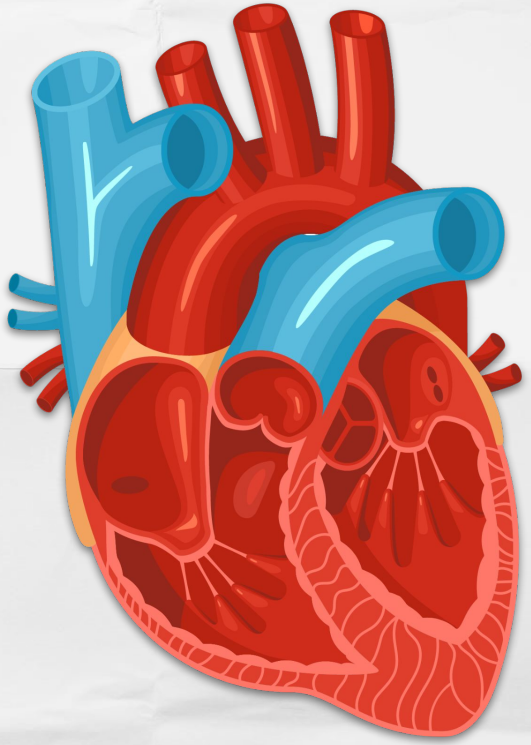
Universitat Pompeu Fabra Barcelona

SANT PAU Campus Salut Barcelona

Hospital de la Santa Creu i Sant Pau

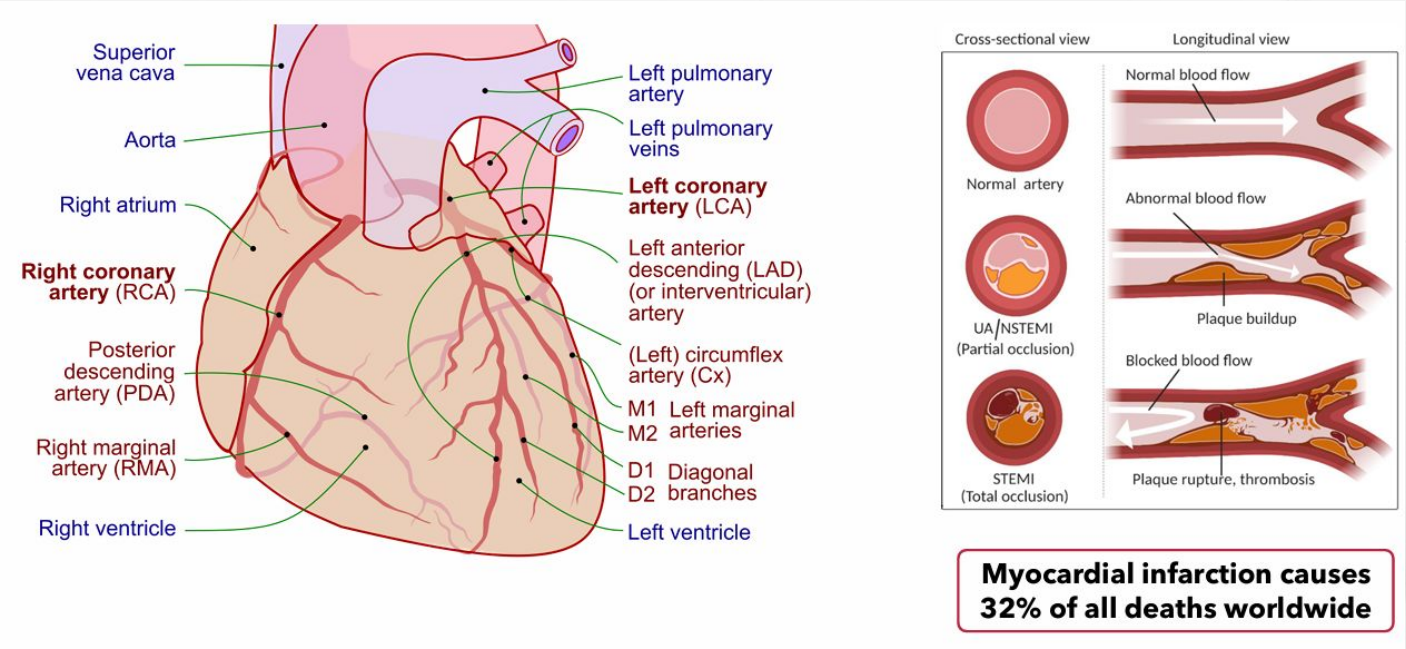
Automated Geometric Stenosis Quantification and CAD-RADS Support for Coronary Artery Disease Assessment and Patient Prioritization



