

OCEAN Reduces the Data Volume of Long Term Measurements

Long term measurements generate voluminous data with their handling and subsequent analysis becoming so extensive, that their cost-benefit equation is questioned. OCEAN - Online Counting Evaluation and Analysis - reduces the data volume at source and is considered a step towards a stress dependent maintenance system.

Design, engineering and testing of new vehicles requires numerous test drives with the vehicles equipped with extensive and costly sensors. Often, more than one hundred test points are attached to the vehicle. The overall expenditure depends not only on the number of measurement points but also on the pertaining measurement equipment (number of channels and disk capacity) and the necessary effort for data analyses. The measurement of wheel forces which are normally picked up by means of odometers is exceptionally cost-intensive. These measurements being carried out on test fields or typical roads result in voluminous data to be processed and analysed. The performance of long term measurements with many specially equipped test vehicles is extensive and costly and, moreover, would generate a data volume which cannot be reasonably processed. Due to these constraints the recording of long-term tests in real-time conditions is not possible, either. The analysis of country-specific stress scenarios owing to different road conditions and driving behaviour entails significant expenditure for the vehicle manufacturer. Long term measurements on several vehicles can still be carried out with reasonable effort by employing simple sensors and online reduction of data by appropriate counting methods. However, such reduced data lack essential information concerning the whole complex stress events. Loading data that were not measured is hardly possible to be established or derived from the reduced data base.

Online reduction of measurement data

The disadvantage of losing information with the acquisition of basic data in the data recorders through online counting methods are overcome by the so-called "Durability Transfer" concept which was developed by Prof. Dr. Ing Andreas Rupp, University of Applied Sciences, Kempten (FH-Kempten). This concept is based on an innovative frequency based data handling of the chassis' accelera-

tions which ensures that the frequency



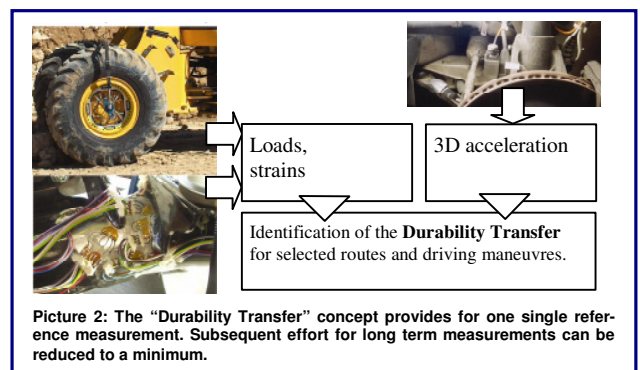
Picture 1. The OCEAN-One data recorder from Swift GmbH reduces the data volume during field testing to relevant characteristics whereas frequency and deterioration relevant information is retained. (Picture: Swift GmbH)

information relevant to the deterioration is retained in the rainflow counting. The OCEAN-One data recorder available with Swift GmbH (Picture 1, www.swift-online.de) carries out online data reduction during long term measurements of any duration. Different drive operation conditions result in typical wheel loads, stresses and cutting loads at various areas of the vehicle (see Picture 2) which are characterised by

- complexity of their coaction,
- their intensity, and
- their frequency.

These drive operation conditions can be identified by their respective chassis' accelerations. However, the stress and load / time response can not be derived from the accelerations being effective at one wheel. But a correlation can be established between the chassis' accelerations and the deterioration of stresses, cutting loads and wheel loads. The "Durability Transfer" concept firstly provides for one single reference measurement at the selected measurement points. This reference meas-

urement is performed once with the test vehicle conventionally equipped with the relevant measurement points while carrying out typical driving manoeuvres on typical roads. The required measurement quantities are identified from the chassis' accelerations by means of the "Durability Transfer" software. Thereafter the effort for subsequent long term measurements can be significantly reduced. The data recorder OCEAN-One just records the three chassis' accelerations. It generates virtual channels through band-pass filtering and then reduces these based on a Rainflow method; in addition the counting results are evaluated online as deterioration. The offline software based on the transfer functions (identified earlier during the reference measurements) reconstructs the deterioration of stresses, loads and the wheel forces at the whole vehicle from the reduced data volume. The limitation to three acceleration sensors reduces the measurement equipment, minimises the disk space for the generated virtual channels to a few kByte and thus simplifies the measurement. In spite of the simplification the relevant information of the whole vehicle's complex stress events is still retained. The reduced effort and expenditures enable more efficient performance of long term measurements at larger scale. This applies equally for commercial vehicles, construction machines or rail vehicles. Analyses can be performed under real service conditions, country specific stress scenarios can be investigated or the deterioration of a vehicle or a whole fleet of vehicles can be individually monitored. The findings of such analyses can be used to schedule and optimise the preventive maintenance works, based not only on the mileage of the vehicle but also on its virtual stress history. *jk*



Picture 2: The "Durability Transfer" concept provides for one single reference measurement. Subsequent effort for long term measurements can be reduced to a minimum.