Dr José Alonso Solís Lemus

Open-Source Software for Surgical Technologies

26th, June 2023

CemrgApp: A Sustainable and Accessible Platform for Cardiovascular Research

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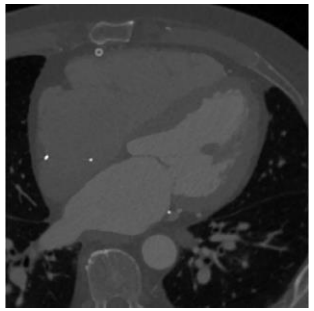
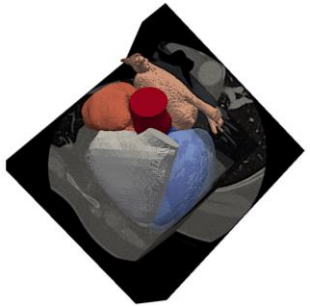
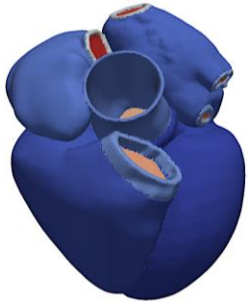
More or less what we do at CEMRG

Patient-specific cardiac anatomical models

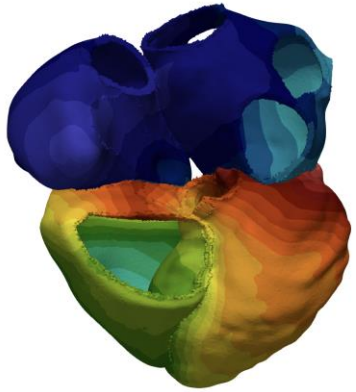
Imaging (MRI, CT, ...) → Segmentation → Meshing → Fibre orientations



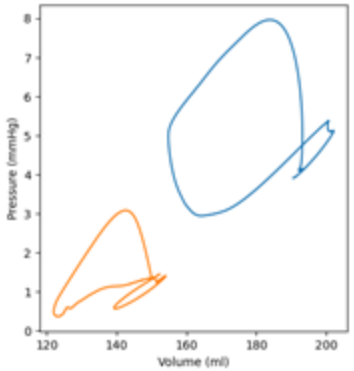




Excitation

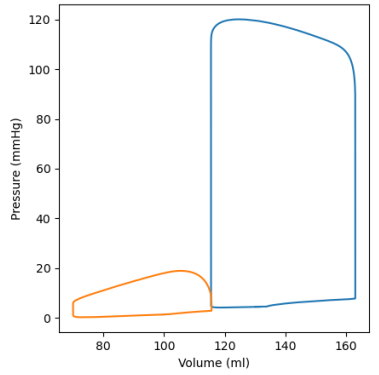


Atrial dynamics

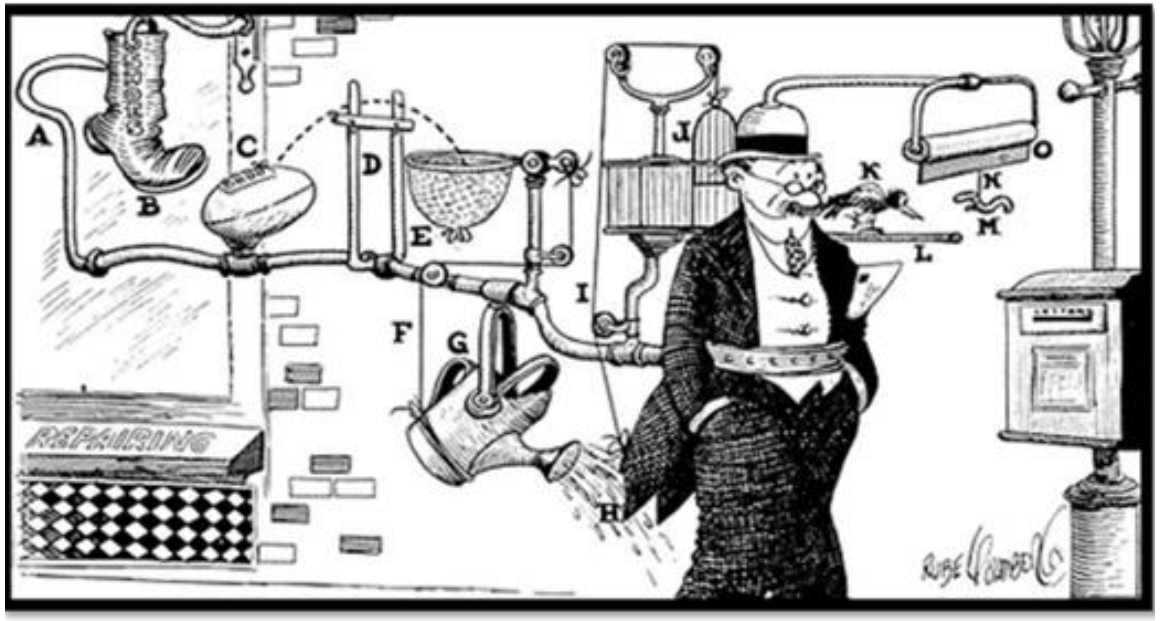


Whole heart motion

Ventricular dynamics



Why CemrgApp?

