
E-LETTER of the Numerics in Control Network NICONET
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Editors: Sabine Van Huffel
Katholieke Universiteit Leuven
Dept. of Electrical Engineering
ESAT-SISTA/COSIC
Kardinaal Mercierlaan 94
B-3001 LEUVEN-HEVERLEE
Belgium
email: Sabine.VanHuffel@esat.kuleuven.ac.be

Ad van den Boom
Dept. of Electrical Engineering
Eindhoven University of Technology
P.O. Box 513, 5600 MB EINDHOVEN
the Netherlands
email: a.j.w.v.d.boom@tue.nl

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1 Welcome to the NICONET E-letter number 6!

This E-letter is sent out quarterly and informs you about the newest
updates Also, new NICONET reports and important NICONET activities are
announced in this E-letter. First of all, we held our Mid-Term Assessment

meeting on December 2, 1999: the NICONET activities were evaluated very positively which implies that we can continue our activities for another 2 years. On December 3, we held our second NICONET workshop at INRIA Rocquencourt near Paris-Versailles in France. The highlights of this workshop are described in our newsletter.

The next issue of this E-letter is planned for April 2000. Please send contributions before April 10. In particular, we encourage contributors to provide information on the use of the SLICOT library (performance, improvements, new suggestions).

Sabine Van Huffel
Chairperson of WGS and Coordinator of NICONET.

2 New issue of the NICONET Newsletter available

Communicated by Sabine Van Huffel:

The fourth issue of our NICONET Newsletter is now available and can be downloaded as compressed postscript file from the World Wide Web URL:

<http://www.win.tue.nl/niconet/> and choose: Newsletters

or from the WGS ftp site:

<ftp://wgs.esat.kuleuven.ac.be> (directory pub/WGS/NEWSLETTER/)
(filename: issue-1-00.ps.Z)

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3 New additions to SLICOT since October 1999

Communicated by Vasile Sima:

There have been two SLICOT Library updates during the period October 1999 -- December 1999: on November 27, and December 18. Known bugs have been corrected out. These resulted in updating five routines (MB04ID, MB04JD, SB04OD, SB10DD, and SB10QD). Several changes have also occurred in the documenting comments of some routines. Details are given in the file Release3.History, located in the root SLICOT directory /pub/WGS/SLICOT/ of the ftp site (mentioned at the end of this section). This file describes the history of all updates performed in the Release 3.0 since October 1997.

On November 27, 1999, Release 4.0 of the SLICOT Library has been announced. Several routines from SLICOT Release 3.0, together to the associated documentation files, example program files, data and results, have been removed. The removed routines have better counterparts, and their removal has been announced in the previous versions of the file Release.Notes (see Release3.History). A table indicating the removed routines, as well as the functionally equivalent routines, is included in the file Release3.History.

Several new user-callable routines, mainly for basic control problems for descriptor systems, have been made available on the ftp site in the period October 1999 - December 1999. They include Analysis Routines, Filtering Routines, Mathematical Routines, Synthesis Routines, and Transformation Routines, performing the following main computational tasks:

- estimation of the distance from a real matrix to the nearest complex matrix with an eigenvalue on the imaginary axis, using either bisection, or bisection and SVD;
- extracting, from a system pencil $S(\lambda)$, a regular pencil having the finite Smith zeros of $S(\lambda)$ as generalized eigenvalues;
- fast recursive least-squares filter using a QR-decomposition based approach;
- the minimum-norm solution to a linear least squares problem, given a rank-revealing QR factorization;
- the minimum norm least squares solution of $\text{op}(R) X = \alpha B$, or $X \text{op}(R) = \alpha B$, with R upper triangular, using singular value decomposition ($\text{op}(R)$ is R or R');
- the smallest singular value of $A - j\omega I$;
- applying the product of elementary reflectors used for QR factorization of a matrix having a lower left zero triangle;
- H-infinity (sub)optimal state controller for a discrete-time system;
- orthogonal reduction of a descriptor system to the controllability staircase form;
- orthogonal reduction of a descriptor system to a system with the same transfer-function matrix and with no uncontrollable finite eigenvalues;
- orthogonal reduction of a descriptor system to the observability staircase form.

The directory tree structure of the compressed library files `slicot.tar.gz`, for Unix platforms, and `slicotPC.zip` (former `slicotPC.tar.gz`), for Windows platforms (Windows 95, 98, and NT), has been changed on the latest Library update. The new tree structure is as follows:

```
slicot      : contains the files libindex.html, make.inc, makefile,
             and the following subdirectories:
  benchmark_data : contains benchmark data files for Fortran benchmark
                   routines (.dat);
  doc           : contains SLICOT documentation files for routines,
                   (.html);
  examples     : contains SLICOT example programs, data, and
                   results (.f, .dat, .res), and makefile, for compiling,
                   linking and executing these programs;
  src          : contains SLICOT source files for routines (.f),
                   and makefile, for compiling all routines and creating
```

an object library;
 SLTools : contains Matlab .m files, mex files (optionally),
 and data .mat files (optionally);
 SLmex : contains Fortran source codes for mexfiles (.f).

