Appendix E

# MATLAB SUPPORT

The accompanying disc contains a set of MATLAB-SIMULINK files. These files provide support for many problems posed in this book, and, at the same time, facilitate the study and application of selected topics.

| File name | Chapter | Brief description |
|---|---|---|
| **amenl.mdl** | *Chap. 19* | SIMULINK schematic to evaluate the performance of a linear design on a particular nonlinear plant. |
| **apinv.mdl** | *Chap. 2* | SIMULINK schematic to evaluate approximate inverses for a nonlinear plant. |
| **awu.mat** | *Chap. 26* | MATLAB data file – it contains the data required to use SIMULINK schematics in file **mmawu.mdl**. This file must be previously loaded to run the simulation. |
| **awup.m** | *Chap. 11* | MATLAB program to decompose a biproper controller in a form suitable to implement an anti-windup strategy – requires the function **p_elcero.m.** |
| **c2del.m** | *Chap. 3* | MATLAB function to transform a transfer function for a continuous-time system with zero-order hold into a discrete-transfer function in delta form. |
| **cint.mdl** | *Chap. 22* | SIMULINK schematic to evaluate the performance of a MIMO control loop in which the controller is based on state estimate feedback. |
| **css.m** | *Chap. 7* | MATLAB function to compute a one-d.o.f. controller for an $n^{th}$-order SISO, strictly proper plant (continuous or discrete) described in state space form. The user must supply the desired observer poles and the desired control poles. This program requires the function **p_elcero.m**. |
| **data_newss.m** | *Chap. 11* | MATLAB program to generate the data required for **newss.mdl** – this program requires **lambor.m**. |
| **dcc4.mdl** | *Chap. 10* | SIMULINK schematic to evaluate the performance of a cascade architecture in the control of a plant with time delay and generalised disturbance. |
| **dcpa.mdl** | *Chap. 13* | SIMULINK schematic to evaluate the performance of the digital control for a linear, continuous-time plant. |
| **dead1.mdl** | *Chap. 19* | SIMULINK schematic to study a compensation strategy for deadzones. |
| **del2z.m** | *Chap. 13* | MATLAB function to transform a discrete-time transfer function in delta form to its Z-transform equivalent. |

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| File name | Directory | Brief description |
|---|---|---|
| **dff3.mdl** | *Chap. 10* | SIMULINK schematic to evaluate the performance of disturbance feedforward in the control of a plant with time delay and generalised disturbance. |
| **distff.mdl** | *Chap. 10* | SIMULINK schematic to compare a one d.o.f. control against a two-d.o.f. control in the control of a plant with time delay. |
| **distffun.mdl** | *Chap. 10* | SIMULINK schematic to evaluate the performance of disturbance feedforward in the control of an unstable plant and generalised disturbance. |
| **lambor.m** | *Chap. 11* | MATLAB program to synthesise an observer – this routine can be easily modified to deal with different plants. |
| **lcodi.mdl** | *Chap. 13* | SIMULINK schematic to compare discrete-time and continuous-time PID controllers for the control of an unstable plant. |
| **linnl.mat** | *Chap. 19* | MATLAB data file, with the linear design data used in solved problem. |
| **mimo1.mdl** | *Chap. 21* | SIMULINK schematic with a motivating example for the control of MIMO systems. |
| **mimo2.mdl** | *Chap. 22* | SIMULINK schematic to simulate a MIMO design based on an observer plus state estimate feedback. |
| **mimo2.mat** | *Chap. 22* | MATLAB data file for **mimo2.mdl.** |
| **mimo3.mdl** | *Chap. 25* | SIMULINK schematic for the triangular control of a MIMO stable and nonminimum phase plant, by using an IMC architecture. |
| **mimo4.mdl** | *Chap. 26* | SIMULINK schematic for the decoupled control of a MIMO stable and minimum phase plant plant, using an IMC architecture. |
| **minv.m** | *Chap. 25* | MATLAB function to obtain the inverse (in state space form) of a **biproper** MIMO system in state space form. |
| **mmawe.mdl** | *Chap. 26* | SIMULINK schematic for the (dynamically decoupled) control of a MIMO system with input saturation – an anti-windup mechanism is used, and directionality is (partially) recovered by scaling the control error. |

