Good methodological practices in radiomics: FAIR-inspired strategies for managing and preserving costly information

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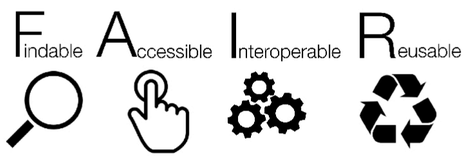
Introduction

- Radiomic activities require **costly information** such as regions of interest drawn by experts (e.g. radiation oncologists) and textural, morphological and statistical signatures obtained from intensive numerical calculations
- The purpose of this work is to develop workflows that **capture** and **preserve** costly information in radiomics and to establish good methodological practices regarding data management

FAIR Principles

The **FAIR** principles [1] are guidelines for data and information systems in the context of good data management practices.



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Data are **Findable**

- Data are described with meta-data and have a unique identifier

Data are **Accessible**

- Retrievable by machines using known and open protocols
- If data are not accessible, meta-data are

Data are **Interoperable**

- Meta-data use a formal, accessible language for knowledge representation
- Meta-data vocabulary is known

Data are **Reusable**

- Meta-data describe the data and the data have a licence

Methods

- We have designed and implemented workflows aligned with the **FAIR** principles to manage radiomic data
- These workflows use recognized standards, permanent identifiers, and terminologies used by the medical imaging community
  - More specifically, our workflows rely on the **DICOM standard** to store not only image-related information but also the context of their capture/generation (who, when, how)
- All the data are pooled in an open-source DICOM server that is queried by radiomic pipelines

Segmentation workflow

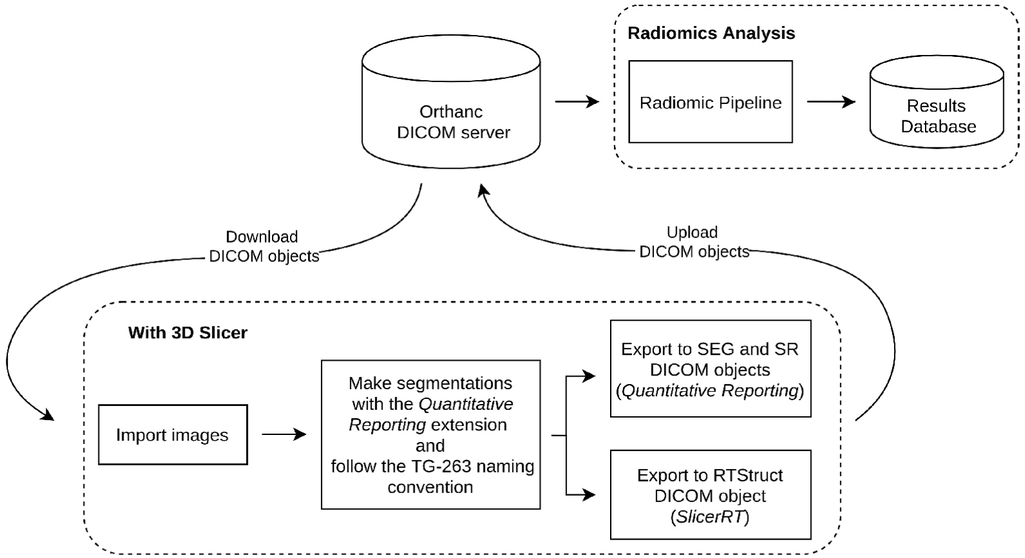

Figure 1 - Workflow for creating and managing Segmentation, Structured Report, and RTStruct DICOM objects with the 3D Slicer [2] and Orthanc [3] open-source software

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Results

- FAIR-inspired workflows were implemented with two open-source software: **3DSlicer** [2] to create DICOM objects and the **Orthanc** DICOM server [3] to manage these objects
- The **Quantitative Reporting** extension [4] of 3DSlicer was used to generate DICOM segmentation objects
- The SlicerRT extension [5] was used to transform segmentations into RT-Struct DICOM objects, using the **AAPM TG-263 naming convention**
- Clinical information pertaining to images was also embedded as DICOM Structured Reports and **linked** to images through unique identifiers
- DICOM objects were stored in an Orthanc server instance
- Radiomic pipelines then interact with Orthanc through its REST API to access images and related information

Conclusion

- The developed workflows, relying on the **DICOM standard**, ensure the quality and reproducibility of radiomics research
- This data management strategy allows us to efficiently store, understand, and reference data and meta-data, and to ensure **reproducible** research activities
- Good practices described in this work allow the creation of well documented, interoperable data sets that can be machine-harvested for large scale radiomics endeavors

References

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