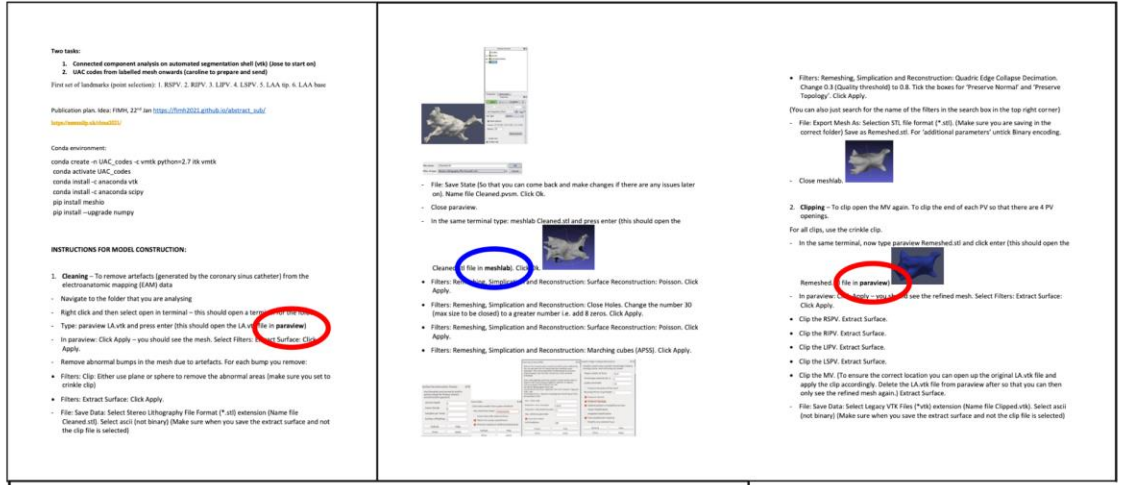


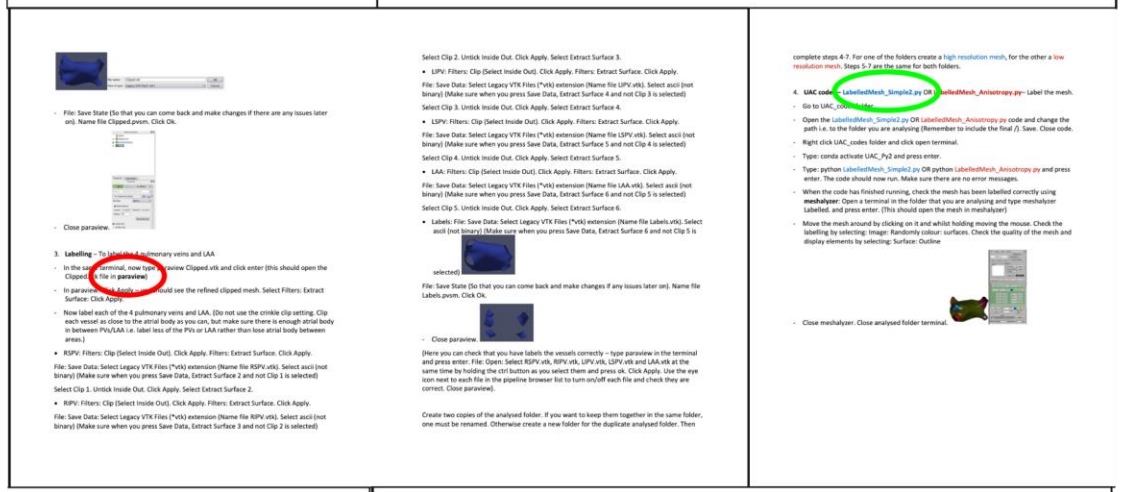
Paraview

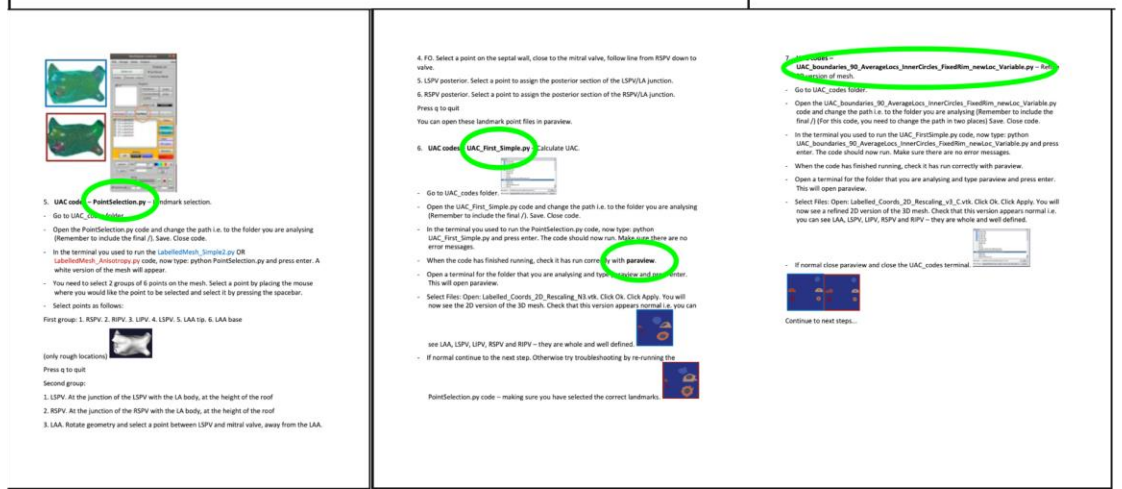
Matlab

Python

CemrgApp







What is CemrgApp?

CemrgApp enables cardiovascular clinical researchers to perform advanced image analysis with limited training