Adrià Cortés Cugat
Mathematical Engineering in Data Science

PhySense Update 2

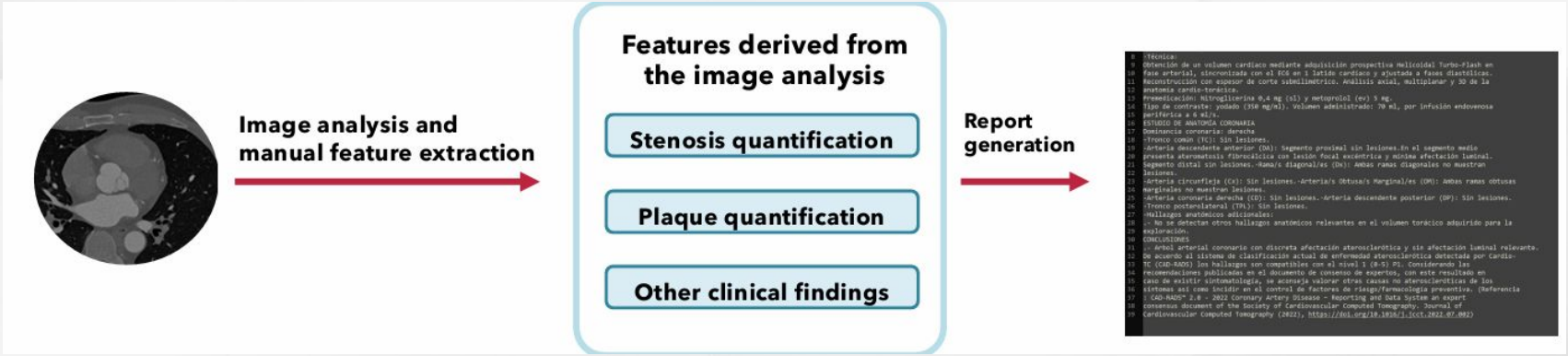
TFG Contextual Information



Acebes, C. (2023). *An Artificial Intelligence Framework for the Prioritization and Reporting of Coronary Artery Disease Patients in a Radiology Department.* Universitat Pompeu Fabra.

Workflow at Hospital de la Santa Creu i Sant Pau

This are the steps that clinicians follow to do a visual image analysis and diagnosis for coronary artery disease assessment. There are much more steps between these phases.



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Problems at Hospital de la Santa Creu i Sant Pau

1. **Elevated Reporting Times**
   - **30 minutes** for non pathological cases.
   - **1-2 hours** for more complex cases.
2. **Fragmentation of the Workflow**
3. **Lack of Automatization**
4. **No Patient Prioritization**

The hospital requires a shift from manual, time-consuming assessment to an automated AI pipeline that handles:

IMAGE ANALYSIS → QUANTIFICATION → REPORTING → PRIORITIZATION

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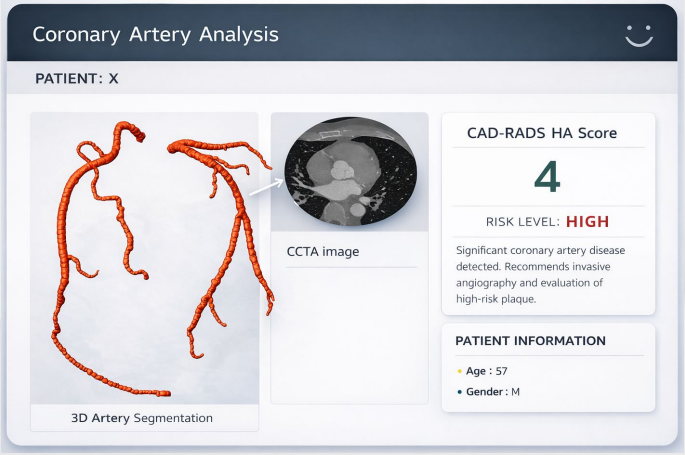
Project Goals & Scope

