# User instructions

## Single frame estimation of myocardial mechanical properties

ZJW 24 May 2016

### Get source code

Clone or download source code from github repository at:

<https://github.com/jennyhelyanwe/LVSimulationSingleFrame.git>

Place code into your selected root folder – note that the file size will end up being quite large once analyses start.

### Set up environment variables

Add the environment variables listed in ‘EnvironmentSetup’ to your environment. Do this by entering the command

gedit ~/.bashrc &

and pasting the lines at the bottom of the bashrc text file.

Modify the directory path for HEART\_FAILURE\_ROOT to the local directory you downloaded the code to.

### Input data

**Imaging data**

Place the CIM models under the folder HEART\_FAILURE\_ROOT/CIM\_Models/Studies/

Run python script found at HEART\_FAILURE\_ROOT/CIM\_Models/Processing\_CIM/

python ProcessingCIM.py

**Haemodynamic data**

Enter the pressure data in units of kPa in a text file found at HEART\_FAILURE\_ROOT/HaemoData/RegisteredPressure/

Name the text file as <study\_name>\_registered\_LVP.txt

Format of file:

Column one – MRI frame numbers starting from end diastole.

Colume two – corresponding pressure value at that frame. If unknown for that frame, put 0.0.

**Record study name and frame numbers**

Add details of new study to text file found at HEART\_FAILURE\_ROOT/ParameterEstimation/StudyNames.txt

Format of file:

<study\_name> \tab <diastasis frame number> \tab <end diastole frame number> \tab <end systole frame number> \tab <total number of frames>

Ensure there are no empty lines at the end of the file.

### Analysis

**Generate surface data cloud**

Run python script found at HEART\_FAILURE\_ROOT/GeomData/

python CIMProcessing.py

**Run analysis**

Run python script found at HEART\_FAILURE\_ROOT/ParameterEstimation/Main/

python main.py <study\_number> \space <log file toggle> \space <forward solve toggle> \space <analyses option>

<study\_number> - the line number (starting from zero) at which the study is listed in the StudyNames.txt file.

<log file toggle> - 0: outputs debug information to command line. 1: outputs debug information to text file found in HEART\_FAILURE\_ROOT/ParameterEstimation/Studies/<study\_name>

<forward solve toggle> - Always leave on (1)

<analyses option> - Always leave at 1 for passive analysis.

### Other helpful tips

**Here are some useful links:**

- [Unix command line basics](http://www.ee.surrey.ac.uk/Teaching/Unix/)

- [Github tutorials](https://guides.github.com/" \t "_blank) and the link to the simulation framework [repository](https://github.com/jennyhelyanwe/LVSimulationSingleFrame)

- [Putty download](http://www.putty.org/) link.

- Email [bioeng-itstaff@list.bioeng.auckland.ac.nz](mailto:bioeng-itstaff@list.bioeng.auckland.ac.nz) for IT support.

- [CMGUI tutorial](https://www.cellml.org/assets/files/embc2010cmgui)

**And some explanations for...**

1. Where to find stress and strain data output:

This can be found in the directory HEART\_FAILURE\_ROOT/ParameterEstimation/Studies/<study\_name>/LVMechanics<study\_name>/PassiveMechanics/OptimisedStressStrain/

The .exdata files in this folder contain the stress or strain values at each element gauss point. I can explain in more detail later on once you are more familiar with running the framework.

2. How to extract basal displacement boundary conditions:

The basal displacement BC's are applied at four nodes at the base of the model. The x, y and z displacements are written to the log file from lines 50 to 53. For example for study PETALE\_P003:

*Nodal displacement:*

*Node 31 x, y, z diplacements =  -1.6981 -8.2657 0.0*

*Node 32 x, y, z diplacements =  -2.3628 0.0 0.7669*

*Node 33 x, y, z diplacements =  -0.6889 -3.1353 0.0*

*Node 34 x, y, z diplacements =  -1.3363 0.0 4.6896*

The log file can be found at HEART\_FAILURE\_ROOT/ParameterEstimation/Studies/<study\_name>/Output