

A THEORETICAL COMPARISON BETWEEN INNER PRODUCTS IN THE SHIFT-INVERT ARNOLDI METHOD AND THE SPECTRAL TRANSFORMATION LANCZOS METHOD*

KARL MEERBERGEN[†]

Abstract. The spectral transformation Lanczos method and the shift-invert Arnoldi method are probably the most popular methods for the solution of linear generalized eigenvalue problems originating from engineering applications, including structural and acoustic analyses and fluid dynamics. The orthogonalization of the Krylov vectors requires inner products. Often, one employs the standard inner product, but in many engineering applications one uses the inner product using the mass matrix. In this paper, we make a theoretical comparison between these inner products in the framework of the shift-invert Arnoldi method. The conclusion is that when the square-root of the condition number of the mass matrix is small, the convergence behavior does not strongly depend on the choice of inner product. The theory is illustrated by numerical examples arising from structural and acoustic analyses. The theory is extended to the discretized Navier-Stokes equations.

Key words. Lanczos method, Arnoldi's method, generalized eigenvalue problem, shift-invert.

AMS subject classifications. 65F15.

*Received November 11, 1997. Accepted for publication August 4, 1998. Recommended by R. Lehoucq.

[†]LMS International, Interleuvenlaan 70, 3001 Leuven, Belgium. Current address: Rutherford Appleton Laboratory, Chilton, Didcot, OX11 0QX, UK. (K.Meerbergen@rl.ac.uk)