Main Mission

Make a bridge between **raw geometric data** and **clinical decision-making** by developing an automated support pipeline for quantification, patient prioritization and CAD diagnosis. (Acebes, 2023 [1])

Coronary Artery Segmentation → Visualization Tool



Specific Objectives

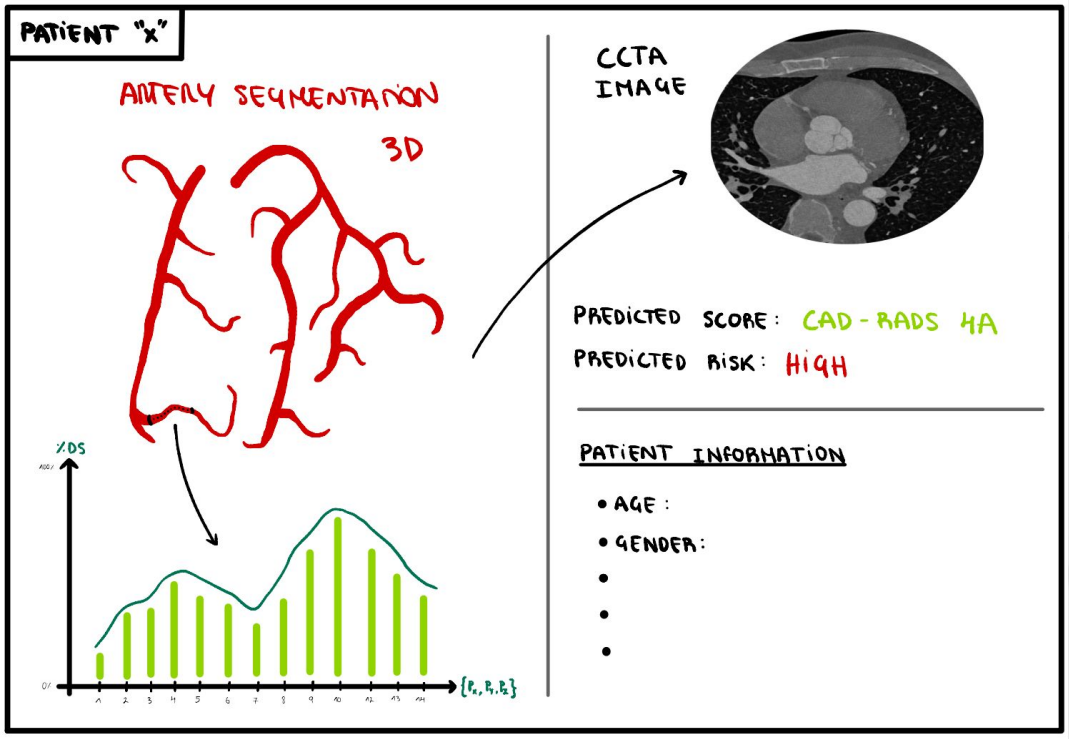
- ## Raw Geometric Data Extraction
  Extract vessel centerlines and topological graphs from the ASOCA binary segmentations in order to obtain the needed input data for the quantification step.

- ## Stenosis Quantification Pipeline
  Develop an automated algorithm to transform raw vessel geometry into clinical metrics (e.g., %DS).

