Technical University of Denmark

Popular science summary of the PhD thesis

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Title of the PhD thesis	Substructuring for Contact and Stochastic Dynamics
PhD school/Department	Department of Civil and Mechanical Engineering

Science summary

* Please give a short popular summary in Danish or English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology:

Many modern engineering systems, such as electroacoustic devices and wind turbines, are built from multiple components that are designed and manufactured individually. This modular approach allows for more efficient development and easier updates to individual parts. However, predicting how the complete system behaves when all components are assembled remains a major challenge, particularly when nonlinear effects or random forces are involved.

This thesis introduces nonlinear and stochastic substructuring methods for analyzing the dynamic behavior of such systems. Instead of modeling the entire structure as one large system, the proposed methodology divides it into smaller parts, i.e., substructures, which are analyzed independently and then coupled together using carefully tailored closed-form relationships. The substructures can be represented either through numerical simulations or experimental measurements, enabling flexible combinations of numerical and experimental data.

The research focuses on systems where nonlinearities, such as contact between components, play a critical role, as well as systems subjected to random excitation, such as wind or waves. The new methods operate in the frequency domain, which allows for more efficient analysis of vibration behavior across a wide range of frequencies. This leads to significant reductions in computational cost while maintaining high accuracy.

Applications include numerical and experimental evaluation of mechanical systems with contact, numerical analysis of mechanical systems with nonlinear absorbers, and offshore structures under wave loading. The results demonstrate that the proposed frequency-domain substructuring techniques offer a powerful and scalable framework for analyzing complex assembled systems with nonlinear and stochastic dynamics.

Please email the summary to the PhD secretary at the department