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| File name | Directory | Brief description |
|---|---|---|
| **mmawu.mdl** | *Chap. 26* | SIMULINK schematic for the (dynamically decoupled) control of a MIMO system with input saturation – an anti-windup mechanism is used, and directionality is (partially) recovered by scaling the controller output. |
| **newss.mdl** | *Chap. 11* | SIMULINK schematic to study a (weighted) switching strategy to deal with state-saturation constraints. |
| **nmpq.mdl** | *Chap. 15* | SIMULINK schematic to evaluate disturbance compensation and robustness in the IMC control of a NMP plant. . |
| **oph2.m** | *Chap. 16* | MATLAB function to perform H2 minimization to solve the model-matching problem. |
| **p_elcero.m** | *Chap. 7* | MATLAB function to eliminate leading zeros in a polynomial. |
| **paq.m** | *Chap. 7* | MATLAB function to solve the pole assignment equation: The problem can be set either for Laplace transfer functions or by using the Delta-transform. This program requires the function **p_elcero.m.** |
| **phloop.mdl** | *Chap. 19* | SIMULINK schematic to evaluate the IMC control of a pH neutralisation plant by using approximate nonlinear inversion. |
| **phloop.mat** | *Chap. 19* | MATLAB data file associated **phloop.mdl** |
| **piawup.mdl** | *Chap. 11* | SIMULINK schematic to evaluate an anti-windup strategy in linear controllers, by freezing the integral action when its output saturates. |
| **pid1.mdl** | *Chap. 6* | SIMULINK schematic to analyze the performance of a PID control that uses empirical tuning methods. |
| **pidemp.mdl** | *Chap. 6* | SIMULINK schematic to use the Ziegler–Nichols tuning method based on closed-loop oscillation: The plant is linear, but of high order, with input saturation and noisy measurements. |
| **pmimo3.m** | *Chap. 25* | MATLAB program to compute the Q controller for solved problem. |
| **qaff1.mdl** | *Chap. 15* | SIMULINK schematic to analyze the loop performance of an IMC control loop of a NMP plant. |

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| File name | Directory | Brief description |
|---|---|---|
| **qaff2.mdl** | *Chap. 15* | SIMULINK schematic to analyze the loop performance of the Smith controller in Q form. |
| **qawup.mdl** | *Chap. 11* | SIMULINK schematic to implement an anti-windup mechanism in the IMC architecture – the decomposition of $Q(s)$ was done by using MATLAB function **awup.m.** |
| **sat_uns.mdl** | *Chap. 15* | SIMULINK schematic to study saturation in unstable plants with disturbances of variable duration. |
| **slew1.mdl** | *Chap. 11* | SIMULINK schematic to evaluate the performance of a PI controller with anti-windup mechanism to control a plant with slew-rate limitation. |
| **smax.m** | *Chap. 9* | MATLAB function to compute a lower bound for the peak of the nominal sensitivity $S_o$ – the plant model has a number of unstable poles, and the effect of one particular zero in the open RHP is examined. |
| **softloop1.mdl** | *Chap. 19* | SIMULINK schematic to compare the performances of linear and nonlinear controllers for a particular nonlinear plant. |
| **softpl1.mdl** | *Chap. 19* | SIMULINK schematic of a nonlinear plant. |
| **sugdd.mat** | *Chap. 24* | MATLAB data file: – it contains the controller required to do dynamically decoupled control of the sugar mill. |
| **sugmill.mdl** | *Chap. 24* | SIMULINK schematic for the multivariable control of a sugar mill station. |
| **sugpid.mdl** | *Chap. 24* | SIMULINK schematic for the PID control of a sugar mill station – the design for the multivariable plant is based on a SISO approach. |
| **sugtr.mat** | *Chap. 24* | MATLAB data file – it contains the controller required to do triangularly decoupled control of the sugar mill. |
| **tank1.mdl** | *Chap. 2* | SIMULINK schematic to illustrate the idea of inversion of a nonlinear plant. |
| **tmax.m** | *Chap. 9* | MATLAB function to compute a lower bound for the peak of the nominal complementary sensitivity $T_o$. The plant model has a number of NMP zeros, and the effect of one particular pole in the open RHP is examined. |

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|---|---|---|
| File name | Directory | Brief description |
| **z2del.m** | *Chap. 13* | MATLAB routine to transform a discrete-time transfer function in Z-transform form to its Delta-transform equivalent. |

**Table E.1.** Description of MATLAB support files