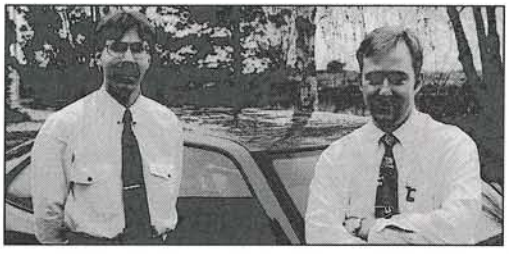
Measuring vibrations in exterior rear-view mirrors on cars

Anders Dahlén, Liceata Engineering AB



Liceata Engineering AB was formed in the autumn of 1994 by Hans Jartoft and Anders Dahlén, and its objectives included designing, with the permission of SAAB, this vibration-measuring equipment and offering it to customers in the car industry, subcontractors and consultancies.

Background

SAAB Automobile had no easy-to-use, repeatable method of measuring vibrations in the exterior rear-view mirrors on cars. The objective was to design a piece of equipment which could easily be fitted to a car and which displayed the vibrations in the rear-view mirrors in a manner which facilitated assessment of the performance of such mirrors. This equipment had to be flexible enough to be used on cars on a vibration rig, in a wind tunnel or on a test track.

Several different principles which were deemed applicable were investigated. We looked at methods such as inferometry and carried out tests using accelerometers. However, it became apparent that one method using a PSD to register the deflection of a laser beam reflected in the rear-view mirror would most accurately meet our requirements.

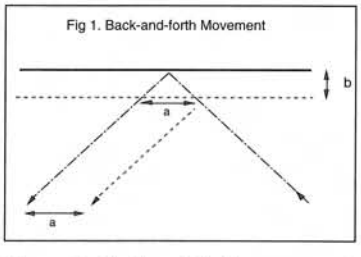


Figure 1: Back-and-forth movement.

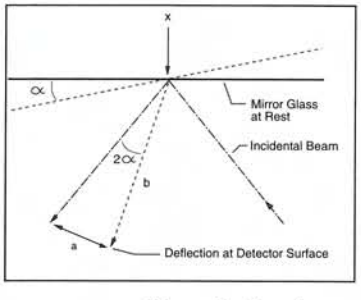


Figure 2: Angular deviation. The deflection depends on the distance between the glass of the rear-view mirror and the detector.

Measurement method

When a rear-view mirror vibrates, the drivers view of the object behind the car is distorted. There are primarily two types of movement which affect the quality of the image: a back-and-forth movement and angular deviation. When measuring the vibrations, it is important to know how these different types of movement are dealt with by the measuring equipment used. The principles of these two types of movement are described in Figures 1 and 2. The arrows represent the incidental laser beam and the reflected laser beam.

The reflected beams are parallel in the first illustration but not in the second. This is an example of properties pertaining to the measurement object which can be used when designing measuring equipment. Placing the detector close to the measurement object permits the user to emphasise the back-and-forth movement, while the contribution made by the angular deflection increases as the detector moves further away. Other factors which may be of significance in this particular case were the manner in which the equipment was attached to the car and the angle of the incidental laser beam.

Equipment

The equipment comprises a frame on which a laser diode and a two-dimensional SiTek PSD is mounted: see Figure 3.

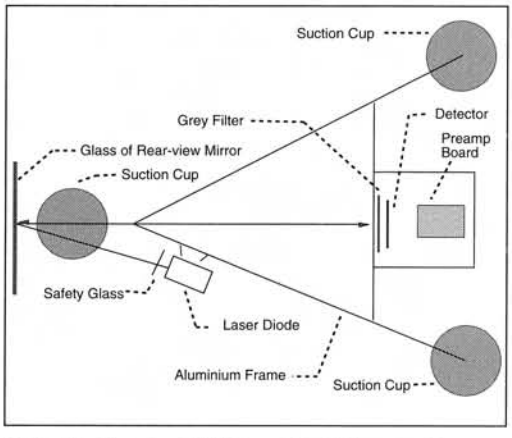


Figure 3: Frame with laser and position-sensing detector fitted.

A preamplifier board is directly connected to the detector. The signals are then transmitted via a flat cable in the car and to a measurement rack where two PM cards from SiTek are used to calculate the position of the reflected laser beam. The position signals are then processed in a data collection system and displayed in an appropriate manner, as a function of time, as an X-Y plot or as a spectrum, for example. The figure below is an example of a signal as a function of time.

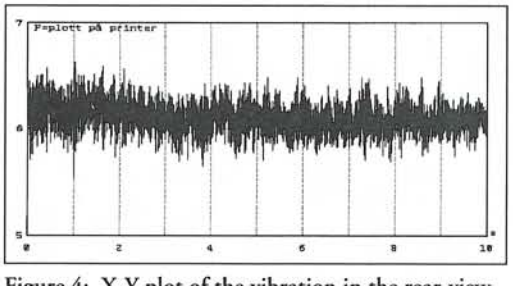


Figure 4: X-Y plot of the vibration in the rear-view mirror.

Since the distance between the glass of the rear-view mirror and the detector is known, the corresponding angular deviation can be calculated.