

E-LETTER of the Numerics in Control Network NICONET
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1 Welcome to the NICONET E-letter number 11!

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. In particular, I would like to mention that we submitted a new proposal to the EC in March 2001 (Accompanying Measures project in the Growth programme) and hope to get further support after December 31, 2001, when the present NICONET project comes to its end.

The next issue of this E-letter is planned for July 2001. Please send contributions before June 30. 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 February 2001

Communicated by Vasile Sima:

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/niconet/`

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

Several new user-callable and computational routines for basic control problems, structured matrices, model and controller reduction, and Wiener system identification have been, or are currently implemented, and will be posted on the SLICOT ftp site in June. They include Analysis Routines, Data Analysis Routines, Identification Routines, Mathematical Routines, and Transformation Routines, performing the following main computational tasks:

- computing the inverse of a given descriptor system.
- computing a reduced order model for an original state-space representation, using the frequency weighted optimal Hankel-norm approximation method.
- constructing a state-space representation of the projection of V^*G or $\text{conj}(V)^*G$ containing the poles of G , from the state-space representations of the transfer-function matrices G and V , for G assumed to be stable and with its state matrix A in a real Schur form.
- constructing a state-space representation of the projection of G^*W or $G^*\text{conj}(W)$ containing the poles of G , from the state-space representations of the transfer-function matrices G and W , for G assumed to be stable and with its state matrix A in a real Schur form.
- computing the convolution or deconvolution of two real signals using the Hartley transform.
- computing the (scrambled) discrete Hartley transform of a real signal.
- computing the incomplete Cholesky factor of a symmetric positive

- definite block Toeplitz matrix, defined by either its first block row, or its first block column.
- solving a system of linear equations $Ax = b$, with A symmetric, positive definite, or, in the implicit form, $f(A, x) = b$, where $y = f(A, x)$ is a symmetric positive definite linear mapping from x to y , using the conjugate gradient algorithm without preconditioning.
 - solving a set of systems of linear equations, $A'^*A^*X = B$, or, in the implicit form, for $A'^*A = f(A)$, with A'^*A positive definite, using symmetric Gaussian elimination.
 - computing a set of parameters for approximating a Wiener system in a least-squares sense, using a neural network approach and a Levenberg-Marquardt algorithm.
 - finding the parameters $PARA$ for a function $F(X, PARA)$ that give the best approximation for $Y = F(X, PARA)$ in a least-squares sense.
 - computing the output of a Wiener system.
 - computing the Jacobian of a Wiener system.
 - converting the linear discrete-time system given as (A, B, C, D) , with initial state x_0 , into the output normal form, with parameter vector $THETA$. The matrix A is assumed to be stable. The matrices A, B, C, D and the vector x_0 are transformed, so that on exit they correspond to the system defined by $THETA$.
 - converting the linear discrete-time system given as its output normal form, with parameter vector $THETA$, into the state-space representation (A, B, C, D) , with the initial state x_0 .
 - computing the output sequence of a linear time-invariant open-loop system given by its discrete-time state-space model (A, B, C, D) , where A is a general matrix (the input and output trajectories are stored differently from SLICOT Library routine TF01MD).
 - reducing the pair (A, E) of a descriptor system to a real generalized Schur form using an orthogonal equivalence transformation, and applying the transformation to the matrices B and C .

In addition, several parallel codes for model reduction and related computational problems (Lyapunov and Sylvester equations, SVD, etc.) have been developed, covering the following functionality:

- Balance and Truncate method.
- Singular Perturbation Approximation method.
- Hankel Norm Approximation method.
- coupled Lyapunov equations solver for the Cholesky factors (based on the Newton iteration for the matrix sign function).
- coupled Stein equations solver for the Cholesky factors (based on the Smith iteration).
- stable Sylvester equation solver (based on the Newton iteration for the matrix sign function).
- SVD of a matrix product.
- matrix sign function using classical Newton iteration.
- rank of upper triangular matrices.

3. SLICOT developments

Communicated by Sabine Van Huffel:

A new SLICOT toolbox on structured matrix decompositions is finalized and is available on the website since February 2001; see <http://www.win.tue.nl/niconet> and click "software" and then "task 1B".

4 New NICONET Reports since February 2001

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: SLWN2001-2.ps.Z
REPORT NUMBER: 2001-2
FORMAT: Compressed postscript.
AUTHORS: Erik Elmroth, Pedher Johansson, Bo Kagstrom, and Daniel Kressner
TITLE: A Web Computing Environment for the SLICOT Library
ABSTRACT: A prototype web computing environment for computations related to the design and analysis of control systems using the SLICOT software library is presented. The web interface can be accessed from a standard world wide web browser with no need for additional software installations on the local machine. The environment provides user-friendly access to SLICOT routines where run-time options are specified by mouse clicks on appropriate buttons. Input data can be entered directly into the web interface by the user or uploaded from a local computer in a standard text format or in Matlab binary format. Output data is presented in the web browser window and possible to download in a number of different formats, including Matlab binary. The environment is ideal for testing the SLICOT software before performing a software installation or for performing a limited number of computations. It is also highly recommended for education as it is easy to use, and basically self-explanatory, with the users' guide integrated in the user interface.
STATUS: available since January 2001

5 NICONET events

Communicated by Peter Benner:

First announcement of a workshop and training course

ADVANCED COMPUTATIONAL TOOLS FOR COMPUTER-AIDED CONTROL SYSTEMS DESIGN

September 27-29, 2001, University of Bremen, Germany

AIMS AND TOPIC:

With the ever-increasing complexity of control systems, efficient computational methods for their analysis and design are becoming more and more important. These computational methods need to be based on reliable and robust numerical software provided by well-tested and user-friendly software libraries.

Further information on SLICOT, NICONET and examples for the application of SLICOT-based software to some control-engineering problems can be found at

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

For more information on the workshop please visit

<http://www.math.uni-bremen.de/zetem/workshops/cacsd>

or contact

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Fax: +49 (0) 421 218-4863
E-Mail: stoever@math.uni-bremen.de

You may register electronically at

<http://www.math.uni-bremen.de/zetem/workshops/cacsd/anmeldung.html>

Deadline for registration is September 1, 2001.

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:

Tenth SIAM Conference on Parallel Processing, Portsmouth, USA,
March 12--14, 2001.

Fifth SIAM Conference on Control and its Applications, San Diego, USA,
July 11--14, 2001.

SIAM Conference on Linear Algebra in Signals, Systems and Control,
Boston, USA, August 13--16, 2001.

IFAC Workshop on Periodic Control Systems, Cernobbio-Como, Italy,
August 27--28, 2001.

First SIAM-EMS Conference on Applied Mathematics in Our Changing World,
Berlin, Germany, September 3--6, 2001.

European Control Conference (ECC 2001), Seminario de Vilar, Porto,
Portugal, September 4--7, 2001.

END OF THE NICONET E-LETTER
