# **README file for the project: *'Generating in silico database of multiple virtual patients with diverse cardiovascular disease’.***

**Authors:** ESR1, Claudia Alessandra Manetti 1

**Supervisor:** Professor Joost Lumens 1

**Affiliation:** 1Department of Biomedical Engineering, CARIM School for Cardiovascular Diseases, Maastricht University, The Netherlands

**Funding:** This work was supported by the European Union's Horizon 2020 Research and Innovation program under the Marie Skłodowska-Curie grant agreement No. 860745

**Date:** 15th November 2023

The project contains two .mat files:

1. **Database\_Output\_VirtualPatients.mat**

The following table contains the output of the CircAdapt model for every virtual patient.

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Description** | **Unit of measure** |
| **Patient\_Sim** | Number of the virtual patient. The missing numbers are due to the filtering that has been previosuly performed (such as: EDV > 451 ml, mLAP > 30 mmHg, EF> 86%) | [-] |
| **HR** | Heart rate | [bpm] |
| **AV\_delay** | Atrioventricular delay | [s] |
| **mLAP** | Mean left atrial pressure | [mmHg] |
| **EF** | left ventricular ejection fraction | [%] |
| **EDV** | left ventricular end diastolic volume | [ml] |
| **ESV** | left ventricular end systolic volume | [ml] |
| **SV** | left ventricular stroke volume | [ml] |
| **dPdt max** | maximal rate of rise of left ventricular pressure | [mmHg/s] |
| **Time** | Vector of time | [s] |
| **LV\_pressure** | left ventricular pressure | [ml] |
| **LV\_volume** | left ventricular volume | [ml] |
| **MV\_flow\_vel** | mitral flow velocity | [m/s] |
| **AV\_flow\_vel** | aortic flow velocity | [m/s] |
| **Pulm\_flow\_vel** | pulmonary flow velocity | [m/s] |
| **nMVO** | sample of mitral valve open | [-] |
| **nMVC** | sample of mitral valve closure. Because we used nMVC as zero-strain reference for the calculation of the strain pattern, nMVC is alway equal to 1 | [-] |
| **nAVO** | sample of aortic valve open | [-] |
| **nAVC** | sample of aortic valve closure | [-] |
| **NameSeg\_AHA** | Name of the 18 segments following the AHA representation | [-] |
| **dT\_AHA** | vector representing the time of activation used as input to the model. The order of the vector follows the order of the AHA representation of the LV in which the LVfw is divided in 18 segments and Septum wall by 6 segments | [s] |
| **LongStrain\_AHA** | longitudinal strain with nMVC as 0-strain reference for the 18 segments of the LV (12 segments LVfw and 6 segments septal wall). | [%] |
| **RadStrain\_AHA** | radial strain with nMVC as 0-strain reference for the 18 segments of the LV. | [%] |
| **VfracScar\_AHA** | volume fraction representing the amout of scar (if present) in each of the 18 segments. | [%] |
| **LongStrain\_avg** | average longitunal stran of the 12 segments of LVfw and of the 6 segments of the septal wall. | [%] |
| **LA\_pressure** | left atrial pressure | [mmHg] |
| **LAVmax** | maximum left atrial volume | [ml] |
| **LAVmin** | minimum left atrial volume | [%] |
| **LA\_LongStrain** | longitudinal strain of the left atria | [%] |
| **MVleak** | presence of mitral valve regurgitation | [-] |
| **numTerScar** | presence of myocardial infarction | [-] |
| **CATscar\_AHA** | territory affected by myocardial infarction (0: no scar, 1: LAD 'left descending aorta', 2:RCA'right coronary artery', 3:LCx 'left circumflex artery ') | [-] |
| **SPS** | Systolic pre-stretch reflects the stretch of the left ventricle free wall during isovolumic contraction (between nMVC and nAVO) in the absence of premature shortening. | [%] |
| **SRS** | Septal rebound stretch reflecrs the amount of stretch in the septal wall after the initial contraction during systole | [%] |
| **SSI** | Systolic stretch index which is equal to the sum of SRS and SPS | [%] |
| **LV\_GLS** | Global longitudinal strainis equal to the average peak strain of each of the 18 segments and can be used as an index of left ventricular performance | [%] |
| **LA\_res** | Left atrial reservoir strain | [%] |
| **LA\_boost** | Left atrial booster strain | [%] |
| **LA\_cond** | Left atrial conduit strain | [%] |

1. **Database\_InputModelParameters\_VirtualPatients.mat**

The following table contains the input parameters used in the CircAdapt model for generating each virtual patient.

