Gating failure detector for myocardial perfusion imaging
Project Management and Software Development for Medical Applications

General Info
Institution: Nuklearmedizinische Klinik und Poliklinik, Klinikum rechts der Isar der TUM
Contact Person: PD Dr. Stephan Nekolla, MSc. Alberto Villagran
Contact Email: stephan.nekolla@tum.de, alberto.villagran@tum.de

Project Abstract
In favor of a constant improvement of the clinical routine in the department of nuclear medicine, a solution for ECG gating failure detection of myocardial perfusion imaging is essential to assure an accurate medical assessment based on cardiac imaging.

Background and Motivation
Myocardial perfusion imaging SPECT (MPI) is widely used in the diagnosis and prognosis of ischemic disease. Through this imaging modality it is possible to detect and evaluate the regions of the left ventricle (LV) which might suffer from a deficient blood supply and also assess the impact of this condition on the contractile function of the LV [1, 2]. There, the left ventricular volumes, the ejection fraction, and the wall motion abnormalities are evaluated using ECG-gated MPI, a method that allows the prospective synchronization of the data acquired from the myocardium with the electrocardiogram signal of the patient [3].

In order to perform the correct clinical assessment, quality control (QC) of the gating process is crucial. Currently, since gating QC is only based on visual inspection of the beat histogram (Fig. 1) and therefore shows potentially a high inter-observer dependency, gating failures are been prone to happen, especially in patients with abnormal ECG (quite often in these patients) and pacemakers. Consequently, extra effort is needed to control and reduce gating failures during ECG-gated MPI [4].

Student’s Tasks Description
- Basic understanding of acquisition and processing steps in MPI SPECT, and clinical needs in diagnosis and prognosis ischemic disease.
- Understanding of medical data handling in a hospital.
- Development of a solution for automatic detection of gating failures in MPI for large datasets with the following requirements:
  - Data extraction from images (fig1).
  - Automatic assessment of gating processing (fig2).
  - Testing in retrospective data (> 100 cases) and potentially application in a MPI SPECT clinical workflow.

Technical Prerequisites
- Knowledge of image processing.
- Good programming language skills in Python/Java.

References


Figure 1. Image example of a gating quality control in myocardial perfusion imaging

Please send the completed proposal to ardit.ramadani@tum.de, zl.jiang@tum.de, jennart.bastian@tum.de and tianyu.song@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.
Please send the completed proposal to ardit.ramadani@tum.de, zl.jiang@tum.de, jennart.bastian@tum.de and tianyu.song@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.

Figure 2. typical beat histogram issues in myocardial perfusion imaging

Incorrect acceptance window (red lines)

Correct acceptance window

abnormal beat histogram: Arrhythmia

abnormal beat histogram: ECG misdetection