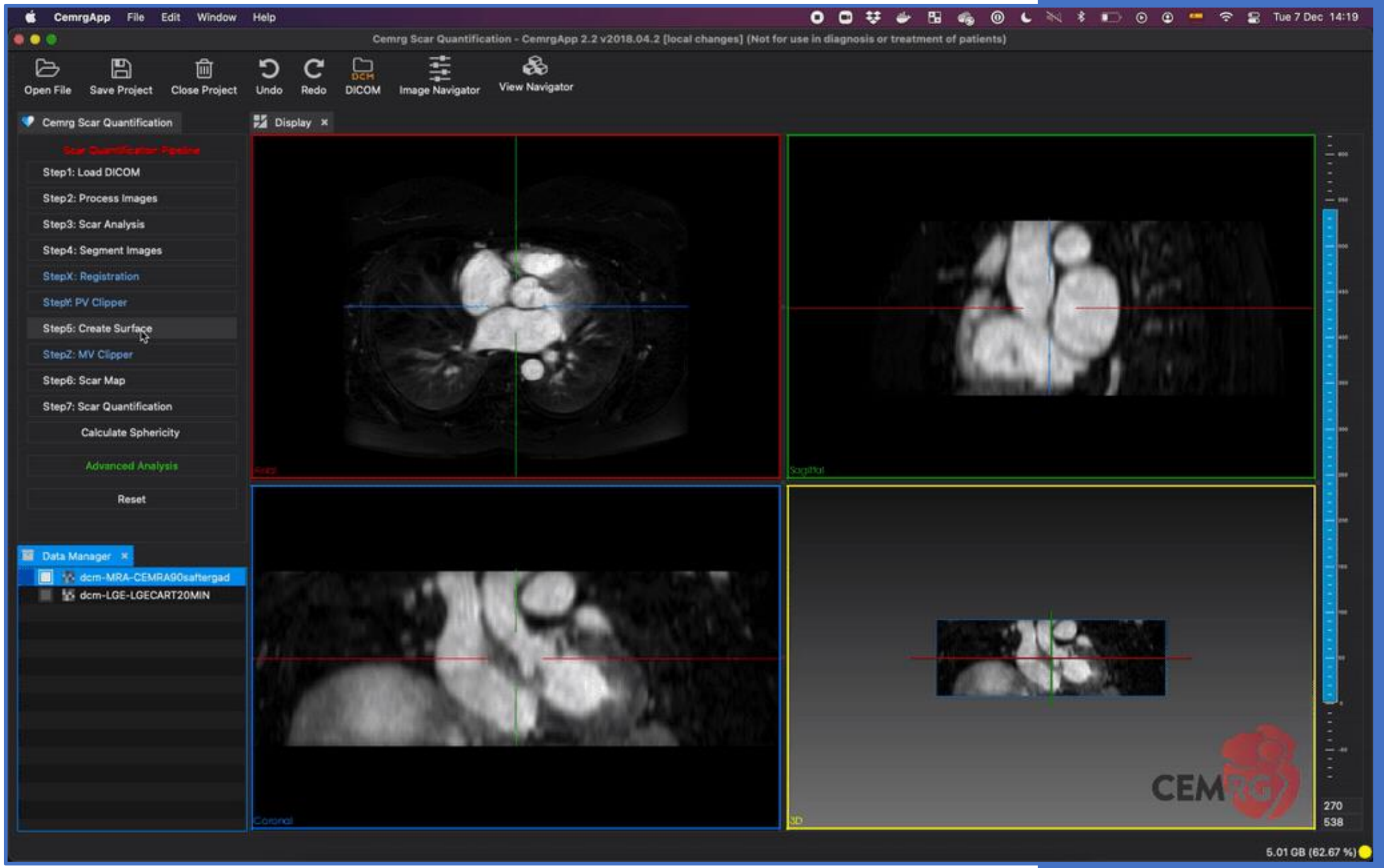
Built on top of MITK (C++)

Custom image processing and computer vision toolkits

Performs: statistical, machine learning, and simulation approaches

Allows the study of physiology, pathology, inform diagnosis and treatment

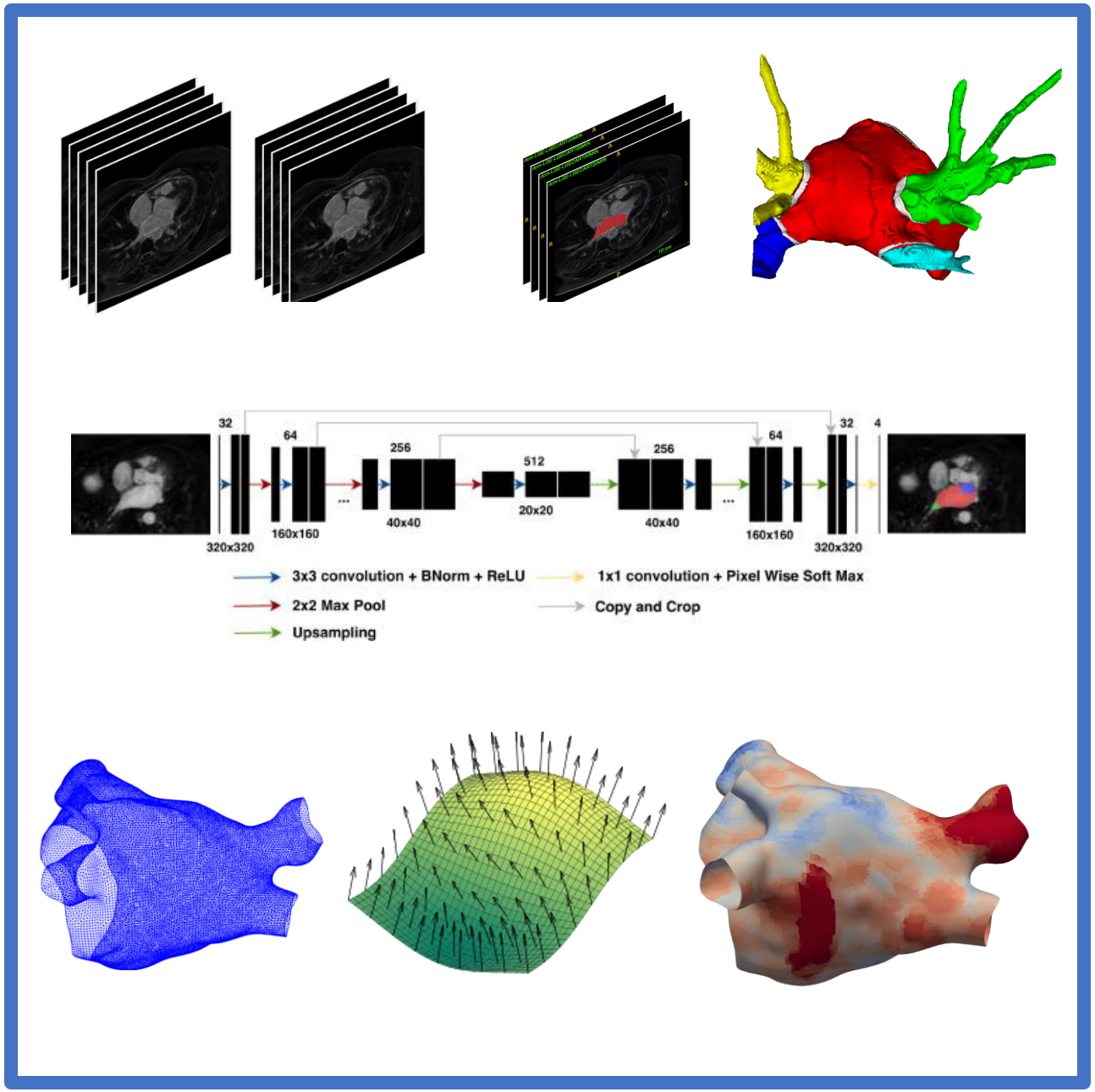
Disclaimer: CemrgApp is a research tool, not a clinical tool and should not be used in diagnosis or treatment for patients