|  |  |  |
| --- | --- | --- |
| **CircAdapt symbol** | **Description** | **Unit of measure** |
| **q0** | Cardiac ouput | L/min |
| **p0** | Mean arterial pressure | mmHg |
| **tCycle** | Cycle time | s |
| **dTauAv** | AV delay | s |
| **AmRef\_LA** | Reference wall area LA | m2 |
| **AmRef\_LV** | Reference wall area LV | m2 |
| **AmRef\_Sv** | Reference wall area septum | m2 |
| **(glob)SfAct** | Active stress coefficient | kPa |
| **(glob)vMax** | Sarcomere shortening velocity | μm/s |
| **TR** | Contractility rise constant | - |
| **(glob)TD** | Contractility decay constant | - |
| **(glob)k1** | Stiffness exponent | - |
| **(glob)LDAD** | Length dependency of activation duration | - |
| **Ls0Pas** | Zero-passive stress sarcomere length | μm |
| **GlobLVtotwall** | Total segmental wall volume | m3 |
| **LVfwWall** | Wall volume LVfw | m3 |
| **SeptWall** | Wall volume septal wall | m3 |
| **dTSv1** | Time of delay of activation patch 1 of septum wall | s |
| **dTSv2** | Time of delay of activation patch 2 of septum wall | s |
| **dTSv3** | Time of delay of activation patch 3 of septum wall | s |
| **dTSv4** | Time of delay of activation patch 4 of septum wall | s |
| **dTSv5** | Time of delay of activation patch 5 of septum wall | s |
| **dTSv6** | Time of delay of activation patch 6 of septum wall | s |
| **dTLv1** | Time of delay of activation patch 1 of left ventricular free wall | s |
| **dTLv2** | Time of delay of activation patch 2 of left ventricular free wall | s |
| **dTLv3** | Time of delay of activation patch 3 of left ventricular free wall | s |
| **dTLv4** | Time of delay of activation patch 4 of left ventricular free wall | s |
| **dTLv5** | Time of delay of activation patch 5 of left ventricular free wall | s |
| **dTSLv6** | Time of delay of activation patch 6 of left ventricular free wall | s |
| **dTLv7** | Time of delay of activation patch 7 of left ventricular free wall | s |
| **dTLv8** | Time of delay of activation patch 8 of left ventricular free wall | s |
| **dTLv9** | Time of delay of activation patch 9 of left ventricular free wall | s |
| **dTLv10** | Time of delay of activation patch 10 of left ventricular free wall | s |
| **dTLv11** | Time of delay of activation patch 11 of left ventricular free wall | s |
| **dTLv12** | Time of delay of activation patch 12 of left ventricular free wall | s |
| **numTercar** | Number of coronary artery territories involved | - |
| **CATscar** | Territory affected by scar:  1 = LAD  3 = RCA  3 = LCx | - |
| **numPortscar** | Number of ‘portions’ affected within the territory  Example in LAD  1 = Ant  2 = AntSept  3 = Ant + AntSept | - |
| **numRingscar** | Number of rings involved | - |
| **Segscar** | The level where the scar is located  1 = mid + base  2 = mid + apex | - |
| **Vfrac1** | Amount of scar (if present) in segment 1 | % |
| **Vfrac2** | Amount of scar (if present) in segment 2 | % |
| **Vfrac3** | Amount of scar (if present) in segment 3 | % |
| **Vfrac4** | Amount of scar (if present) in segment 4 | % |
| **Vfrac5** | Amount of scar (if present) in segment 5 | % |
| **Vfrac6** | Amount of scar (if present) in segment 6 | % |
| **Scark11** | Stiffness of scar (if present) in segment 1 | - |
| **Scark12** | Stiffness of scar (if present) in segment 2 | - |
| **Scark13** | Stiffness of scar (if present) in segment 3 | - |
| **Scark14** | Stiffness of scar (if present) in segment 4 | - |
| **Scark15** | Stiffness of scar (if present) in segment 5 | - |
| **Scark16** | Stiffness of scar (if present) in segment 6 | - |
| **Scarsfact11** | Contractility of scar (if present) in segment 1 | kPa |
| **Scarsfact12** | Contractility of scar (if present) in segment 2 | kPa |
| **Scarsfact13** | Contractility of scar (if present) in segment 3 | kPa |
| **Scarsfact14** | Contractility of scar (if present) in segment 4 | kPa |
| **Scarsfact15** | Contractility of scar (if present) in segment 5 | kPa |
| **Scarsfact16** | Contractility of scar (if present) in segment 6 | kPa |
| **ExtScar** | Total number of segments with scar | - |
| **ScoreScar** | 0: no scar  1: scar volume fraction <25%  2: 25% < scar volume fraction <50 %  3: 50% < scar volume fraction <75 %  4: scar volume fraction > 75% | - |
| **SfAct\_LA** | Contractility left atrium | kPa |
| **k1\_LA** | Stiffness left atrium | - |