

E-LETTER of the Numerics in Control Network NICONET
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http://www.win.tue.nl/wgs/E-letter.html

or from the WGS ftp site:

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1 Welcome to the NICONET E-letter number 3!

As announced in our first issue, 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 are announced in this E-letter.

The next issue of this E-letter is planned for July 1999. Please send contributions before July 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.

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2 New additions to SLICOT since January 1999

Communicated by Vasile Sima:

There have been no updates of the SLICOT Library since December 1998. However, several new user-callable and auxiliary routines for basic and robust control problems have been implemented, and will be made available on the ftp site on June 1999. They include Analysis Routines, Mathematical Routines, Synthesis Routines, and Transformation Routines, performing the following main tasks:

- model reduction for unstable systems using either the square-root or the balancing-free square-root Balance & Truncate model reduction method for the alpha-stable part of the system;
- model reduction for unstable systems using either the square-root or the balancing-free square-root Singular Perturbation Approximation model reduction method for the alpha-stable part of the system;
- computing a solution, optionally corresponding to specified free elements, to a real linear least squares problem;
- "periodic" Hessenberg reduction: reducing a product of p real full square matrices, H = H_1*H_2*...*H_p, to upper Hessenberg form, where the reduced H_1 is upper Hessenberg, and the reduced H_2, ..., H_p are upper triangular, using orthogonal similarity transformations, without evaluating the product;
- computation of the p real orthogonal matrices performing the "periodic" Hessenberg reduction;
- "periodic" Schur decomposition: finding the factored Schur form and the eigenvalues of a product of matrices, H = H_1*H_2*...*H_p, with H_1 an upper Hessenberg matrix and H_2, ..., H_p upper triangular matrices, essentially without evaluating the product;
- pole assignment for a given matrix pair (A,B) using real Schur form of A;
- eigenstructure assignment for a controllable matrix pair (A,B) in orthogonal canonical form;
- condition estimate and forward error bound for the solution of a continuous-time or a discrete-time algebraic Riccati equation;
- solving continuous-time or discrete-time algebraic Riccati equations using the enhanced Schur vector method (incorporating scaling and iterative refinement), with condition estimates and forward error bounds;
- condition estimate and forward error bound for the solution of a continuous-time or a discrete-time Lyapunov equation;
- solving continuous-time or discrete-time Lyapunov equations with condition estimates and forward error bounds;
- H_2 optimal controller synthesis;
- computation of H_2 optimal state feedback and output injection

  matrices;
- computation of H_2 optimal controller state-space matrices;
- H_infinity sub-optimal controller synthesis;
- computation of H_infinity state feedback and output injection
  matrices;
- computation of H_infinity controller state-space matrices;
- computation of closed-loop system state-space matrices;
- balancing a descriptor system triple (A - lambda E,B,C);
- reducing a descriptor system pair (A - lambda E,B) to a QR- or
  RQ-coordinate form using an orthogonal transformation matrix such that
  the transformed descriptor system pair has the reduced descriptor
  matrix E in an upper trapezoidal form;
- given a descriptor system (A - lambda E,B,C), orthogonal transformation
  matrices Q and Z are computed such that the transformed system
  (Q'*A*Z - lambda Q'*E*Z, Q'*B, C*Z) is in the form

$$Q'*A*Z = \begin{pmatrix} A11 & A12 \\ A21 & A22 \end{pmatrix}, \quad Q'*E*Z = \begin{pmatrix} Er & 0 \\ 0 & 0 \end{pmatrix},$$

  where Er is either a diagonal or an upper triangular invertible
  matrix, and A22 is optionally reduced similarly;
- reducing a descriptor system (A - lambda*E,A,B,C) to an input-output
  equivalent "controllability" or "observability" staicase form,
  displaying the structure of the system.

Other routines that will be added to the Library will be announced in
the next issue of this Newsletter.

In addition, few bugs in the previously existing routines have been
fixed. 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, mentioned
below. Previous updates are described, in reverse chronological order,
in the file Release.History, located in the same directory. These files
will be updated in June 1999.

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.

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3 New NICONET Reports since Janaury 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: nic1999-1.ps.Z
REPORT NUMBER: 1999-1
FORMAT: Compressed postscript.
AUTHORS: Peter Benner, Enrique S. Quintana-Orti, Gregorio Quintana-Orti
TITLE: A portable subroutine library for solving linear control problems on distributed memory computers
ABSTRACT: This paper describes the design of a software library for solving the basic computational problems that arise in analysis and synthesis of linear control systems. The library is intended for use in high performance computing environments based on parallel distributed memory architectures. The portability of the library is ensured by using the BLACS, PBLAS, and ScaLAPACK as the basic layer of communication and computational routines. Preliminary numerical results demonstrate the performance of the developed codes on parallel computers. The suggested library can serve as a basic layer for PSLICOT, a parallel extension of the Subroutine Library in Control Theory (SLICOT).
STATUS: available since January 1999

FILE NAME: nic1999-2.ps.Z
REPORT NUMBER: 1999-2
FORMAT: Compressed postscript.
AUTHORS: Peter Benner and Heike Fassbender
TITLE: SLICOT drives tractors!
ABSTRACT: We describe the successful application of a SLICOT subroutine in a control engineering problem. Based on GPS data it is possible to automatically steer farm vehicles along a prescribed trajectory. The bottleneck for the successful on-line implementation of a LQG regulator is the numerical solution of a discrete-time algebraic Riccati equation in real-time and at high accuracy. This is achieved employing a Fortran-77 subroutine from the Subroutine Library in Control Theory SLICOT.
STATUS: available since January 1999

FILE NAME: nic1999-3.ps.Z
REPORT NUMBER: 1999-3
FORMAT: Compressed postscript.
AUTHORS: Bert Haverkamp
TITLE: Efficient implementation of subspace method identification algorithms
ABSTRACT: This paper summarises the results of a study to improve existing Subspace Method Identification (SMI) algorithms. Significant improvements in calculation speed can be achieved by combining components from existing algorithms

namely N4SID and MOESP. A second improvement can be achieved by more efficient implementation of critical parts of the algorithms.
STATUS: available since March 1999

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4 Meetings and symposia (to be) attended by NICONET partners

Communicated by Vasile Sima en Sabine Van Huffel:

Forthcoming Conferences related to the NICONET areas of interest, where NICONET partners submitted or will submit proposals for NICONET/SLICOT-related talks and papers, and/or will disseminate information and promote SLICOT, are the following:

Computer-Aided Control System Design, CACSD '99, Hawaii, August 22-26, 1999.

The Fourth International Congress on Industrial and Applied Mathematics, Edinburgh, Scotland, ICIAM99, July 5-9, 1999.

European Control Conference, Karlsruhe, Germany, 31 August-3 September, 1999.

Fourteenth Householder Symposium on Numerical Linear Algebra, Chateau Whistler, Whistler B.C., Canada, June 14-18, 1999.

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5 Coming NICONET events

Communicated by Vasile Sima en Sabine Van Huffel:

Our next NICONET meeting will be held at Delft University of Technology, The Netherlands, on May 31 and June 1, 1999.

Our second two-days NICONET workshop will be held in the direct neighbourhood of Paris, France, on December 2-3, 1999. This workshop is open for everybody. More information follows in our next E-letter.

END OF THE NICONET E-LETTER
