

Description of Codes for Chapter 4: Cardiovascular Systems Simulation

Section 4.1: Empirical fit to Frank-Starling curve

The script to generate the model fits plotted in Figure 4.2 is 'CO_curves.m'. This script uses the function of Equation (4.1) to generate the curves in the figure for the parameter values indicated in the figure legend.

Section 4.2: The Guyton model of the circulation

The script 'circ_model1.m' plots the data and model fits of Figure 4.6; the script 'circ_model2.m' plots the curves illustrated in Figures 4.7 and 4.8.

The script 'FSG_stability.m' runs that stability trajectories for the combined Frank-Starling-Guyton model to generate Figures 4.9 and 4.10. This script calls the ODE files 'dXdT_stab1.m' (for Figure 4.9) and 'dXdT_stab2.m' (for Figure 4.10). The essential difference between these two ODE files is the equation used to specify the Frank-Starling cardiac output.

Section 4.3.1: Pulsatile mechanics (simple circuit)

Simulations of the Ellwein varying elastance model coupled to the simple circuit of Figure 4.15 may be conducted by running the script 'VaryingElastance_noL.m', which calls the ODE function 'dXdT_varE1.m', which computes the right-hand side of the model (Equations (4.13)-(4.15)). The ODE function, in turn, calls the 'PVfunction.m', which computes the varying elastance model of Equations (4.11) and (4.12).

Section 4.3.2: Pulsatile mechanics (complex circuit)

Simulations of the complex circuit of Figure 4.16 may be conducted by running the script 'FitDataFromGreggEtAl.m', which calls the ODE function 'LargeCircuitODE.m'. This ODE function uses the same varying elastance model in 'PVfunction.m' that is used by the example in Section 4.3.1. Running the script 'FitDataFromGreggEtAl.m' generates the output illustrated in Figures 4. 17 and 4.18.

The script 'varE_preload' is used to probe how the simple circuit of Figure 4.15 responds to changes in left atrial filling pressure. The script calls the same model used in Section 4.3.1, with the ODE function 'dXdT_varE1.m' and left-ventricular pressure volume relationship computed by 'PVfunction.m'. This script generates the results and plots of Figure 4.19.

The script 'varE_HR' is used to probe how the simple circuit of Figure 4.15 responds to changes in heart rate. The script calls the same model used in Section 4.3.1, with the ODE function 'dXdT_varE1.m' and left-ventricular pressure volume relationship computed by 'PVfunction.m'. This script generates the results and plots of Figure 4.21.

Section 4.4.1: Baroreceptor model

The script 'varE_preload_baro' is used to probe how the model of Section 4.1.1 responds to changes in left atrial filling pressure. The script calls the ODE function 'dXdT_varE2.m' and left-ventricular pressure volume relationship computed by 'PVfunction_baro.m'. This script generates the results and plots of Figure 4.23.