EngineWatch

6D measurement of engine motion

In vehicle development, exact information about engine-to-body clearance is necessary to ensure an optimal design of the available space. For example, the engine must not collide with other parts in the engine bay when the driver changes gears or deals with difficult driving maneuvers. AICON's optical measuring system EngineWatch is now available to measure engine movements precisely.

The system acquires engine movements in six degrees of freedom (6-DOF), both during a test drive and in a test station. Thus it replaces traditional devices such as mechanical travel sensors. The position and orientation of the measured points is depicted with absolute values in the vehicle coordinate system.

At the same time, it is also possible to monitor movements of other relevant parts in the engine bay, for example movements of the battery box. The optical measuring system EngineWatch works on a non-contact base i.e. without a mechanical connection between sensor and engine block. Therefore EngineWatch delivers reliable measuring results, also under extreme dynamic conditions. The measuring frequency goes up to 490Hz, and measuring data can be recorded for an unlimited period of time.
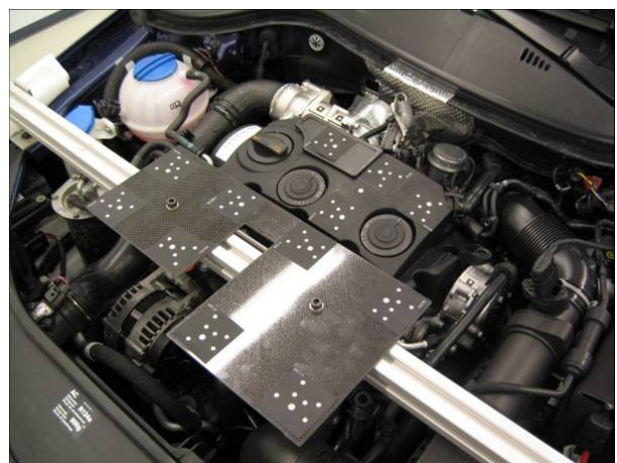
reference points on the engine block

Advantages at a glance

- short setup time
- 6-DOF measurements of movements in real time
- high accuracies (X, Y, Z: ± 0.1mm, angular accuracy ± 0.015°)
- measuring frequency up to 490Hz at unlimited measuring time
- measuring results are shown as absolute values in vehicle coordinate system
- no mechanical connection between sensor and engine block
- camera mount does not need high stability
- used for test drive and test station
- high speed camera also applicable for motion analysis of any other object


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Functional principle

EngineWatch is built around the high speed camera TraceCam F. The camera consists of a high resolution CMOS sensor, an integrated high performance flash, and an image analysis processor. TraceCam F features extremely short shutter speeds of just a few microseconds that are necessary for long-duration tests. It also ensures the system is robust and stable over time.

Mounted on a fixture, the TraceCam F camera directly focuses the engine block. The measuring principle is based on the detection of relative movements of two solid bodies. Therefore reference targets are placed on the engine block and on the car body in a way that the camera will focus all targets at the same time. Setup and calibration of the system take less than 30 minutes. The position of the camera to the engine block does not need to be stable as EngineWatch recalculates its position continuously using the reference targets. Hence, camera movements cannot influence the measuring results.

The measuring images are analysed in the sensor. Thus only the digital data are transferred to the notebook computer in real time, not the entire images. EngineWatch calculates the positions of the measuring points in X, Y, Z, and the rotation angle (alpha, beta, gamma) as absolute values in the vehicle coordinate system. For the presentation of the results, a path-time-diagram is created showing the X, Y, Z movements in the vehicle coordinate system. In order to visualize the measured movements in a CAD system, the measuring results can be exported to post-processing software via an interface.
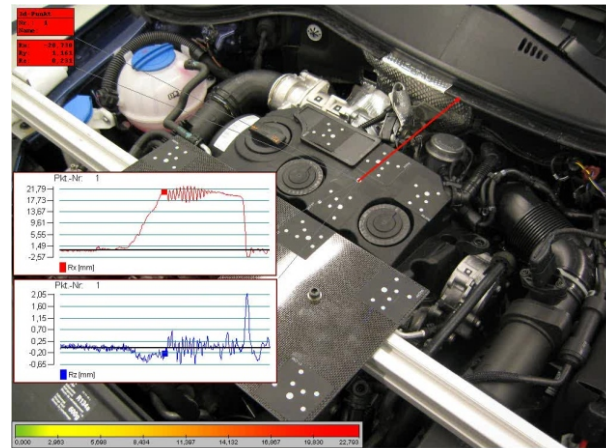
result presentation path-time-diagram for XYZ movements in vehicle coordinate system

Further areas of application - MoveInspect

The applied high speed digital camera TraceCam F can also be used for other motion analyses dealing with a big number of measuring points. When conducting a 3D analysis of other objects than the engine, at least two cameras are necessary that monitor the part from different viewing angles. The repertoire comprises e.g. door slam tests, closure tests of hoods, convertible tops, and windows, or material tests. Detailed information is available in our product brochure MoveInspect.

MoveInspect for 3D measurements of dynamic processes

Specifications

System	EngineWatch
System components	MoveInspect basic system with high speed camera TraceCam F, syncbox for 1-4 cameras (cascadable), laptop computer with EngineWatch software, one set of coded targets (ANCO-code), thereof 50 on magnetic mount, callibration panel with transportation case
Operating system	Microsoft® Windows® XP
Power supply	test drive: 12 Volt vehicle power system, test station: 90 - 240 Volt
Max. acquisition frequency	490Hz
Synchronization	20 mA Loop / TTL clock & enable IN/OUT
EngineWatch data set	X, Y, Z, alpha, beta, gamma, number of picture, time stamp (ASCII-Format)
Measuring volume (X, Y, Z)	1.000mm x 1.000mm x 500mm
Accuracy XYZ	± 0.1mm
Angular accuracy	± 0.015°