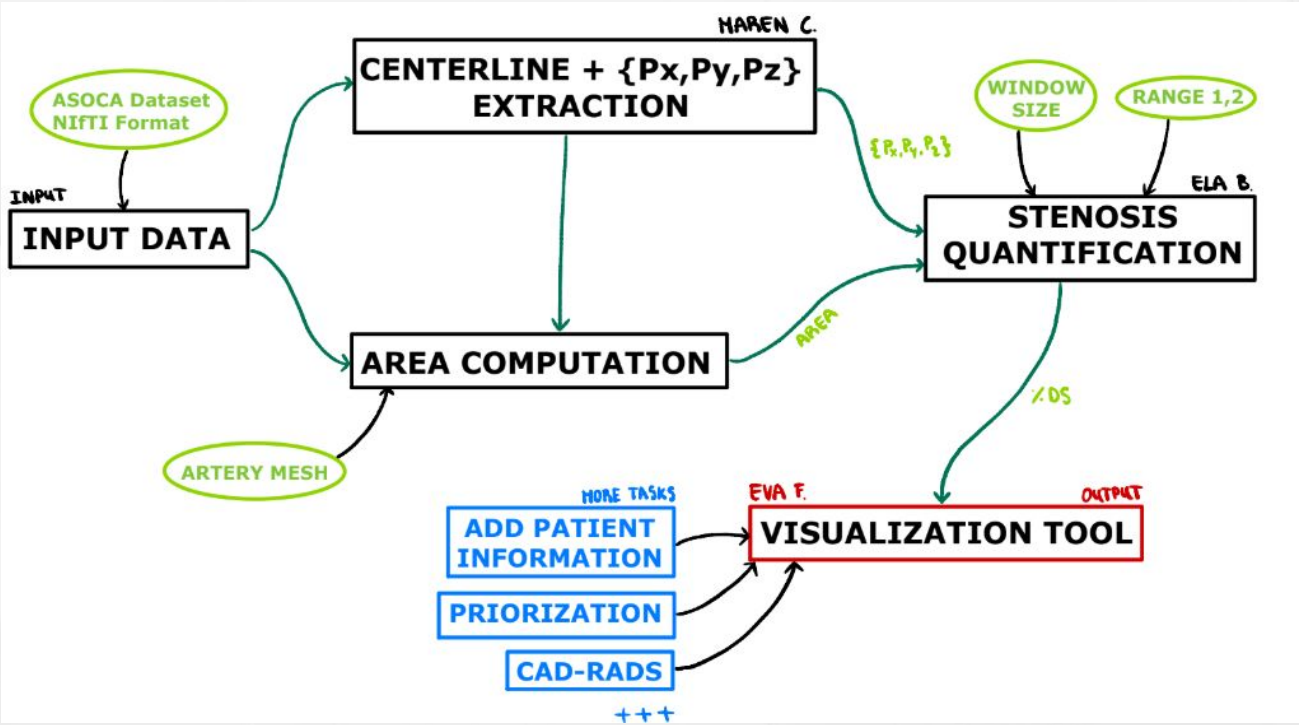
- ## Patient Risk Prediction
  Compute **CAD-RADS** score predictions based on quantitative findings to assign patient priority levels.

- ## Integrated Visualization Tool
  Create a reliable visual decision-support tool that aggregates stenosis metrics, priority scores and other possible patient information to facilitate fast assessment to clinicians.

Final Ideal Output: Visualization



Proposed Workflow



Data

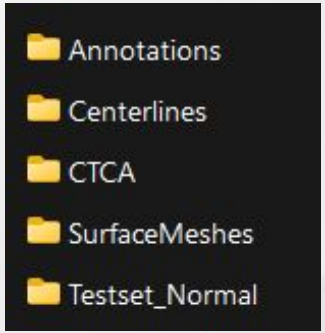
ASOCA Dataset

It is one of the most commonly used resources for coronary artery segmentation. It is composed of only 40 cases:

- 20 healthy → "Normal"
- 20 with CAD → "Diseased"

Which type of information does the dataset has?

- Annotations: *Normal_1.nrrd*
- Centerlines: *Normal_1.vtp*
- CTCA: *Normal_1.nrrd*
- SurfaceMeshes: *Normal_1.stl*
- Testset_Normal: *0.nrrd*



Further Tasks To Investigate

- Synthetic data generation to validate the entire pipeline.
- Explore which feature should be added to the visualization tool.
- Explore different ML methods for stenosis quantification.
- Quantify other CAD metrics beyond stenosis, e.g., plaque detection.
- Link the obtained data with the Eva's prioritization system.

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