

# Reliability of Wavelet Packet System Identification

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## ABSTRACT

In recent years various methods have been developed to identify structural system parameters. One approach for dynamical system identification is the application of wavelets. [1] uses Daubechies wavelets within a wavelet transformation algorithm and [2] investigates the biorthogonal wavelet transformation.

The basic challenge of such wavelet-based methods is the determination of an optimal set of approximation and detail coefficients to set up the linear equation system for the identification of the unknown parameters. A major improvement compared to the simple wavelet transformation is achieved by using wavelet packets. [3] presents an automatic best basis search to determine a suitable set of coefficients. However, this algorithm is not unique and identifies only one of the best sets of coefficients.

Due to the frequency decomposition of the wavelet analysis all these methods can handle a high noise level. Of course, the quality of the solution still depends on the noise level. The current practice of verifying the results are based on the known parameters or those obtained by other methods. Both ways are suboptimal to identify parameters of a genuine structure.

This study investigates the possibilities to increase the reliability of the identification of the system parameters by means of wavelet transformation and the wavelet packet algorithms without the knowledge of the correct solution. Condition numbers and optimization methods are used to detect the best set of coefficients to set up an optimal equation system. Furthermore, the presented methods are discussed regarding their challenges and feasibilities for practical system identification.

The developed algorithms have been implemented in the *SIang* Software package, which is available at the Bauhaus-University Weimar for research activities.

## References

- [1] V. Zabel, *Applications of Wavelet Analysis in System Identification*. PhD Thesis, Bauhaus-University Weimar, 2003.
- [2] M. Brehm et al. , Applications of Biorthogonal Wavelets in System Identification. *P. Neittaanmäki, T. Rossi, K. Majava, and O. Pironneau (eds.) Proceedings of the 4th European Congress on Computational Methods in Applied Sciences and Engineering, Jyväskylä, 24-28 July, 2004.*
- [3] M. Brehm et al. , Applications of Wavelet Packets in System Identification . *76. Annual Conference of the International Association of Applied Mathematics and Mechanics (GAMM), University of Luxembourg, March 28 - April 1, 2005.*