Fault-Detection by Result-Checking for the Eigenproblem[1]

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Abstract. This paper proposes a new fault detection mechanism for the computation of eigenvalues and eigenvectors, the so called eigenproblem, for which no such scheme existed before, to the best of our knowledge. It consists of a number of assertions that can be executed on the results of the computation to determine their correctness. The proposed scheme follows the Result Checking principle, since it does not depend on the particular numerical algorithm used. It can handle both real and complex matrices, symmetric or not. Many practical issues are handled, like rounding errors and eigenvalue ordering, and a practical implementation was built on top of unmodified routines of the well-known LAPACK library. The proposed scheme is simultaneously very efficient, with less than 2% performance overhead for medium to large matrices, very effective, since it exhibited a fault coverage greater than 99.7% with a confidence level of 99%, when subjected to extensive fault-injection experiments, and very easy to adapt to other libraries of mathematical routines besides LAPACK.