



Development of a DynamicPET simulator for diagnosis and treatment of cancer

Project Management and Software Development for Medical Applications

General Info

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Project Abstract

The analysis of Dynamic PET volumes is a valuable tool in oncology. However, acquiring Dynamic PET is expensive and time consuming. Luckily, the research in the field can advance also using simulation. Current Dynamic PET simulators are written in MATLAB, which is suboptimal in the research community. The goal of the project is to generate Python code for the simulation of Dynamic PET volumes based on an existing MATLAB repository.

Background and Motivation

Positron Emission Tomography (PET) is a Nuclear Medicine imaging modality in which a radioactive tracer is injected in the patient. Conventional (static) PET volumes are acquired over 30 minutes and show the accumulation of the tracer in the body. Instead, in Dynamic PET many volumes are acquired sequentially as frames of variable duration (3D+t) [1]. This type of acquisition allows us to visualize the kinetic of the tracer in the body, starting from the injection to the accumulation in pathological and physiological regions.

The analysis of Dynamic PET volumes can provide useful metrics in the diagnosis and treatment of many cancers. However, short-frame Dynamic PET volumes can be acquired only with novel long-axial field-of-view PET scanners, which are expensive and not wide spread. While this type of hardware becomes available to larger populations, simulated Dynamic PET can be used to develop algorithms and methods. The BC Cancer Research Center, our partner institution in Vancouver developed a MATLAB code able to simulate Dynamic PET volumes of phantoms which includes the

pharmacokinetic of the tracer [2], as well as the physics of the interaction of the radiation with the human tissues and the measurement noise. Having a Python version of this Dynamic PET simulator would be beneficial, as it would enhance the compatibility with existing code base [3]

Student's Tasks Description

The student will translate an existing repository from MATLAB code to Python. While ensuring that the Python code has the same functionalities and results of the MATLAB code, the student is expected to improve the readability and the generalizability of the code by using the fundamentals of object-oriented programming (classes, functions, global variables). The use of existing libraries (such as PyTomography [4]) is encouraged.

Technical Prerequisites

The project requires a sound practical knowledge of MATLAB and Python. Previous theoretical knowledge of Nuclear Medicine imaging and pharmacokinetic modeling is beneficial.

References

- [1] Sari H et al. "First results on kinetic modelling and parametric imaging of dynamic 18F-FDG datasets from a long axial FOV PET scanner in oncological patients."
<https://doi.org/10.1007/s00259-021-05623-6>
- [2] Watabe H "Compartmental modeling in PET kinetics. Basic Science of PET Imaging"
https://doi.org/10.1007/978-3-319-40070-9_14
- [3] De Benetti F et al. "Self-supervised Learning for Physiologically-Based Pharmacokinetic Modeling in Dynamic PET."
https://doi.org/10.1007/978-3-031-43907-0_28
- [4] <https://github.com/curit/PyTomography>