Performing modal analysis typically consists of three basics steps: measuring the data, identifying of a modal model, and validating the model. For the second step, a very popular modal parameter estimator is the polyreference Least-squares Complex Frequency-domain (pLSCF) estimator, commercially known as PolyMAX. The PolyMAX estimator is computationally fast and always produces very clear stabilization diagrams, even when numerous modes are to be identified. The major drawback of the PolyMAX estimator is that the accuracy of its estimates deteriorates for high noise levels.

In this dissertation, we suggest improvements for the PolyMAX estimator in three distinct ways. The first part concerns the use of matrix orthogonal polynomials. We propose a new method to avoid the transformation from the orthogonal to the power polynomial basis that is known to be an ill-conditioned process. In the second and the third part, we introduce two different modal parameters estimators specifically designed to keep the advantages of the PolyMAX estimator while adding new features such as improved estimates in high-noise cases, proper handling of the measurements uncertainty in the estimation process and easy calculation of the uncertainty bounds on the estimated modal parameters. The estimator introduced in the second part is a combination of the Maximum Likelihood (ML) estimator, based on a common denominator rational fraction polynomial model, and the PolyMAX estimator. The estimator introduced in the third part is a ML estimator based on the modal model formulation. Both estimators show improved estimates of the modal parameters compared with the PolyMAX estimator. All estimators developed in this work are validated
and compared with some of the existing modal parameter estimators by means of simulations and real-life measurement data