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SLICOT Contributors' Kit 2.1

Abstract

The SLICOT library in its present Release 2.0 contains about 90 user-callable Fortran subroutines. A number of chapters and sections, such as the state space synthesis chapter SB on Sylvester, Lyapunov and Riccati equations including various applications of these techniques, have obtained a high degree of maturity. Other chapters are only weakly covered or are still empty.
This contributor's kit document aims the enhancement of submission of new subroutines into upcoming releases of the SLICOT library. We outline the requirements a contribution has to satisfy in order to be accepted into the SLICOT library and we describe two different routes to be followed when making a submission. Furthermore, we give a brief overview of the possible benefits of distributing your system and control software through SLICOT. With this contributor's kit we hope on the one hand to minimize the burden (and hence also the submission time) to both the submitter and the members of the WGS, currently responsible for new releases of SLICOT, and on the other hand to stimulate potential contributors to make a valid submission. Over the past, submissions have mainly be made by a rather restrictive number of scientists directly involved with the creation of SLICOT. However, to further expand the library and to keep it up to date, the members of the WGS solicit submissions from outside this small community.

1 Brief account on the history and main characteristics of the SLICOT library.

The current Release 2.0 of SLICOT is a library of about 90 user-callable Fortran subroutines mainly for the analysis, synthesis and design of linear, time-invariant systems. The original Release 1.0 was the result of merging two existing libraries, namely SLICE [5] and SYCOT [6]. SLICE is a subroutine library developed at Kingston Polytechnic which has been distributed by NAG since 1987. Independently, the subroutine library SYCOT was being developed by WGS. The WGS is a Benelux Working Group on Software and consists of a number of experts in both control theory, numerical analysis and software design from Belgian and Dutch Universities, Research Institutes and Industry. The issue of this first release has been made possible by a collaborative effort between NAG and WGS.

One of the primary attributes of routines included in the present release of the SLICOT library is numerical robustness. This will be the basic requirement for all contributions to future releases. In this way, future releases will contribute to the realization of the original goal of the SLICOT endeavor, namely *the realization of a portable library of basic, high-quality routines for system and control theory and signal processing, particularly with respect to numerical reliability and computational efficiency.*

The SLICOT library can be used as a basic building block for more sophisticated interactive analysis and design packages. A dedicated and userfriendly tool has been designed by NAG to ease the use of the SLICOT subroutines in the widely used interactive MATLAB package [1]. This tool, referred to as the NAG Gateway Generator (NGG) [2] is currently available for various platforms. The MGG project is a successor of the Matlab Gateway Compiler (MGC) [3] project initiated by WGS.

The SLICOT library is available as standard Fortran 77 code in either single or double precision. Each user-callable subroutine is accompanied by an example program which illustrates the use of the subroutine and can act as a template for the user's own routines. The SLICOT Library Manual [4] provides an introduction to the library, gives some background information to the numerical algorithms used and provides a description of each user-callable subroutine, together with a listing of the example programs and their output. SLICOT is a stand-alone library and should compile under a standard conforming compiler with no changes necessary to the source code. An overview of the content of Release 2.0 of the SLICOT library is given in [4].

2 How to make a contribution?

When you are doing active research in the domain of system/control theory or signal processing, you may have developed your own (fortran or matlab) subroutine library within your own university or institute. When you think some of these routines have a wide scope of interest or when you think your research results are of practical interest, there is one way to realize this thought. Make a submission to the SLICOT library. Two possible routes are suggested to get a submission accepted. These routes are outlined in the following table :

	Route 1	Route 2
STEP 1	Check whether some of your existing routines fill a gap in Release 2.0 of SLICOT, see section 4	Check whether your new research results fill in one of the high priority areas, defined in section 5
STEP 2	Adapt your routines according to the SLICOT standards [7]	Motivate students in an assignment during their study to implement the new ideas according to the SLICOT standards [7]
STEP 3	Interactive cooperation between the potential contributor and the WGS. The latter group is giving advise on modifying the code and is also testing the reliability and usability of the code to various test cases.	
STEP 4	**Acceptance**	

A combination of both routes is possible. In the next section, we outline some guidelines to be taken into account in adapting a routine or in developing a new routine according to the SLICOT standards.

