
E-LETTER of the Numerics in Control Network NICONET
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1 Welcome to the NICONET E-letter number 5!

This E-letter is sent out quarterly and informs you about the newest updates
of the SLICOT library, the main product of NICONET, and its performance.
Also, new NICONET reports and important NICONET activities are announced in
this E-letter. Please, don't forget to registrate for our next workshop which

will be held near Paris, France, in December 1999 and submit a poster contribution (see Section 4).

The next issue of this E-letter is planned for January 2000. Please send contributions before January 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 additions to SLICOT since July 1999

Communicated by Vasile Sima:

The latest full library update took place on September 1, 1999. Three routines (SB02RD, SB03OR, and SB03OT) have been updated, for fixing some bugs. Details are given in the file Release.Notes, located in root directory pub/WGS/SLICOT/ on the WGS ftp site,

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

which describes the latest changes in the library contents or routine updates (till the next SLICOT Release). Previous updates are described, in reverse chronological order, in the file Release.History, located in the same directory. These files are updated whenever needed.

Several new user-callable routines for basic control problems for descriptor systems, and robust control, have been made available on the ftp site. They include subroutines from the Analysis Routines and Synthesis Routines chapters of the library, performing the main tasks listed below:

- H-infinity norm of a continuous-time stable system;
- H2 optimal state controller for a discrete-time system;
- H-infinity (sub)optimal state controller for a continuous-time system;
- H2 optimal state controller for a continuous-time system;
- Closed-loop system matrices for a system with robust controller;
- Normalization of a system for H-infinity controller design;
- State feedback and output injection matrices for an H-infinity (sub)optimal state controller (continuous-time);
- H-infinity (sub)optimal controller matrices using state feedback and output injection matrices (continuous-time);
- H2 optimal controller matrices for a normalized discrete-time system;
- H2 optimal controller matrices for a discrete-time system;
- normalization of a system for H2 controller design;
- state feedback and output injection matrices for an H2 optimal state controller (continuous-time);
- H2 optimal controller matrices using state feedback and output injection matrices (continuous-time);
- balancing the matrices of the system pencil corresponding to a descriptor triple (A-lambda E, B, C);
- orthogonal reduction of a descriptor system pair (A-lambda E, B) to the QR-coordinate form;
- orthogonal reduction of a descriptor system pair (C, A-lambda E) to

- the RQ-coordinate form;
- orthogonal reduction of a descriptor system (A-lambda E,B,C) to an SVD coordinate form;
- orthogonal reduction of a descriptor system (A-lambda E,B,C) to an SVD-like coordinate form;
- finding a reduced (controllable, observable, or irreducible) descriptor representation (Ar-lambda*Er,Br,Cr) for an original descriptor representation (A-lambda*E,B,C).

Moreover, additional components of the new, SLICOT-based Matlab toolboxes have been posted on the ftp site (directory pub/WGS/SLICOT/Mexfiles/PC). Besides the two mexfiles for model reduction, posted on June 1999, five new mexfiles for standard and generalized Sylvester and Lyapunov equations, Riccati equations, as well as for system transformations, and system reduction to canonical forms or minimal realizations, have been included. By the end of September, other three mexfiles have been added, for computing the H-infinity norm of a continuous-time stable system, and for solving H-infinity and H2 (sub)optimal design problems for continuous-time and discrete-time systems. All mexfiles can be directly called on Windows 9x or NT platforms (using Fortran 90 memory allocation scheme). The mexfiles are invoked by a series of m files, also provided. Included are some Matlab test programs and mat files with test data. The work is in progress, and new mexfiles will be added. Partial performance results and comparisons with Matlab functions have been reported.

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.

The whole library is available as the file `slicot.tar.gz`, in the root directory `pub/WGS/SLICOT/`. The file `slicotPC.tar.gz`, available in the same directory (`pub/WGS/SLICOT/`), and containing the MS-DOS version of the Fortran source codes of the SLICOT library, has not yet been updated with the new additions.

