Development of a testing method for automotive shock absorber noise

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Abstract

The noise of automotive shock absorbers can be investigated and evaluated by considering the shock absorber as a single, standalone noise generating component or as a part of a fully operational car [1]. Both approaches may be justified and appropriate, depending on the noise problem at issue. Nevertheless, if one wants to analyze the nonlinear and transient behavior of automotive shock absorbers and other elements in car wheel suspensions in full detail, and especially if the emphasis is on the methodology development rather than on real-life measuring conditions, the use of a "semi-realistic" test rig and some simple, well controlled operating conditions can be advantageous.

The paper describes the design and fabrication of a test setup, investigates the possibilities and limitations of a simple vibro-acoustic model of a car wheel suspension and reports on the development of a special 'transfer path analysis' method, adopted to the specific needs of shock absorber noise investigations.

The hardware of the system is based on the rear part of a fully trimmed car, see Fig. 1. The car is put on a robust steel frame, supported by rubber elements in front and by a special wheel supporting assembly in the rear. The essential element of this assembly is a specially converted air spring, taking up the static load of the car but still enabling dynamic excitation by a powerful electrodynamic shaker, see Fig. 2. Depending on the amplitude and frequency content of the excitation signal, various source generating mechanisms in the shock absorber can be activated and the resulting vibration and vibro-acoustic transmission investigated.

Figure 1: Test set-up, showing the car part, steel frame, shaker and data acquisition system. (Note that the left wheel is removed for reciprocal acoustic tests.)

Due to the strong nonlinearity of dominant noise sources in the wheel suspension, the definition of a simple single input / multiple transmission / single output model is not obvious. Nevertheless, it is shown that by using appropriate shaker excitation and reference signals for the FRF measurements, meaningful results can be obtained. Two sorts of transfer function measurements have been per-

formed: pure mechanical FRF measurements between acceleration input / output signals, and vibro-acoustical measurements between acceleration input and sound pressure output signals.

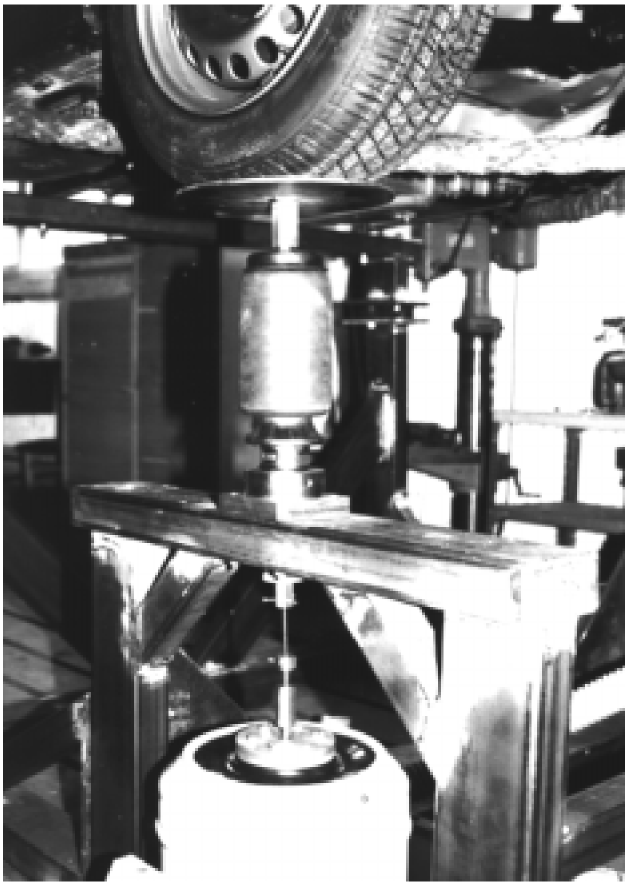

Figure 2. Wheel support assembly of the test rig. Shown are the steel frame, the air spring for static load and the electrodynamic shaker providing dynamic load on the tyre (by moving a steel rod going through the air spring).

Based on these transfer function measurements, the development of a special TPA method is also outlined and the evaluation of the first test results are shown. It was found that the applicability and accuracy of the method depends largely on precise bushing characteristics. A further evaluation of the method is in progress during the preparation of this abstract.

References

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2. *Uitwisseling van Technologie met Oog op Produktverbetering in Autoindustrie (UTOPIA).* International co-operation project with the Technical University of Budapest, financed by the Flemish Government and supported by Monroe Belgium, LMS International and K.U.Leuven.