Report of the IEEE CSS on CACSD

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Here is a summary of the activities of the TC during the second semester of 2008.

*** Software developments ***

C. SciYalmip v1.0 beta - http://www.laas.fr/OLOCEP/SciYalmip/index.html

SciYalmip is an attempt to implement within the Scilab environment the existing Matlab package YALMIP developed by Johan Loefberg for defining and solving advanced optimization problems. SciYalmip cannot support the whole family of solvers that are supported by YALMIP due to Matlab dependencies. However, the current version of SciYalmip supports 2 Scilab external solvers: CSDP by Brian Borchers and SDPA by Masakazu Kojima's team. Also there are some Scilab internal solvers which are being supported: LMISOLVER, LINPROG, QUADPROG. SciYalmip was designed to keep the interface as close as possible to Matlab's YALMIP. So if you are familiar with YALMIP, it should not be too difficult to start using SciYalmip. SciYalmip has been tested on Linux and Windows based platforms. It has been developed by Sergey Solovyev (N.I.Lobachevskii Univ. Nizhny Novgorod, Russia) and Pavel Pakshin (R.E.Alekseev Nizhny Novgorod State Tech. Univ, Russia).

*** Numerical methods for polynomials ***

I would like to mention several recent developments in numerical methods for polynomials, with the hope that they may have some impact onto computer-aided control system design methods.

On page 32 of the excellent survey article [N. J. Higham, M. Konstantinov, V. Mehrmann, P. Petkov. The sensitivity of computational control problem. IEEE Control Systems Magazine, February 2004], the authors claim that "Numerical analysts usually prefer the matrix/vector setting over polynomial and rational functions", or in other words, state-space methods over polynomial methods. They explain that "The reason for the preference for the matrix/vector approach in numerical methods is that the sensitivity of the polynomial or rational representation is usually higher than that of a matrix/vector representation". Recent achievements in numerical, methods for polynomials may however change the trend, in my opinion:

. chebfun project by N. F. Trefethen's team at Oxford Univ, UK - Collection of algorithms and software system in object-oriented Matlab, which extends familiar powerful methods of numerical computation involving numbers to continuous or piecewise-continuous functions. The idea is to use Chebyshev polynomial bases in a numerically stable and efficient way. Polynomial interpolation and root extraction can be carried out easily on polynomials of degree a thousand or more. See http://www.comlab.ox.ac.uk/projects/chebfun

. apatools project by Z. Zeng at Northeastern Illinois Univ, USA - A software toolbox for Approximate Polynomial Algebra, implemented for Maple and Matlab. The software can compute to machine precision polynomial roots of high multiplicity, e.g. for the polynomial (x-1)^30(x-2)^18(x-3)^12, see http://www.neiu.edu/~zzeng/apatools.htm

. eigensolve algorithm by S. Fortune, Bell Labs, USA - Iterative algorithm that approximates roots of a polynomial by computing eigenvalues of companion matrices expressed in Lagrange bases.

The algorithm can e.g. compute roots of the Wilkinson polynomial (x-1)(x-2)..(x-200), see [S. Fortune. An iterated eigenvalue algorithm for approximating roots of univariate polynomials. J. Symbolic Computation, 33:627-646, 2002] and http://www1.bell-labs.com/topic/swdist

. mpsolve algorithm by D. Bini, G. Fiorentino, Univ. Pisa, Italy - Can also approximate roots of univariate polynomials of high degree, see [D. A. Bini, G. Fiorentino. Design, Analysis, and Implementation of a Multiprecision Polynomial Rootfinder. Numerical Algorithms, 23:127-173, 2000] and http://www.dm.unipi.it/cluster-pages/mpsolve/

. spectral factorization of discrete-time polynomials of degree up to one million could be achieved with a Matlab implementation using the FFT, see [G. A. Sitton, C. S. Burrus, J. W. Fox, S. Treitel. Factoring very-high-degree polynomials. IEEE Signal Processing Magazine, November 2003]

It is hoped that these recent achievements can help control engineers design efficient and numerical reliable polynomial methods.

*** Conferences ***

N. Karampetakis (AG on symbolic methods) organizes the 6th International Workshop on Multidimensional (nD) Systems in Thessaloniki, Greece, June 29-July 1, 2009, http://www.nds09.org Deadline for submission of full papers and special sessions is February 1st, 2009.

N. Karampetakis was an invited session chair of the International Symposium on Computer-Aided Control Systems Design, IEEE Multiconference on Systems & Control (MSC'08), San Antonio, Texas, September 3-5, 2008.

V. Sima (AG on numerics) organized and chaired an invited session at this conference. The session was co-organized and co-chaired by Daniel Kressner.

D. Peaucelle and Y. Ebihara (AG on LMIs) organized an invited session at the IFAC World Congress 2008 in cooperation with Yasuaki Oishi, Nanzan University, Japan.
The session title is "LMIs and Algebraic Methods in Control".

P. Mostermann (AG on hybrid dynamical systems) is the industrial co-chair of the 2009 IFAC Conference on Analysis and Design of Hybrid Systems.

M. Hromcik (AG on polynomial methods) organized an invited session at the IFAC World Congress 2008. Together with V. Kucera, he is preparing a workshop on polynomial design methods at the EUROCAST 2009 event, to be held in February 2009 in Las Palmas de Gran Canaria, Spain.

*** Journals, books ***

P. Mostermann (AG on hybrid dynamical systems) is about to kick off a series of books on Computational Analysis, Synthesis, and Design of Dynamic Systems for CRC Press, see
http://msdl.cs.mcgill.ca/people/mosterman/calls/casd/casd_cfa.pdf
Anybody who has any interest in publishing as part of this series is encouraged to contact P. Mostermann.

*** Next meeting ***

I am planning a meeting of the TC during the European Control Conference, 23-26 August 2009, Budapest, Hungary.