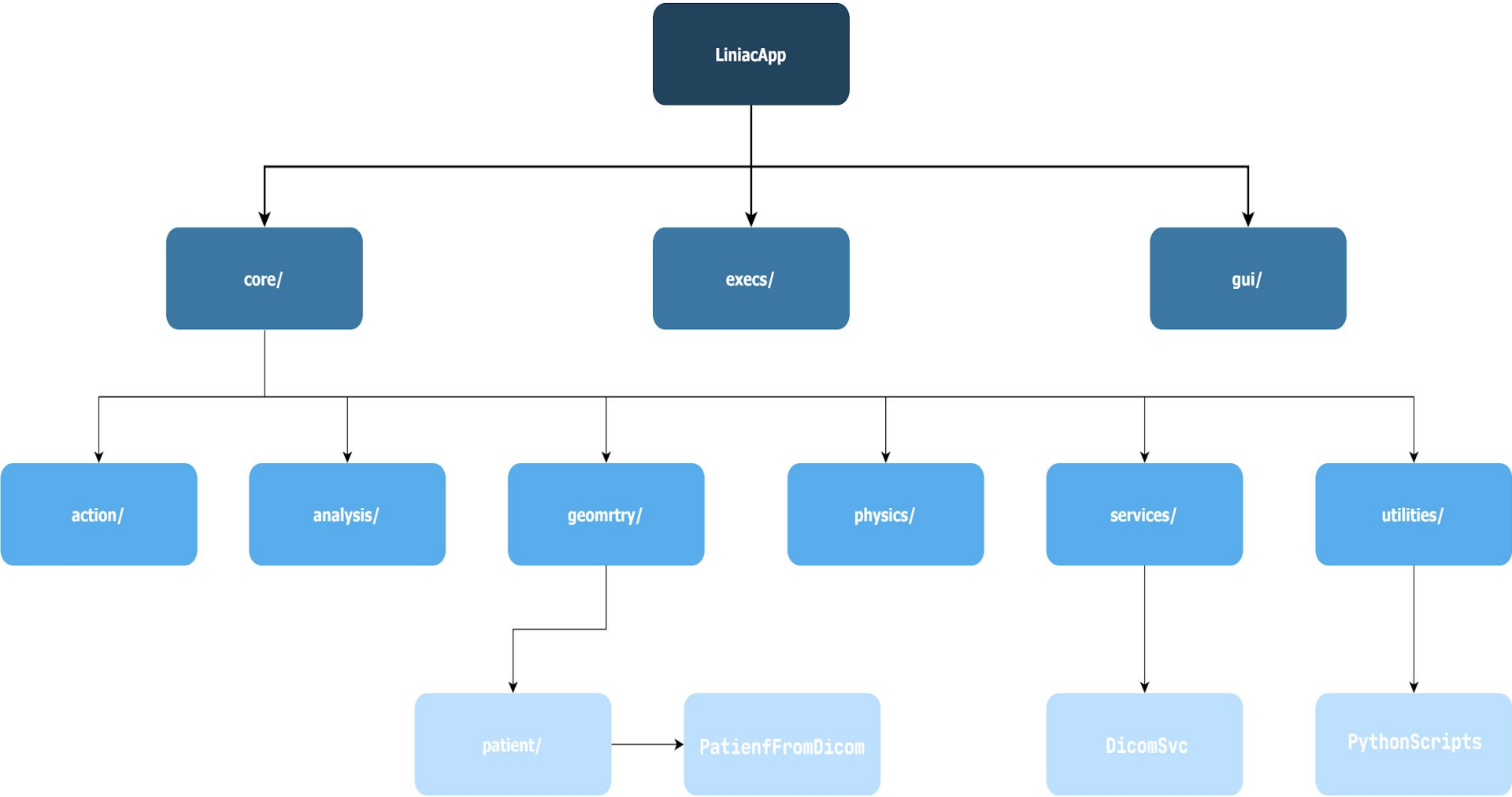
Pydicom:

Our proposal is to utilize well developed python coded pydicom module to I/O operation on DICOM files. Despite the fact that it was written in the slow language (python), the convenience and efficiency with which this library performs its tasks encouraged us to use it.

The strategy of binding C++ with python.

We decided to use the pybind11 library to link the two languages together. Pybind11 allows us to embed a Python interpreter in a C++ program.




LiniacApp
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physics/
services/
utilities/
patient/
PatienfFromDicom
DicomSvc
PythonScripts

Status of the work

So far it has been implemented:

- Creating several Jupyter Notebooks, containing python code to read and extract selected information from DICOM files.
- Geant4-linac-app itself has added features imported from Jupyter Notebook. Which functionality has been extended.
- DicomSvc has been initialized.
- In the Geant4-linac-app was added the possibility to collect and store geometric data from DICOM files.