CemrgApp File Edit Window Help
Tue 7 Dec 14:19
Cemrg Scar Quantification - CemrgApp 2.2 v2018.04.2 [local changes] (Not for use in diagnosis or treatment of patients)
Open File
Save Project
Close Project
Undo
Redo
DICOM
Image Navigator
View Navigator
Cemrg Scar Quantification
Step1: Load DICOM
Step2: Process Images
Step3: Scar Analysis
Step4: Segment Images
StepX: Registration
StepY: PV Clipper
Step5: Create Surface
StepZ: MV Clipper
Step6: Scar Map
Step7: Scar Quantification
Calculate Sphericity
Advanced Analysis
Reset
Data Manager
dcm-MRA-CEMRA90saftergad
dcm-LGE-LGECART20MIN
Display
Sagittal
Coronal
3D
CEMRG
270
538
5.01 GB (62.67 %)

Key Features

- Image processing
  - Registration
  - Segmentation
  - Machine Learning tools
- Mesh manipulation
- In-house algorithms
- Collaborations from other groups

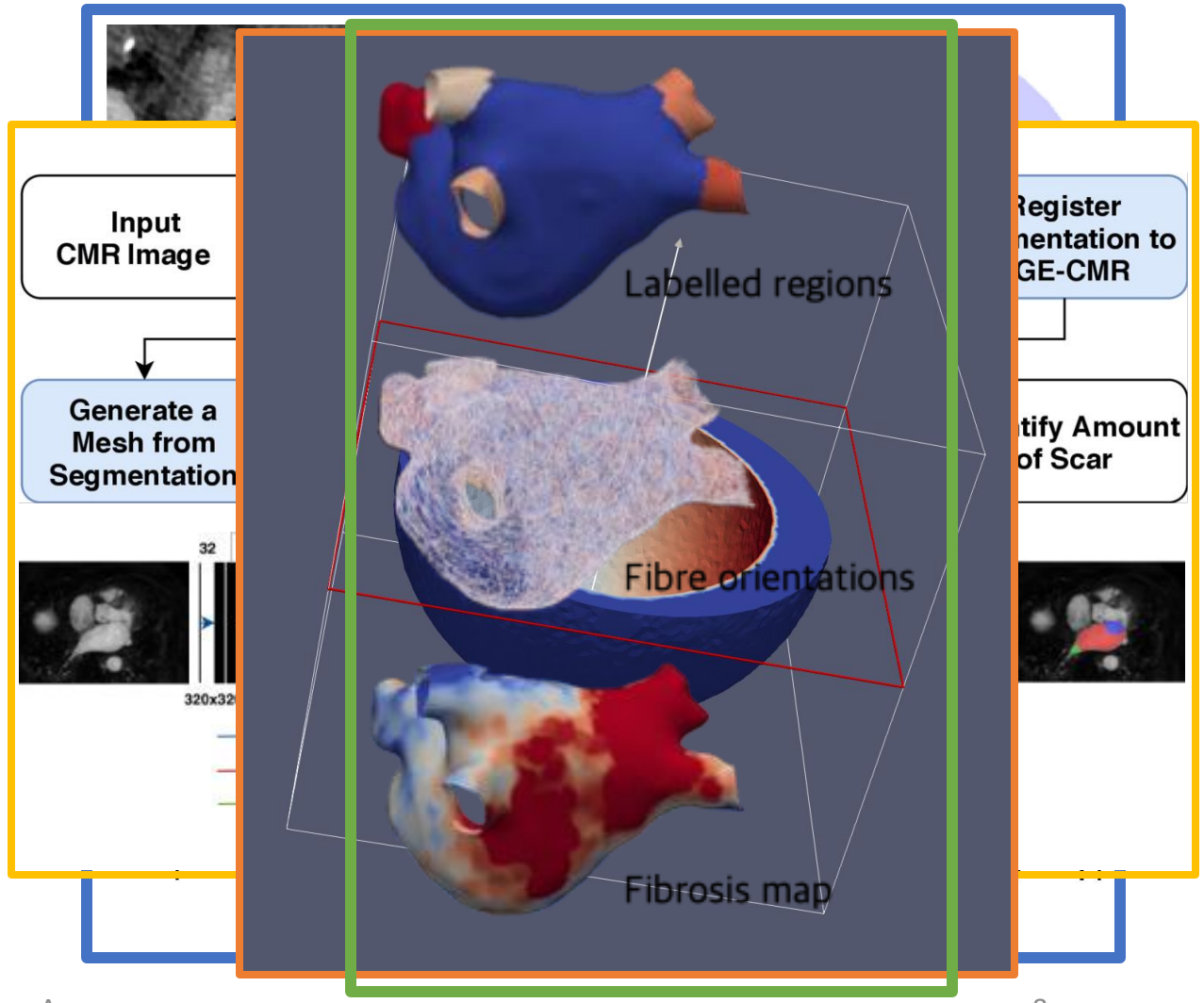
These can be combined into plugins, to address a specific task