Currently, there are no makefiles for the PC version, and no executable Matlab files (e.g., .dll files) have been included. These files may, however, be separately taken from the ftp site.

The tree structure of the ftp site has been slightly changed at the latest SLICOT update, by adding three subdirectories and several subsubdirectories, and deleting other two subdirectories. The new subdirectories and their contents are listed below.

FD/ : Fast Recursive Least Squares Filters.
 FD01/

 MatlabTools/ : Matlab files and mexfiles, contained in its
 subdirectories:
 Unix/
 SLTools/ : Matlab source and data files (.m and .mat).
 SLmex/ : Fortran source codes for Matlab mexfiles based on
 SLICOT library (.f).
 Windows/
 SLToolboxes/ : Matlab executable files (.dll) grouped in
 several archives, according to their functionality.
 SLTools/ : Matlab source and data files (.m and .mat).
 SLdemos/ : Matlab source and executable files (.m, .mat, and .dll),
 for a GUI-based demo.
 SLmex/ : Fortran source codes for Matlab mexfiles based on
 SLICOT library (.f).

 contrib/ : routines which were previously proposed for being
 included in the SLICOT Library, but which could not
 be included yet. These routines do not follow the
 latest SLICOT Implementation and Documentation
 Standards, but could be of interest to some users.
 Included are G. Miminis' routines for solving the
 Pole Placement Single-input or Multi-input problem,
 and A.J. Geurts and C. Praagman's routines for
 computing a unimodular polynomial matrix $U(s)$ such
 that $R(s) = P(s) * U(s)$ is column reduced, given a
 polynomial matrix $P(s)$.

Note that the former directory Mexfiles (under SLICOT/ directory), and all its subdirectories have been removed, their contents being replaced by the contents of the new directory MatlabTools/ and its subdirectories. In addition, the entire subdirectory LAPACK_N of /pub/WGS/SLICOT/, containing used LAPACK files not included in LAPACK Release 2.0, has been removed, because the needed files are now included in the LAPACK Release 3.0.

The latest changes in the library contents or routine updates - till the next SLICOT Release - are announced in the file Release.Notes, located in directory /pub/WGS/SLICOT/ on the WGS ftp site. Previous updates are described, in reverse chronological order, in the file Release.History, located in the same directory.

SLICOT routines can be downloaded from the WGS ftp site:

<ftp://wgs.esat.kuleuven.ac.be>

(directory /pub/WGS/SLICOT/ and its subdirectories) in compressed (gzipped) tar files. On line .html documentation files are also provided there. The library and its documentation are also accessible from the WGS homepage at the World Wide Web URL:

<http://www.win.tue.nl/wgs/>

after linking from there to the SLICOT web page and clicking on the FTP site link in the freeware SLICOT section.

4 New NICONET Reports since October 1999

Communicated by Sabine Van Huffel:

The following NICONET reports can be downloaded as compressed postscript files from the World Wide Web URL:

<http://www.win.tue.nl/niconet> and choose: reports

or from the WGS ftp site:

<ftp://wgs.esat.kuleuven.ac.be> (directory pub/WGS/REPORTS/)

FILE NAME: SLWN1999-14.ps.Z
REPORT NUMBER: 1999-14
FORMAT: Compressed postscript.
AUTHORS: Jorn Abels and Peter Benner
TITLE: CAREX --- A Collection of Benchmark Examples for
Continuous-Time Algebraic Riccati Equations (Version 2.0)
ABSTRACT: A collection of benchmark examples is presented for the
numerical solution of continuous-time algebraic Riccati
equations. This collection may serve for testing purposes
in the construction of new numerical methods, but may also
be used as a reference set for the comparison of methods.
The collected examples focus mainly on applications in
linear-quadratic optimal control theory. This version
updates an earlier benchmark collection and includes one
new example.
STATUS: available since November 1999

FILE NAME: nic1999-15.ps.Z
REPORT NUMBER: 1999-15
FORMAT: Compressed postscript.
AUTHORS: D.W. Gu, P.Hr. Petkov and M.M. Konstantinov
TITLE: H_∞ Loop Shaping Design Procedure Routines in SLICOT
ABSTRACT: This report briefly introduces the H_∞ loop shaping
design procedure (LSDP) and its implementation in the
software package SLICOT. The developed routines are
tested in a design example and are included as appendices.
STATUS: available since November 1999

FILE NAME: SLWN1999-16.ps.Z
REPORT NUMBER: 1999-16
FORMAT: Compressed postscript.
AUTHORS: Jorn Abels and Peter Benner
TITLE: DAREX --- A Collection of Benchmark Examples for Discrete-
Time Algebraic Riccati Equations (Version 2.0)
ABSTRACT: This is the second part of a collection of benchmark
examples for the numerical solution of algebraic Riccati
equations. After presenting examples for the continuous-
time case in Part I (CAREX), our concern in this paper is
discrete-time algebraic Riccati equations. This collection
may serve for testing purposes in the construction of new
numerical methods, but may also be used as a reference set
for the comparison of methods. This version updates an
earlier benchmark collection. Some of the examples have
been extended by incorporating parameters and there have
been some new additions to the collection.
STATUS: available since December 1999

