Report on "Solving Large-Scale Semidefinite Programs in Parallel" by Madhu V. Nayakkankuppan

This paper presents a parallel implementation of the spectral bundle method, which was originally proposed by Helmberg and Rendl [12], for solving large-scale SDPs (semidefinite programs). There are three major points that should be evaluated. The first point is some techniques to enhance the computational efficiency of the spectral bundle methods, which include an active block strategy and a subdifferential model. The second point is an efficient parallel implementation of the spectral bundle method. In particular, distribution of data matrices C, A_i $(i = 1, 2, \ldots, m)$ to processors looks to work effectively in the proposed parallel implementation of the spectral bundle method for solving huge-scale SDPs. The third point is numerical results. This referee is satisfied with the first and second points, but feels that the third point is a little bit weak and could be strengthened. See Comment 4 below. The paper is well-organized and the presentation is clear.

1. p.4, equation (7): $\langle \bar{g}, \bar{g} \rangle \;\rightarrow\; \langle g, g \rangle$?

2. p.15, Table 1: Concerning the SDP relaxations arising from quantum chemistry, a little more information on 22 blocks should be given, for example, the largest and average block sizes.

3. p.20, Table 7: At row NaH and column 64: I suspect that 00:08:20 and 00:07:40 are typo since these times are too small compared to the case of 32 cpus.

4. I feel that numerical results reported in Section 9 are a little bit weak to see the real power of the parallel spectral bundle method. Specifically, as you mention, numerical results on the SDP relaxations arising from quantum chemistry are of no practical importance. Also, numerical results on similar and larger size SDPs of the same type with higher accuracy were reported in the recent papers [28] and

   [A] M. Yamashita, K. Fujisawa, M. Fukuda, M. Kojima and Kazuhide Nakata, "Parallel Primal-Dual Interior-Point Methods for SemiDefinite Programs", B-415, Dept. of Math. and Computing Sciences, Tokyo Institute of Technology.

   Among the problems listed in Table 1, two problems theta-5k-67k and theta-5k-100k, which are really large or huge scale, certainly deserve to be solved by the paralell spectral bundle method. Additional numerical experiment may not be easy, but it would be nice if you could add numerical results on some large scale problems from SDP relaxations arising from combinatorial optimization to show the real power of the parallel spectral bundle method. You may be interested in the paper

   [B] K.Nakata, M.Yamashita, K.Fujisawa, M.Kojima, "A Parallel Primal-Dual Interior-Point Method for Semidefinite Programs Using Positive Definite Matrix Completion", B-398, Dept. of Math. and Computing Sciences, Tokyo Institute of Technology, where problems with m=40,000 arising from SDP relaxations of max cut and max clique problems are solved.

5. The parallel spectral bundle method works more effectively on an SDP with data matrices consisting of smaller size block matrices rather than an SDP with larger scale data matrices consisting of a single sparse block. Is this true? If so, to handle SDPs with the latter type of data matrices, it may be a good idea to combine the conversion method proposed in the paper [6,19], which converts an SDP with data matrices of a sparse single block into an SDP with data matrices of many small blocks.