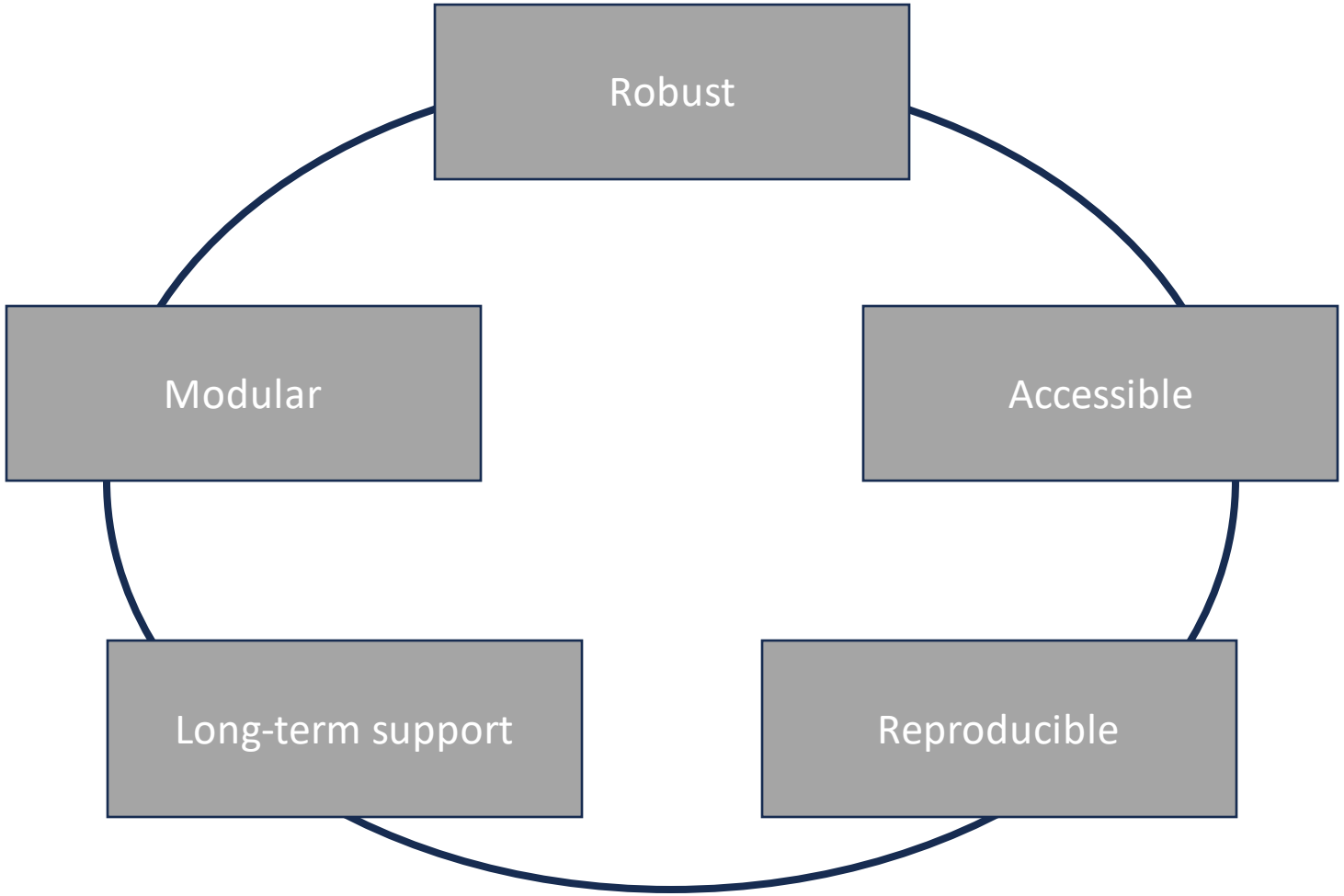
Applications of CemrgApp

Five main workflows (plugins):

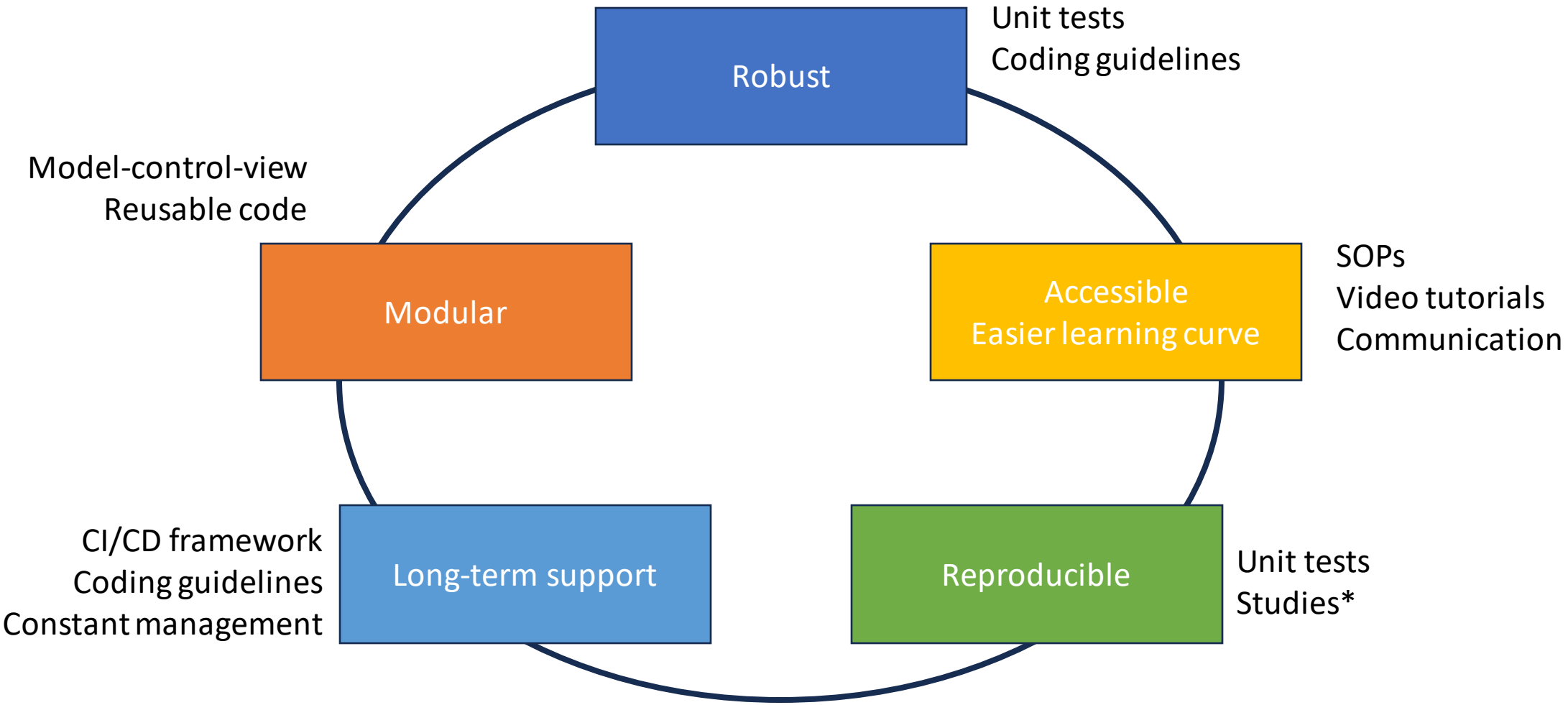
- Motion Quantification
- Anatomical Measurements
- Morphological Measurements
- Scar Quantification
- Atrial Toolkit



