

## **Summary of the submitted Ph.d. thesis: Damping Estimation in Operational Modal analysis.**

The vibrations of a structure, when too high, can be responsible for many inappropriate events, for example discomfort for humans and fatigue failure of structural components.

A structure that is forced to vibrate has mechanisms that disperse the vibration energy and thus limit the vibration; this mechanism is known as *damping*.

Traditional designs have in the past resulted in heavy structures with high stiffness, that is not that vulnerable to vibrations and thus the damping of the structure has not been an important property to know.

With new designs and materials, many modern structures are lighter and more flexible, which in general makes the structure vulnerable to vibration and the knowledge of damping an important property to know.

The damping property of a complex structure can, however, be notoriously difficult to predict analytically due to the complexity of the damping mechanism. Therefore, it is often wanted to estimate the damping experimentally. Operational Modal Analysis (OMA) is an experimental technique that is used for dynamic characterization of structures, which include the damping. OMA provides an estimate of a mathematical model of the dynamics of a structure based on measured vibration responses of the structure. The model is presented in the so-called modal domain where the dynamics of the structure are described by *modes*, which have a natural frequency, a damping ratio and a mode shape; these together are known as the modal parameters. It is well known that the damping estimates from OMA can be associated with larger uncertainties than the natural frequencies and mode shapes, and it seems like a common opinion that the damping estimates from OMA are seldom reliable.

In the present thesis it has, however, been shown that the reliability of damping estimates from OMA is similar to that obtained from the more trusted Experimental Modal Analysis. The focus of the present thesis is on the usage of correlation functions in OMA and especially the challenges in obtaining reliable damping estimates. The usage of correlation functions in OMA, which is common, has been found attractive because the estimation of correlation functions does not include any choices and because the effect of measurement noise can be significantly reduced. However it has in addition been found that extra care must be taken when the damping is of important outcome. The damping estimates have been found much more sensitive to the choices made in an OMA than the natural frequencies and mode shapes. These choices include the usage of the correlation functions and the measurement time and strategy used when measuring the vibrations of the structure. Based on the found results some recommendations are suggested by the author, which are intended for cases where damping estimates are an important outcome.