Abstracts of the Webinar presentations, May 19th 2021:

1. TORSIONAL VIBRATIONS & THERMODYNAMICS - HOW DO THEY CONNECT?

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Abstract

As a direct consequence of the EEDI regulation, engines are becoming progressively smaller in relation to the size of ship they shall propel which results in a higher power density (mean effective pressure, mep) of the engine. Additionally, emissions regulations on the one hand and cost considerations on the other make system-wide thinking progressively more important. One example of this is the interaction between the thermodynamics (i.e. firing pressure curves) of the engine and the torsional vibrations in the propulsion system.

A well-known aspect is the LowTV tuning as employed by WinGD since 2005 where the firing pressure curve is modified in the area of the main torsional resonance in the low speed area such that the resulting tangential excitation forces are reduced in order to reduce the countermeasures needed to prevent inadmissible torsional vibrations in the installation components. A more recent example are the low pressure two-stroke gas engines that have become very common in the market. The firing pressure curves in these gas engines are completely different from what is known from the conventional diesel engines - this obviously has its implications for the torsional vibrations.

A third example shall be the variance of the firing pressure characteristics over the rating field, including the resulting implications for torsional vibrations.

2. ENHANCED TORSIONAL VIBRATION MODEL VERIFICATION BY MEANS OF CYLINDER PRESSURE MEASUREMENTS

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Abstract

The accuracy of a torsional vibration calculation (TVC) is mainly influenced by the correctness of input parameters such as inertia, stiffness, gas excitations and damping. Due to the uncertainty of the TVC, classification societies require a torsional vibration measurement (TVM) on sea trial for verification. On two-stroke direct driven propulsion systems, the TVM is normally done by measuring the crankshaft angular velocity or by strain gauge measurement on the intermediate shaft. All new two-stroke engines from MAN Energy Solutions (MAN ES) are equipped with PMI, a system capable of recording the angular velocity and the cylinder pressure for all cylinders. In this paper we have studied different methods for improving the TVC model by removing the uncertainty of the major excitation source, the gas excitations. One of the ideas we have studied is normalization of the measured angular amplitude harmonics by the corresponding measured tangential pressure excitations to eliminate the excitation variation. The normalized measured figures are compared with calculations of the torsional vibration for unity harmonic excitations. The normalized measured torsional vibration amplitudes appear much smoother as a function of speed and are therefore easier to compare with calculations. Furthermore, the modal analysis methods applied on the normalized data can extract the natural frequency and system damping with good precision. This may potentially be an enhanced method for torsional vibration model verification.

3. INFLUENCE OF ALTERNATIVE FUELS ON TORSIONAL VIBRATIONS

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Abstract

The need for emission reduction strategies for large bore combustion engines has been a main driver in engine development over the last years. The technologies applied have different impacts on torsional vibrations.

In the first part of the paper a short overview on relevant rules and measures to reduce engine emissions is given. Although a reasonable portion of them have a minor influence on the torsional vibrations (TV), it is necessary to study them.

In the main part, the influence of diesel, natural gas and hydrogen on the TV on an engine is studied. For this study cylinder pressure characteristics derived from these different fuels are applied to a torsional vibration model of an engine. The comparison of these simulations helps to understand the impact of the combustion of these selected fuels on torsional vibrations.

Nevertheless, the large variety of possible fuels lead to a high number of configurations and possible operation modes which need to be investigated at present and even more in the future.

4. STEP BY STEP MODEL BASED SYSTEM TESTING APPROACH FOR DRIVELINE TORSIONAL VIBRATION STUDY WITH APPLICATION FOR BOOMING AND TIP IN ATTRIBUTES

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Abstract

Over the past decades many drivers have made the automotive world change. Going towards lower fuel consumption, reaching higher safety level for driver and passenger, even significant steps towards autonomous vehicles have been taken in the recent years. But whatever the innovations, step forwards, mind changes in our mobility habits, the industry considers the driving experience, subjective feeling, comfort as being at the center of the design choices.

Torsional vibration issues generated by the torque irregularities of a combustion engine or transient phenomena is a typical concern for auto OEMs or driveline manufacturers. This paper describes a Model Based System Testing approach for optimization of the driveline. A three-step approach is presented starting with system simulation model creation. Model parameterization is done either from specifications or retrieved from component reverse engineering. The model is then validated using the Functional Mockup Interface (FMI) 2.0 standard for direct test/simulation comparison. Finally, the validated model is used for NVH target optimization in view of next vehicle design. Two concrete example cases are used to illustrate the concept: booming noise optimization in a benchmark vehicle with CPVA and tip in vibration in a known vehicle using different ECU control parameters.