Sustainable Development



Sustainable Development



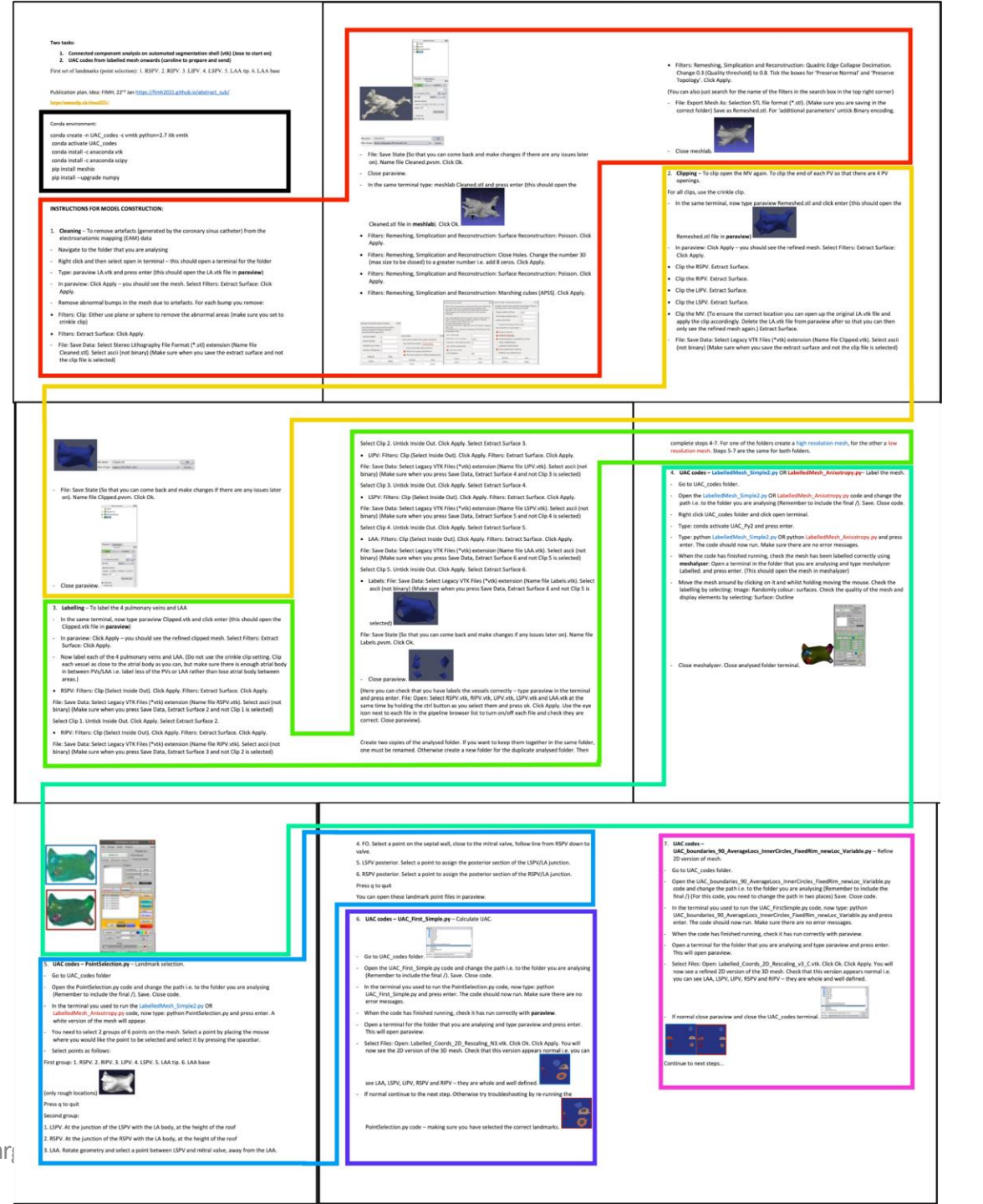
Reproducibility Study

Objective

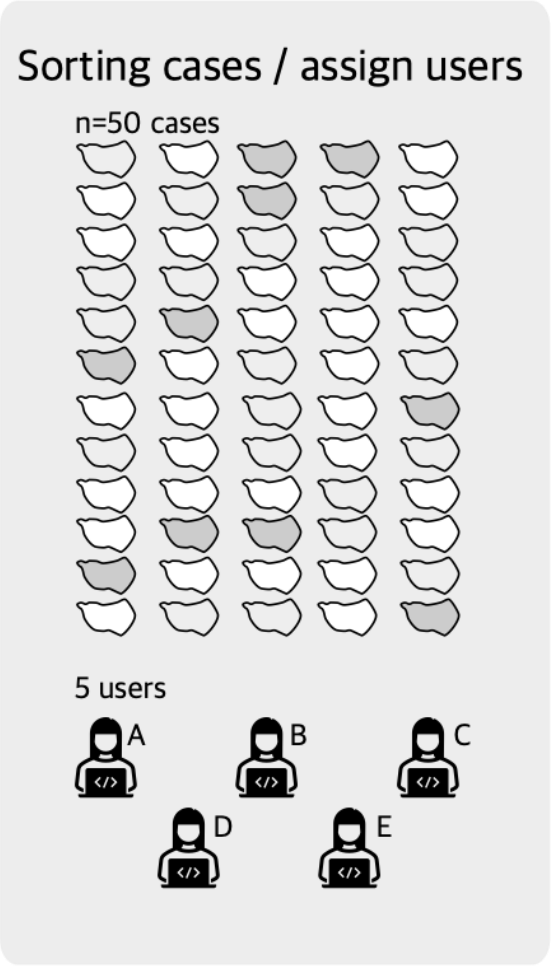
Create a model suitable for electrophysiological simulations from a patient MRI scan

