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**Lecture in CSM:**

# Virtual Acoustic Prototyping: Fundamentals and Industry Case Studies

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## ABSTRACT

The analysis of structural dynamics is an essential step in the development of high-tech mechanical systems. This requires the creation of experimental or virtual dynamic models of the system components, which are then assembled to evaluate the dynamic properties of the complete product.

Blocked forces have revolutionized the design, testing, and simulation of complex structures across a variety of industries, most notably the automotive or household appliance sectors. In short, blocked forces describe the dynamic forces that an operating source (such as an engine, motor, or pump) imparts to a perfectly rigid receiver. What makes the blocked force so unique? It is a sub-structural invariant; the blocked force is an independent property of the vibration source and does not depend on the receiver to which the source is mounted. This enables the transference of the blocked force from, say, a test bench to a model or simulation. So-called virtual acoustic prototyping makes it possible to simulate acoustic responses of yet-to-be-developed products, allowing design and performance to be optimized early in the development process, reducing the need for significant prototyping efforts.

Whilst the invariance of the blocked force has been known for many decades, its direct measurement has always been fraught with difficulties. This work discusses experimental research efforts performed at ULFS in recent years, aiming to increase robustness in the experimental estimation of blocked forces. Academic papers are backed by various industry case studies carried out at ULFS, demonstrating the applicability of blocked forces in the early stages of product development.