3 Routine implementation according to the SLICOT standards.

The adaptation of your existing routines or the development of new routines according to the present standards of the SLICOT library might require a substantial amount of work. From past experience we feel that this ought to be done by the contributor, but again this is open for discussion.

A document has been issued by WGS that precisely describes these standards in detail [7]. On the one hand the adaptation involves the inclusion of existing subroutines of the SLICOT, LAPACK, BLAS and NAG libraries wherever possible. A description of the routines contained in Release 2.0 of SLICOT is given in [4]. The Lapack routines are documented in the LAPACK USERS' GUIDE [12], the auxiliary routines are only listed in this guide. The BLAS routines are described in the references [9], [10] and [11]. The routines from the NAG Library are documented in the NAG Manual [8]. A list of lower level routines used in SLICOT Release 2.0 is available from the WGS office. For contributions to future releases (beginning with Release 3.0), WGS highly recommends the usage of the new, de facto standard, linear algebra library LAPACK.

On the other hand, the implemented algorithms should have proved their numerical reliability. Therefore, a submission should include reference material (such as scientific publications or example programs demonstrating the operation of a routine under critical circumstances) that establishes this latter important property. Other algorithmic properties such as efficiency and user-friendliness might also play a role, however these are less stringent.

4 Areas of high priority in new releases of SLICOT.

In the next Release 3.0 of SLICOT the five areas indicated in the next table are defined as high priority areas. We especially invite interested contributors to make a submission in one of these areas. When you want to make a contribution in one of these areas, you can submit this contribution to the person of local contact assigned to that particular area.

Priority Area	**Person of Local Contact**
System Identification	Dr.ir. A.J.W. van den Boom Eindhoven University of Technology Dept. of Electrical Engineering P.O. Box 513 NL-5600 MB Eindhoven, The Netherlands e-mail: ersicavdb@er.ele.tue.nl tel: ++ 31 402 473289 fax: ++ 31 402 434582
$H\infty$ control and μ-synthesis Model Reduction	Dr. A. Varga DLR Oberpfaffenhofen German Aerospace Research Establishment Inst. for Robotics & System Dynamics (FF-DR) Oberpfaffenhofen, D-82230 Wessling, Germany e-mail: Andreas.Varga@dlr.de tel: ++ 49 8153 282407 fax: ++ 49 8153 281441
Time-varying Systems	Dr.ir. M.H.G. Verhaegen Delft University of Technology Dept. of Electrical Engineering P.O. Box 5031 NL-2600 GA Delft, The Netherlands e-mail: verhaege@dutentb.et.tudelft.nl tel: ++ 31 15 781442 fax: ++ 31 15 623271
Descriptor Systems	Prof. Dr. V. Mehrmann Technische Universitaet Chemnitz-Zwickau Fachbereich Mathematik Reichenhainer Str. 41 D-09107 Chemnitz, Germany e-mail: mehrmann@mathematik.tu-chemnitz.de tel: ++ 49 371 531 8367 (2659 Secretary) fax: ++ 49 371 531 2657

5 What is your benefit?

First of all, contributing to the SLICOT library must be seen as a scientific achievement. This is mainly because the current routines and those accepted in the future releases carry the label of (numerical) reliability. This high degree of confidence will hence stimulate and promote your ideas within the community of universities and industries active in the field of systems, control theory and signal processing.

Second, there is a direct benefit to your students. The implementation of newly developed research results or the recoding of existing routines according to the SLICOT standards will stimulate their proficiency in the development of professional software.

The centralization of these routines into a single library will facilitate and stimulate the distribution.

Finally, for a substantial contribution, you may request WGS for a copy of SLICOT at a reduced rate or for free. For that purpose, you fill in the special order form attached to this document and return it to the secretariat of WGS:

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