A complicated pipeline…

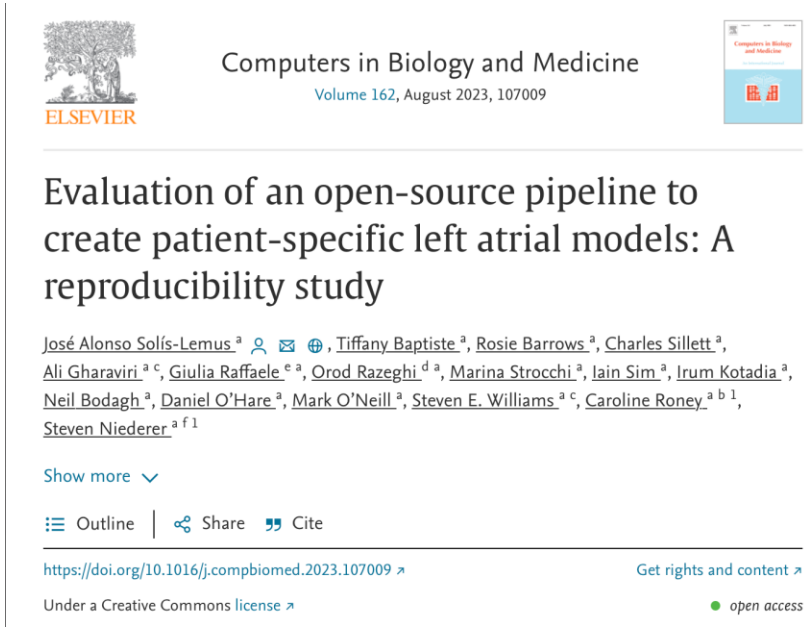
- Lengthy: 4.5h to complete a single case
- Manual and involved process
- Susceptible to user error
- Not reproducible
- Not scalable



Reproducibility Study: Left Atrial EP Models



Reproducibility Study: Left Atrial EP Models



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Computers in Biology and Medicine

Volume 162, August 2023, 107009

Evaluation of an open-source pipeline to create patient-specific left atrial models: A reproducibility study

José Alonso Solís-Lemus [a], Tiffany Baptiste [a], Rosie Barrows [a], Charles Sillett [a], Ali Gharaviri [a c], Giulia Raffaele [e a], Orod Razeghi [d a], Marina Strocchi [a], Iain Sim [a], Irum Kotadia [a], Neil Bodagh [a], Daniel O'Hare [a], Mark O'Neill [a], Steven E. Williams [a c], Caroline Roney [a b 1], Steven Niederer [a f 1]

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https://doi.org/10.1016/j.compbiomed.2023.107009

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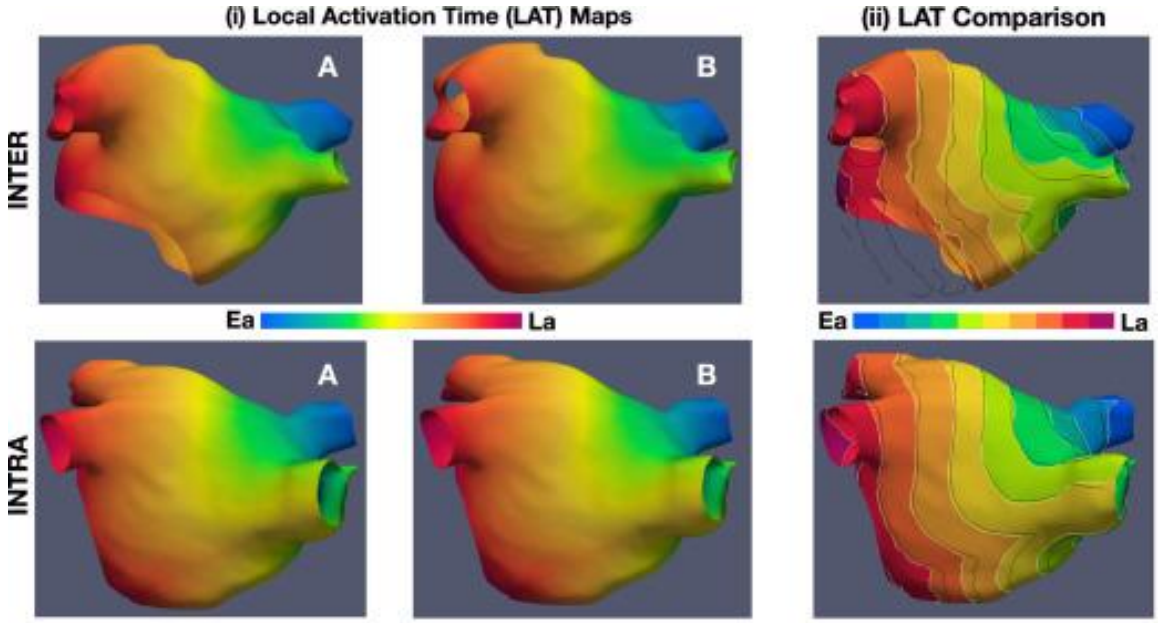
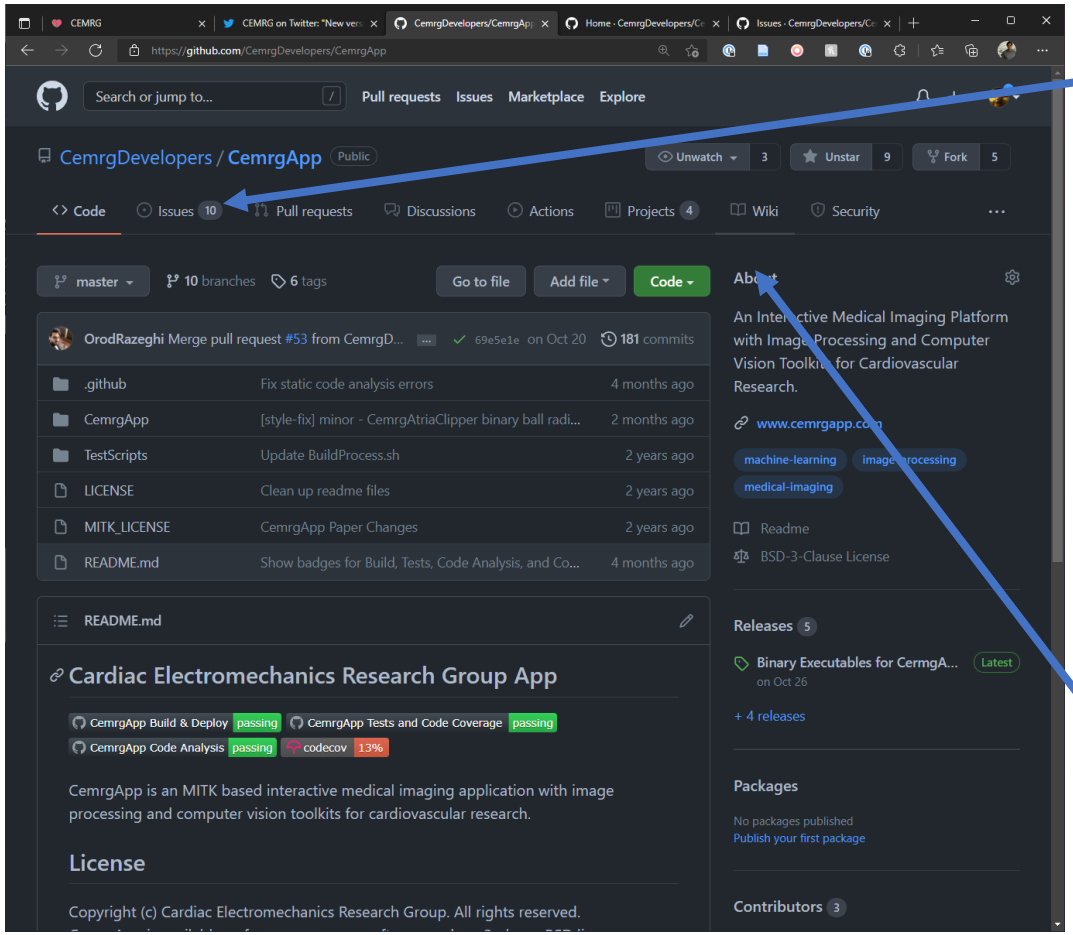


