APPENDIX I
MODAL ASSURANCE CRITERION FOR THE CYLINDER

To verify that the structural resonant frequencies of the cylinder (as described in Chapter 2) are similar to the modal frequencies, the modal assurance criterion (MAC) is applied (Maia and Silva, 1998). The MAC can be used to establish a measure of how close the operating shape approximates the mode shape of the cylinder and to determine the location of the modal natural frequencies. At a resonant frequency, the structural operating shape will be dominated by a particular mode at that frequency. In the analysis presented in Chapter 2, the cylinder's resonant frequency is used to approximate the location of the modal natural frequency. Modal frequencies and resonant frequencies of a structure are not necessarily the same. This is especially true if the modes are not well separated. If adjacent modes are close in frequency, then the operating shape will be dominated by nearby modes.

In this work the MAC is applied to the experimentally measured spatial operating shape (as described in Chapter 4). The operating shape is compared to the spatial mode shape as defined in Eq. 2.8. The theoretical mode shape may not be exactly the same as the mode shape for the cylinder due to imperfections in the created boundary conditions. Therefore the results from the MAC are not exact but should be sufficiently close for comparison purposes.

The spatially measured operating shape (Chapter 4) and the theoretical mode shape for the cylinder are compared between 900 and 2400 Hz. The MAC is performed on the data for eight different modes {(2,1), (3,1), (4,1), (3,2), (4,2), (2,2), (1,1), (5,1)}. The maximum value of the MAC for each comparison is indicative of the location of the modal natural frequency. The magnitude of the MAC at each of these peaks is a measure of how well the operating shape approximates the theoretical mode shape. If the operating shape matches the mode shape perfectly, the MAC at that frequency is unity. The result for the seven different comparisons is shown in Fig. I.1. The results are also compared in Table I.1.

Based on Fig. 2.7 and the results presented in Table I.1 and Fig. I.1. adjacent mode coupling is apparent. This is particular true for modes with low MAC magnitudes.

Table I.1 Comparison of modal properties for the cylinder

Mode	Experimentally Measured Resonant Frequency [Hz]	Modal Natural Frequency [Hz]	Difference [Hz]	MAC
(2,1)	948	952	4	0.978
(3,1)	972	972	0	0.820
(4,1)	1528	1528	0	0.973
(3,2)	1836	1820	16	0.955
(4,2)	2044	2044	0	0.946
(2,2)	2113	2120	7	0.877
(1,1)	2232	2208	24	0.745
(5,1)	2395	2384	11	0.834

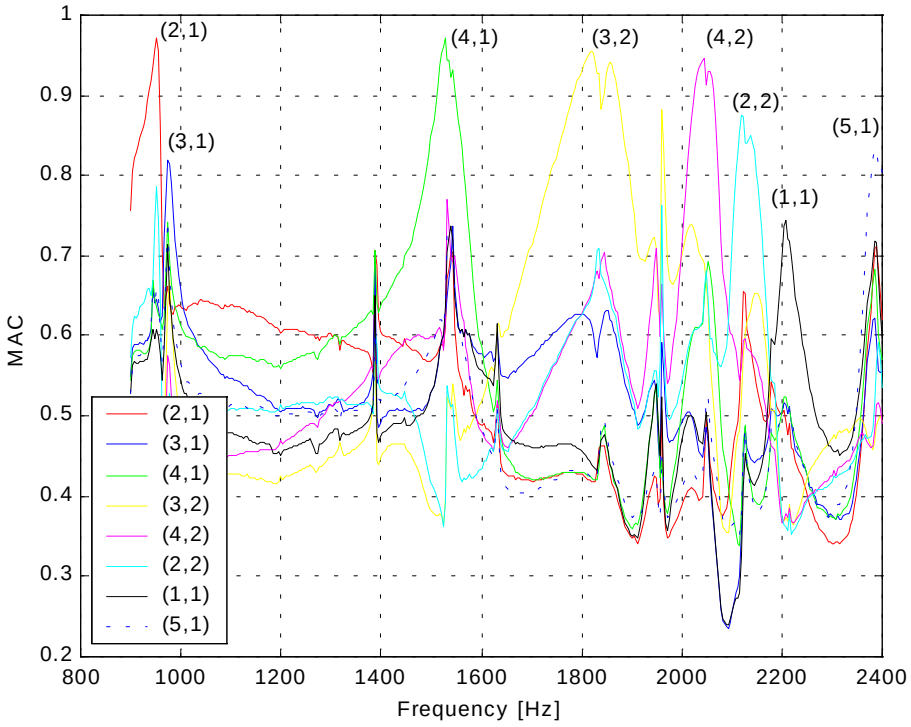

Figure I.1 Comparison of the MAC of the cylinder operating shape for the different modes.