CHAPTER 7

Conclusion

7.1 CONCLUSION

Two frequency domain force identification procedures were considered in this work, i.e. the frequency response function method and modal coordinate transformation method. Both numerical and experimental examples were used to assess the performance of each technique.

The objective of this research was to implement these methods in an experimental investigation on a simple, well-behaved structure, given the lack of experimental work pertaining to especially the modal coordinate transformation method. A single harmonic force was determined on an aluminium beam subjected to different boundary conditions. The work was then extended to predict two sinusoidal forces from measured acceleration and strain signals.

The frequency response function was sufficiently successful in identifying the forces for the majority of experimental studies, with the exception of the dual force inputs on the free-free beam, which certainly requires further attention. Some of the most important issues concerned with this method are:

- Force predictions at the structural resonant frequencies are likely to behave ill-conditioned due to errors in the measured response and frequency response functions.
- The method has the ability to account for the residual terms, which might have a significant effect on the accuracy of the frequency response function and consequently the force estimates.
- Frequency response functions must be measured at all the expected force input locations.

In the modal coordinate transformation method the pseudo-inverse is generally well-conditioned and the analysis is computationally much faster than the former method. The method also has the advantage of identifying forces at locations that are not included in the initial frequency response function measurements. Despite the advantages associated with the modal coordinate transformation method this method has shown rather limited success. The difficulties encountered were not as much due to the numerical formulation of the method as they were to the prerequisites required:

- This method requires a good set of modal parameters from which one should be able to reconstruct the originally measured frequency response functions.
- More modes are needed in the force identification process than the number of modes required in the modeling of the response of a structure.
- The contribution of residual terms of the truncated modes should be small in the analysis frequency range.

Based on the results presented it was concluded that the frequency response function method was superior to the modal coordinate transformation method for the experimental examples considered.

7.2 FUTURE WORK

Further experimental studies on more complex structures should be investigated to make the force identification methods more applicable to real engineering structures.

The determination of distributed forces needs to be further developed. In particular, the number of equivalent discrete force estimates that one would require to approximate a particular continuous forcing function.

The issue concerning the truncation problem, i.e. the number of modes required to successfully apply the modal coordinate transformation method also requires further research.

It would also be interesting to examine the effect of measurement positions with respect to the excitation locations on the condition number and accuracy of the force estimates, considering three particular situations: a) fully collocated inputs and outputs; b) partially collocated inputs and outputs; and c) fully non-collocated inputs and outputs. This suggestion follows from the fact that for some time domain identification methods the relative position of the inputs and outputs has been found to have a significant influence on the stability of the inverse problem.