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# ALGORITHMS FOR APPROXIMATING THE $H_\infty$ NORM

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## Abstract

$H_\infty$  norm methods are used in control theory to design optimal controllers. The controllers are designed so as to minimize the  $H_\infty$  norm of the  $n \times n$  closed-loop transfer matrix where  $n$  is the system order. This optimization procedure necessitates efficient methods for the computation of the  $H_\infty$  norm itself. Existing methods compute  $H_\infty$  norm accurately but the cost is multiple singular value decompositions or eigenvalue decompositions of size  $n$ , making them impractical when  $n$  is large. We present a novel method which provides a fast computation of the  $H_\infty$  norm for large and sparse matrices, such as the ones arising in the control of PDE's. The method is a nested fixed point iteration, where the outer iteration is a Newton step and the inner iteration is associated with the problem of the computation of the  $\varepsilon$ -pseudospectral abscissa, i.e. the real part of a rightmost point of the  $\varepsilon$ -pseudospectrum of a linear operator in a sense to be precised. We characterize fixed points of the iteration, proving a locally linear rate of convergence for small enough  $\varepsilon$ . We will give some applications to the control of PDE's. We also prove some regularity results about  $\varepsilon$ -pseudospectral abscissa, including global Lipschitzness, which led to a resolution of the Lewis-Pang conjecture. If time permits, I will describe some of our other work on fixed-order controller design. This is joint work with Michael Overton and Nicola Guglielmi.

**Date :** Friday, December 30, 2011

**Time:** 14:00

**Place:** IMBM Seminar Room, Boğaziçi University