ESTRO MOBILITY GRANT (TTG) REPORT

Title of the report: Quantitative imaging in Magnetic Resonance imaging

HOST INSTITUTE:
Princess Margaret Cancer Centre (PMCC), Toronto ON, Canada

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Aim of the visit: medical imaging can play a crucial role in the development of personalized medicine in radiation oncology. In fact, patients' scans embed much information ('features') than can be exploited only by visual inspections. This information can be used to develop Artificial Intelligence (AI)-based clinical models aiming at predicting patients' response to the delivered treatment. Therefore, the best treatment for each patient and oncological disease can be exploited. The automated extraction of quantitative features from medical images has been referred as 'radiomics'. Radiomics has been apply deeply in Computed Tomography (CT) for lung and head and neck cancers. Conversely, there are only few applications of radiomics in Magnetic Resonance (MR) and Diffusion Weighted (DW) imaging for cervix, rectal and breast cancers, where MR is the leading diagnostic modality. The goal of the visit was to setup a collaboration for research projects related to radiomics applied to cervix, and rectal cancers.

PMCC represents a desired partner, since it complements the core competencies of MAASTRO due to strong emphasis on imaging physics, combined with imaging processing research, especially for MR.

Details of the scientific content of the visit: identified goals: a) engagement of clinicians in the project; b) release of needed infrastructure / software for automated features extraction, c) curation of datasets, and d) definition of scientific / clinical outcomes to be investigated.

a) Following several meeting with clinicians, two different lines of research have been set-up: radiomics in rectal cancers and radiomics in cervix cancers. Both the lines have one or two PI (Principal Investigators) who are experienced (> 5 years) radiation oncologists, combined with a team of medical physicists, scientific programmers and biostatisticians.
b) The infrastructure needed to perform the studies has been delivered from MAASTRO to PMCC. This includes an open source software for the automated extraction of radiomics features from patients scans, and several tools to transform clinical data and computed features as FAIR (Findable Accessible Interoperable Reusable) compliant data to allow a second phase of the projects based on distributed learning. PMCC has shared its expertise and tools for advanced statistical analysis for clinical prediction modelling and MR / DW images analysis based on AI.
c) Two different datasets, one for rectal cancers patients and one for cervix cancer patients have been curated and collected. Those datasets include acquired scans, but also clinical variables such as for example overall survival. Additional curation of the data will be performed on both sites for the next phases of the project.
d) An agreement on the desired academic deliverables has been achieved between the two institutions. The first part of the projects will be dedicated to investigate the robustness of extracted radiomics features with respect to different acquisition settings, inter-observer variability in tumour delineations and pre-processing steps (e.g. images filtering) applied before features' computation. Then, the predictive value of robust features will be investigated. This approach will lead to at least two publications, one more technical, focused on features reproducibility and one more clinical-based on optimal features selection methods for clinical modelling.

Results from the study undertaken: preliminary results on a smaller dataset from PMCC regarding features stability have been obtained. The results integrated a previous work developed within MAASTRO that will be presented, together with some representative from PMCC, at the European Conference of Medical Physics, Copenhagen (22-26 August 2018).