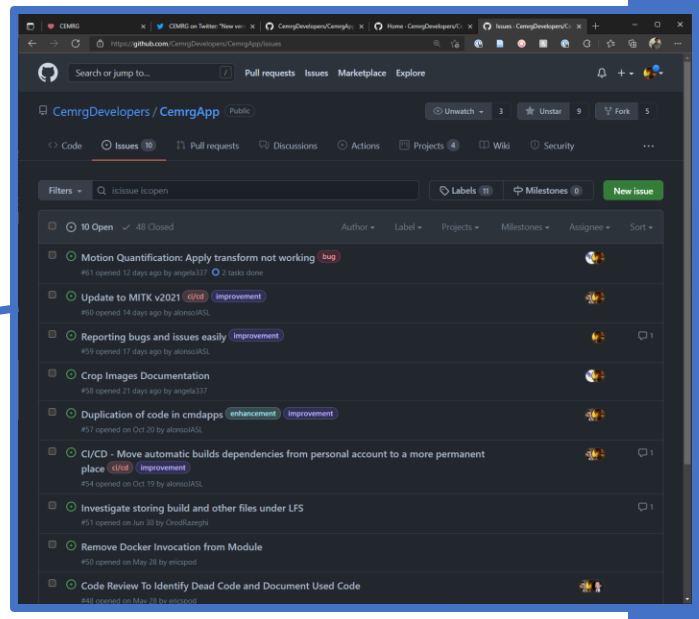
- Model building time **reduced** to just **16.7 min**.
- **Impact** of operator variability is **similar** to that of image resolution or fibre field

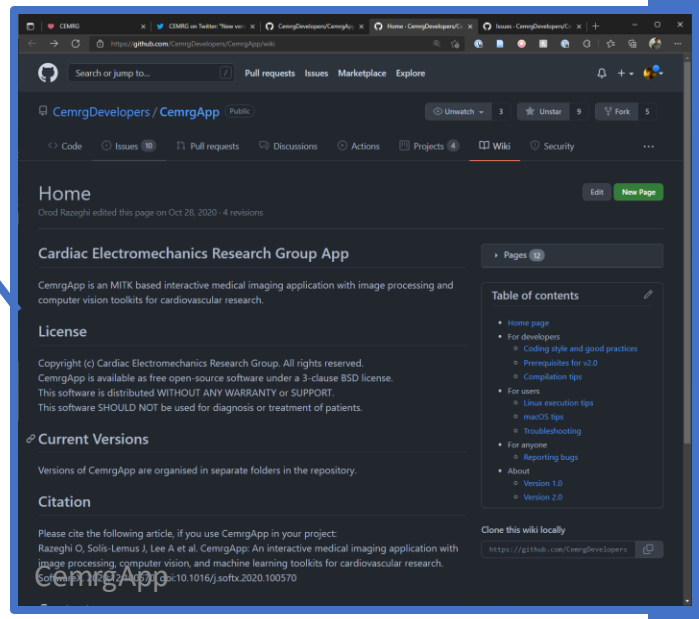
Reproducibility Study: Practical Implications

- To **support** upcoming frameworks for generating patient-specific atrial models (and beyond)
- The **first** simulation-study **reproducibility template**
- CemrgApp is fully open-source, runs on standard laptops, and follows standardised methodologies

Get Involved!







@CEMRG_

cemrg.com

cemrgapp.com

github/OpenHeartDevelopers

Take home message

We believe CemrgApp has the potential for:

- the **development** of patient-specific computational heart models,
- facilitating their **adoption into clinical** applications, and
- enable research with **larger cohorts**