APPENDIX A

SOME EXISTING SOFTWARE FOR CONTROL SYSTEMS DESIGN AND ANALYSIS

In this appendix, we will give a brief description of some of the existing software for control systems design and analysis.

A.1 MATLAB CONTROL SYSTEM TOOLBOX

As the title suggests, MATLAB *Control System Toolbox* is based on the well-known matrix computations software "MATLAB." It is a collection of M-files which implement some of the numerically viable algorithms for control system design, analysis, and modeling.

The control systems can be modeled either as transfer functions or in state-space form. Both continuous-time and discrete-time systems can be handled. The toolbox has excellent graphic capabilities and various time and frequency responses can be viewed on the screen and analyzed.

The software can be obtained from The MathWorks, Inc., 24 Prime Park Way, Natick, MA 01760-1500
Tel: (508) 647-7000, Fax: (508) 647-7001, URL: http://www.mathworks.com
Newsgroup: Comp. soft. sys. matlab.
See MATLAB Control System Toolbox: Users Guide (1996) for details.

A.2 MATCONTROL

MATCONTROL is also a collection of **M-files implementing major algorithms of this book.** MATCONTROL is primarily designed for classroom use—by using this toolbox, the students (and the instructors) will be able to compare different algorithms for the same problem with respect to efficiency, stability, accuracy, easiness-to-use, and specific design and analysis requirements.

A.3 CONTROL SYSTEM PROFESSIONAL—ADVANCED NUMERICAL METHODS (CSP-ANM)

Control System Professional (*CSP*) based on *"Mathematica"* is a collection of *Mathematica* programs (1996) to solve control systems problems. *CSP-ANM* extends the scope of CSP by adding new numerical methods for a wide class of control problems as well as for a number of matrix computations problems that have extensive uses in control systems design and analysis.

ANM is compatible with, and requires, *Control System Professional* 2.0 or later. The software has been developed by Biswa Nath Datta and Daniil Sarkissian (with the help of Igor Bakshee from Wolfram Research Incorporation).

"Typically, *Advanced Numerical Methods* provides several numerical methods to solve each problem enabling the user to choose from most appropriate tool for a particular task based on computational efficiency and accuracy." Users can select the most appropriate tool for a given task or have the package choose a suitable method automatically based on the size of data and the required accuracy. Thus, the package, though oriented mostly for professional users, is also an important tool for students, researchers, and educators alike.

The algorithms implemented in the package have been taken mostly form the current book by the author. More details can be found from *http://www.wolfram.com/products/applications/ann*

Software and manual: There is a User's Manual written by Biswa Nath Datta and Daniil Sarkissian (2003) with help from Igor Bakshee and published by *Wolfram Research, Inc.*. Both the software and the manual can be obtained from:

Wolfram Research, Inc., 100 Trade Center Drive, Champaign, Illinois 61820-7237, USA
Tel.: (217) 398-0700, Fax: (217) 398-0747
E-mail: Info@wolfram.com, URL: www.wolfram.com

A.4 SLICOT

SLICOT is a Fortran 77 **S**ubroutine **L**ibrary **i**n **C**ontrol **T**heory. It is built on the well-established matrix software packages, the **B**asic **L**inear **A**lgebra **S**ubroutines (BLAS) and the **L**inear **A**lgebra **P**ackage (LAPACK). The library also contains other mathematical tools such as discrete sine/cosine and Fourier transformations. The routines can be embedded in MATLAB by an appropriate interface thus enhancing the applicability of the library.

For a brief description of the library, see the paper **"SLICOT—A Subroutine Library in Systems and Control Theory"** by Peter Benner, Volker Mehrmann, Vasile Sima, Sabine Van Huffel, and Andras Varga in *Applied and Computational Control, Signals, and Circuits* (Biswa Nath Datta, Editor), Birkhauser, 2001. The official website for SLICOT is: *http://www.win.tuc.nc/niconet*

A.5 MATRIX$_X$

MATRIX$_X$, as the title suggests, is built on functions that are most commonly used for matrix computations. It is broken into several modules. The principal ones are *MATRIX*$_X$ Core, Control, and System Build, Optimization, and Robust Control. The core module contains the core MATLAB commands with some modifications and extensions. The control module contains both classical and modern control commands.

The *MATRIX*$_X$ core and control modules are command driven, while the system build module is menu driven. This module allows the users to simulate the systems by building the block diagrams of the systems on the screen. MATRIX$_X$ is a product of *Integrated Systems, Inc.* There exist a *MATRIX*$_X$ User's Guide (1991) and a book by Shahian and Hassul (1992) describing the functional details of the software.

A.6 SYSTEM IDENTIFICATION SOFTWARE

Each of the software packages **MATLAB Control System Toolbox, Control System Professional, Control System Professions—Advanced Numerical Methods, SLICOT, MATRIX$_X$**, etc., has its own software module for system identification. See Chapter 9 of this book for details.

There now also exist a few software packages, especially designed for system identification. We describe three of them in the following.

A.6.1 MATLAB System Identification Toolbox

This toolbox has been developed by Prof. Lennart Ljung of Linköping University, Sweden. The toolbox can be used either in command mode or via a Graphical User Interface (GUI). The details can be found in the Users' manual (Ljung 1991) and MathWorks website: **http://www.mathworks.com**

A.6.2 *X*math Interactive System Identification Module, Part-2

This is a product of Integrated System Inc., Santa Clara, USA, 1994. It is a GUI-based software for multivariable system identification. The details can be found in User's Manual (VanOverschee *et al.* 1994).

Website: http://www.isi.com/products/MATRIX$_X$/Techspec/MATRIX$_X$-*X*math/*xm*36.html.

A.6.3 ADAPT$_X$

This software package has been developed by W.E. Larimore. For details, see the Users Manual (Larimore 1997). **Website:** *http://adaptics.com*

Some further details on these softwares and subspace state-space system identification software can be found in the recent paper by DeMoor *et al.* (1999).

References

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