FILE NAME: SLWN1999-17.ps.Z
REPORT NUMBER: 1999-17
FORMAT: Compressed postscript.
AUTHORS: Andras Varga and Paul Van Dooren
TITLE: Summary report of topic I.A.
ABSTRACT: This report surveys the deliverables of Task I.A. of the
NICONET project. We first give a brief description of the
control problems that are solved by the basic numerical
tools developed in this Task and we list the different
routines of SLICOT that correspond to these control
problems and that are available via ftp. We then describe
the toolboxes that give interactive access via Matlab or
Scilab to those routines and describe the benchmark
problems for this Task. We finally give a few numerical
examples exhibiting the accuracy and speed of the new
tools and describe a demo for the routines of this Task.
STATUS: available since December 1999

FILE NAME: SLWN1999-18.ps.Z
REPORT NUMBER: 1999-18
FORMAT: Compressed postscript.
AUTHORS: Andras Varga
TITLE: Task II.B.1 - Selection of Software for Controller
Reduction
ABSTRACT: This working note presents a short overview of methods
suitable for controller reduction. A first class of methods
considered are general purpose methods for reduction of
unstable systems, as for example, absolute and relative
error methods or frequency weighted methods, both in
combination with modal separation or coprime factorization
techniques. Special frequency weighted controller reduction
methods able to preserve closed-loop stability and even
closed-loop performance are also discussed. A selection of
user callable and supporting routines to be implemented
for controller reduction is proposed.
The new routines will be included in the SLICOT library.
STATUS: available since December 1999

FILE NAME: nic1999-19.ps.Z
REPORT NUMBER: 1999-19
FORMAT: Compressed postscript.
AUTHORS: Ad van den Boom, Ton Backx and Yucai Zhu
TITLE: Benchmarks for Identification
ABSTRACT:
STATUS: soon available

FILE NAME: SLWN1999-20.ps.Z
REPORT NUMBER: 1999-20
FORMAT: Compressed postscript.
AUTHORS: Michel Verhaegen
TITLE: Symbolic and computational pre-processing in physical
parameter estimation of multi-body mechanical systems
ABSTRACT: The objective of this note is to highlight the scope and
computational (symbolic and/or arithmetic) tasks of turning
a physical parameter estimation problem into a (constraint)
optimization problem. Concrete examples show the need for
symbolic (object-oriented) modeling environments for
defining the structure of the physical system to be used
in the parameter optimization step. Without this
(interactive) software environment for compiling a physical
parameter estimation problem into an optimization problem,
standardization of commercial optimization routines is of
little or no interest.
STATUS: available since November 1999

FILE NAME: SLWN2000-1.ps.Z
REPORT NUMBER: 2000-1
FORMAT: Compressed postscript.
AUTHORS: P. Petkov, D.-W. Gu, Mihail M. Konstantinov and V. Mehrmann
TITLE: Condition and Error Estimates in the Solution of Lyapunov
and Riccati Equations
ABSTRACT: The condition number estimation and the computation of
residual based forward error estimates in the numerical
solution of matrix algebraic continuous-time and
discrete-time Lyapunov and Riccati equations is considered.
The estimates implemented involve the solution of
triangular Lyapunov equations along with usage of the
LAPACK norm estimator. Results from numerical experiments
demonstrating the performance of the estimates proposed are
presented.
STATUS: available since January 2000

5 NICONET events

Communicated by Sabine Van Huffel:

Our third NICONET workshop will be held in Louvain-la-Neuve, Belgium,
in December 2000. More details follow in forthcoming issues of this
E-letter.

6 (Forthcoming) Meetings and symposia attended by NICONET partners

Communicated by Vasile Sima and Sabine Van Huffel:

Conferences related to the NICONET areas of interest, where NICONET partners presented or will present NICONET/SLICOT-related talks and papers, and/or disseminate information and promote SLICOT, are the following:

MATLAB'99 Spanish Conference, organised by the 'Departamento de Informatica y Automatica' (Computer and Automation Department) of the 'Universidad de Educación a Distancia' from Spain.

3rd MATHMOD (mathematical modelling), VIENNA, Austria, February 2-4, 2000

AspenWorld 2000 in Orlando, USA, February 7-11, 2000

Mathematical Theory of Networks and Systems (MTNS2000), Perpignan, France, June 19-23, 2000

UKACC International Conference CONTROL 2000,
University of Cambridge, United Kingdom, 4 - 7 September 2000

IEEE International symposium on Computer-Aided Control System Design,
CACSD'2000, Anchorage, Alaska, Sept.25-27 2000.

END OF THE NICONET E-LETTER
