Feedforward control of acoustic tests

Wezenbeek, S.; Laumann, S.; de Klerk, Dennis

Publication date
2016

Feedforward control of acoustic tests

Sebastian Wezenbeek [(1)], Sascha Laumann [(2)], Dennis de Klerk [(3)]

[(1)] ***TU Delft***
Mekelweg 2, 2628 CD Delft, Netherlands
EMail: s.j.j.m.wezenbeek@student.tudelft.nl
[(2)] ***Müller-BBM Vibroakustik Systeme GmbH***
Robert-Koch-Str. 13, 82152 Planegg
EMail: SLaumann@muellerbbm-vas.de
[(3)] ***Müller-BBM Vibroakustik Systeme B.V.***
Veldweg 81, 8051 NP Hattem
EMail: DdeKlerk@MuellerBBM-vas.nl

ABSTRACT

During a rocket launch a spacecraft is, among other loads, exposed to a potentially damaging acoustic load. Prior to space flight, ground tests are performed to determine whether a spacecraft, or a specific part thereof, can withstand the acoustic load. In a reverberation room, a typical sound pressure field is generated to simulate a rocket launch. An acoustic feedback control algorithm shapes a noise signal in order to achieve a given spectral pattern. The sound pressure levels are controlled in third octave bands.

A downside of feedback control in this particular case finds its origin in the time delay of the different subsystems. Especially excitation of the reverberation room results in a delayed response. Consequently, controlling the sound pressure level might lead to inaccuracies, because the influence of previous control actions cannot be observed instantly. Since the delay caused by this transient behaviour gains significance as the change in excitation increases, the feedback algorithm especially lacks efficiency when the test is started.

To bring the sound pressure level faster to the desired level, a different approach is studied. In contrast to feedback control algorithm, a feedforward control algorithm can operate efficient on a system with a delayed response.

The main advantage is of this approach is that by reducing the sound build-up time, energy is saved. However, identification of the system characteristics is, to an even greater extent, required for this approach. Therefore, for instance, non-linear acoustic phenomena that appear in high energy sound fields are quantified.

When the desired sound pressure level is approached, feedback control assures that the sound pressure levels remain constant. The knowledge acquired in the more thorough system identification can also be used to improve the feedback control. A stable sound pressure level throughout the test increases the reliability of the test as the chance of undertesting is minimized. What's more, unnecessary damage is prevented as the risk of overtesting is decreased.