3 New NICONET Reports since July 1999

Contributed 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/wgs/reports.html>

or from the WGS ftp site:

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

FILE NAME: nic1999-10.ps.Z
REPORT NUMBER: 1999-10
FORMAT: Compressed postscript.
AUTHORS: Petko Petkov, Mihail Konstantinov, Da-Wei Gu, Volker Mehrmann
TITLE: Numerical solution of matrix Riccati equations: a comparison of six solvers
ABSTRACT: We present results from the evaluation of six solvers intended for the numerical solution of continuous-time matrix algebraic Riccati equations. The solvers include the MATLAB functions from different toolboxes and two Fortran 77 solvers developed by the authors. The comparison implements two benchmark problems each comprising 1600 6-th order Riccati equations with known solutions. For each solver and each equation we compute the relative forward and backward errors and for two of the solvers we investigate the accuracy of condition and error estimates. Some conclusions concerning the numerical behaviour of the solvers are given.
STATUS: available since August 1999

FILE NAME: SLWN1999-11.ps.Z
REPORT NUMBER: 1999-11
FORMAT: Compressed postscript.
AUTHORS: Volker Mehrmann, Vasile Sima, Andras Varga and Hongguo Xu
TITLE: A MATLAB MEX-file environment of SLICOT
ABSTRACT: Several MEX-files are developed based on SLICOT Fortran subroutines. The MEX-files provide new tools for the numerical solution of some classical control problems, such as the solution of linear or Riccati matrix equations computations in the MATLAB environment. Numerical tests show that the resulting MEX-files are equally accurate and much more efficient than the corresponding MATLAB functions in the control system toolbox and the robust control toolbox. In order to increase user-friendliness the related m-files are also developed so that the MEX-file interface to the corresponding SLICOT routines can be implemented directly and easily.
STATUS: available since August 1999

FILE NAME: SLWN1999-12.ps.Z
REPORT NUMBER: 1999-12
FORMAT: Compressed postscript.
AUTHORS: Da-Wei Gu, Petko Hr. Petkov and Mihail Konstantinov
TITLE: H_{inf} and H₂ optimization toolbox in SLICOT
ABSTRACT: This report summarizes the progress made in the sub-task IV.A of the NICONET project. Selected routines to implement H_{inf} and H₂ (sub) optimization syntheses are listed, which have all been standardized and included in the SLICOT package. The integration of those routines in MATLAB has also been completed; the mex files are attached in the appendices. This report discusses the selection and testing of benchmark problems with regard to the developed routines, and the comparisons made between these routines and others available in MATLAB. In particular, two industrial benchmark case studies, namely the controller design of a Bell 205

helicopter and a distillation column design, are introduced and the design results, obtained using the developed routines, are analysed.

STATUS: available since September 1999

FILE NAME: nic1999-13.ps.Z

REPORT NUMBER: 1999-13

FORMAT: Compressed postscript.

AUTHORS: Anton Stoorvogel

TITLE: Numerical problems in robust and H_∞ optimal control

ABSTRACT: After formulating the H_∞ control problem for linear, time-invariant and finite-dimensional systems, the difficulties in the computation of the optimal performance are discussed, as well as the problems encountered in computing controllers.

STATUS: available since September 1999

4 NICONET events

Communicated by Sabine Van Huffel:

Our second NICONET workshop will be held at INRIA Rocquencourt in France on December 3, 1999. This workshop is open for everybody and is announced below:

Second NICONET WORKSHOP:

NUMERICAL CONTROL SOFTWARE: a useful tool in industry

Friday, December 3, 1999, INRIA Rocquencourt, France

Second Announcement and Call for Posters

This workshop organized by the European Numerics in Control thematic Network (NICONET) aims to bring together engineers, mathematicians, computer scientists and practitioners from industry and academia dealing with numerical software in systems and control and their implementation and use in industrial practice.

Recent advances on the use of numerical software libraries especially designed for solving systems and control engineering problems in a numerically reliable and efficient way will be discussed. The current status of the freely available SLICOT library will be extensively discussed, as well as industrial control applications and future extensions, comprising parallel versions and practically oriented benchmarks. SLICOT is a valuable tool for the reliable solution of many control problems, and for large-scale, computer-intensive control problems and real-time applications, SLICOT can lead to significant performance improvements.

Chairpersons: Francois Delebecque, Serge Steer (local organizers) and Sabine Van Huffel (project coordinator).

Organizing Committee: T. Backx, P. Benner, A. van den Boom, J. De Cuyper, A. Coville, D.W. Gu, S. Hammarling, V. Hernandez, B. Kagstrom, M. Konstantinov, V. Mehrmann, A. Moner, P. Petkov, V. Sima, A. Stoorvogel,

P. Van Dooren, A. Varga, M. Verhaegen, R. Wohlgenuth.

Workshop Program:

The morning session consists of a tutorial training course including demos of the newly developed SLICOT toolboxes which enable the use of SLICOT routines within the user-friendly CACSD packages MATLAB and Scilab. In the afternoon, plenary talks are scheduled describing the use of numerical control software in diverse industrial control applications. In addition, a poster session of contributed papers illustrates new developments in control software and their performance in engineering practice and industrial applications.

- 9h-10h: 'The numerics in control library SLICOT: an introductory presentation' by Dr. Ad van den Boom (Eindhoven University of Technology) and Prof. Sabine Van Huffel (Katholieke Universiteit Leuven)
- 10h30-12h30: Introductory presentations of the newly developed SLICOT toolboxes including demos
- 'Basic software tools' by Prof. Paul Van Dooren (Universite Catholique de Louvain)
 - 'Model reduction' presented by Dr. Andras Varga (DLR, Oberpfaffenhofen)
 - 'Subspace identification' by Prof. Michel Verhaegen (Delft University of Technology)
 - 'Robust control' presented by Dr. Dawei Gu (University of Leicester)
- 14h-16h: Plenary session (tentative schedule)
Presentation of Scilab through a large industrial application by Eric Demay from Electricite de France.
- Industrial control applications of SLICOT presented by the NICONET industrial partners:
Ir. Joris De Cuyper from LMS International, Leuven, Belgium.
Ir. Arnaud Coville from SFIM Industries, Massy, France.
Dr. ir. Jobert Ludlage from IPCOS, Boxtel, the Netherlands.
- 16h-17h30: Demos and poster session
17h30-18h: Closing discussion
18h: Reception

The final program will be announced on the NICONET website
<http://www.win.tue.nl/wgs/niconet.html>

Participants of the workshop receive:

- A copy of the workshop program and proceedings book
 - A copy of the last version of the SLICOT Software Library and Toolboxes (upon request)
- Documentation on SLICOT and NICONET

Prospective authors are invited to submit two copies of a camera-ready paper (1 to 5 pages long), describing the contents of the poster contribution, to the workshop secretariat (see address below) for review. Address and e-mail should be provided if possible. All accepted contributions, as well as documentation for the tutorial training course and the plenary session, will be published in the workshop proceedings.

Author's Schedule:

Submission of camera-ready paper (1-5 pages): November 10, 1999.
Notification of acceptance as poster presentation: November 15, 1999.

Registration Information:

Please register your attendance to the workshop at the address below before November 15, 1999.

The attendance to the workshop, the documentation and the software are free.

Second NICONET workshop Registration Form, Friday December 3, 1999.

Name:
Title:
Company/Institution:
Area:
Address:
Phone:
Fax:
e-mail:

To the attention of Mrs Christine Bren at the workshop secretariat

By Fax: + 33-1-39635638

By Mail: INRIA, Relations Exterieures
Domaine de Voluceau Rocquencourt B.P. 105
78153 Le CHESNAY CEDEX (France)

By WWW: <http://www-rocq.inria.fr/Niconet/register.html>

By e-mail: symposia@inria.fr

5 (Forthcoming) Meetings and symposia attended by NICONET partners

Communicated by Vasile Sima and Sabine Van Huffel:

December 2, 1999. Mid-term assessment meeting of NICONET organized at INRIA, Rocquencourt, France, will be attended by all partners.

December 4, 1999. NICONET meeting organized at INRIA, Rocquencourt, France, will be attended by all partners.

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, February 7-11, 2000

MTNS2000, Perpignan, France, June 19-23, 2000

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

CACSD'2000 Symposium to be held in Anchorage, Alaska, Sept. 2000.

END OF THE NICONET E-LETTER
