EVENTS

Automotive Testing Expo 2006
Shanghai
September 6–8, 2006

Engine & Environment
Graz
September 7–8, 2006

Fisita 2006
Yokohama
October 22–27, 2006

Automotive Testing Expo 2006 Detroit
Detroit
October 25–27, 2006

- **The new AVL ramp calibration system and the new IndiCal calibration software**
- **Indicating and Visiolution modules easily combined for the most comprehensive measurement tasks**
- **Release news: CONCERTO 3.8 IndiCom 1.5**
- **AVL Gas Exchange and Combustion Analysis (GCA)**
- **ECU interface: cause and effect analysis between ECU and combustion processes**
- **New 4CA1 crank angle calculator**
- **New spark plug sensor with integrated measuring element**

CHANGE THE PLUG!

New spark plug sensors with integrated measuring element for cylinder pressure measurement in Otto engines

The new spark plug sensor with integrated measuring element represents an absolute product highlight. In contrast to the measurement concept used to date involving a spark plug adaptor and pressure sensor, the new spark plug sensor with integrated measuring element heralds a new indicating product generation. The combination of the spark function with cylinder pressure measurement in a relatively small housing together with a low eccentricity of the spark gap of just 1.1 mm sets a new standard in cylinder pressure measurement. The high sensitivity for a spark plug with integrated measuring element combined with the high rigidity of the sensor body ensures outstanding signal quality. Thanks to the new spark plug sensor with concentric insulated connector, the preparation time of the engine is shorter as the measurement function is a fixed component of the spark plug sensor. The previously-required separate fitting of the pressure sensor into the spark plug adaptor is no longer necessary. With the launch of the spark plug sensor, a new insulator by Bosch also comes into use. This insulator with solid sintered-in platinum tip has already proven its robustness in a 30,000 km continuous running test under operational road conditions.
The ZI spark plug sensor (spark plug with integrated measurement function) with the also new, platinum-reinforced earth electrode is available in sizes M10 and M12 with the following characteristics:

	ZI21 (M10)	ZI31 (M12)
Pressure range [bar]	0 ... 200	0 ... 200
Overload range [bar]	250	250
Sensitivity [pC/bar]	8	12
Linearity [% FSO]	± 0.5	± 0.5
Sensitivity change at 200 °C ± 50 °C [bar]	< 0.6	< 0.6
Cyclic drift at p_i = 7 bar, 1300 min^{-1}	±0.6	± 0.6

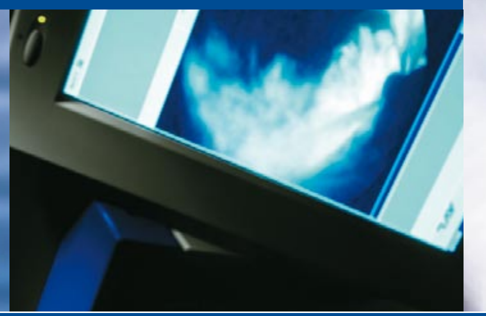
AVL combustion measurement technology

With single cylinder engines, indicating and optical instruments and techniques, AVL combustion measurement technology offers a comprehensive, modular platform for the development of combustion systems.

Accuracy and work-effectiveness in all tasks relating to combustion process development are dramatically improved by the synergizing of these various technologies.

- Single-cylinder engines and compact test bed for the verification of basic thermodynamic functions
- Transparent engines for the optimization of sophisticated injection and combustion processes
- Indicating technology for the comprehensive evaluation of thermodynamic sequences
- Endoscope and camera for close inspection of components in intake / exhaust manifolds and in the combustion chamber
- Visiolution methods for flame evaluation

AVL is the only supplier to provide the complete solution in combustion measurement technologies – from idea to product – from in house use on AVL's development test beds to products and testing methods applied by our customers.



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AVL

CONNECTING EXPERIENCE

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EDITORIAL

Dear reader,

This issue of the Combustion Measurement Newsletter will appear just in time for the 7th International Symposium on Internal Combustion Diagnostics. The variety of submitted topics emphatically emphasizes the topicality of this event. Also in this issue you will find up-to-date topics that will introduce you to new opportunities in combustion measurement technology and thus simplify your trade fair routine. It is not just a question of measurement alone, nor even the backup and follow-up, ultimately the documentation of plausible measurements is a central topic – keyword: AVL SDM SensorDataManagement.
This process support involves all parts of the indicating measurement chain (sensor, amplifier, data acquisition and data processing) that with their additional functions for SensorDataManagement are ideally coordinated with each other, but which are also flexible enough to meet your everyday requirements.
In addition, it is even more a question of supplementing indicating in its standard application through additional results from optical measurements and through linking with simulation tools, keywords: linking of indicating and Visiolution, AVL GCA Gas Exchange and Combustion Analysis. You will find suggestions on what is possible regarding added value in the combination of enhanced measurement and integrated calculation.
Thanks to ease of use, all products provide a significant increase in information in a considerably shorter time and support for your individual processes.

I hope you enjoy reading this issue,

Regards
Rüdiger Teichmann

INTERVIEW

Roland Moidl
Instrumentation: combustion development
BMW Motoren GmbH

The new AVL ramp calibration system and the new calibration software IndiCal as an important component of AVL SDM SensorDataManagement

1. For a long time now BMW Motoren GmbH in Steyr has been calibrating pressure sensors independently in-house. What is the reason for the switch-over of the calibration process to an automated solution using the new AVL ramp calibration system and the new AVL IndiCal calibration software?

Increasingly pressing demands for process reliability and efficiency made it necessary to scan the market for appropriate solutions.

Particular importance was attached to an overall solution with an end-to-end workflow, from calibration and data management to parameterization of the indicating system.

Our requirements were met admirably by the solution that was finally chosen.

In detail, these are:
- High efficiency of the calibration process;
- End-to-end networking right through to sensor identification in the sensor;
- Alternative solution of a sensor data connector;
- Compatibility with our systems and thus easy system integration;
- End-to-end SensorDataManagement with run time monitoring of sensors.

2. What expectations do you have for the new AVL ramp calibration system and the new AVL IndiCal calibration software?

Our expectations for the new calibration concept can be summed up as follows:
- Efficient calibration process with system-supported diagnosis of all sensors necessary for pressure indication;
- Quality assessment of sensors across the complete measurement range in one work step;
- Central archiving and networking of calibration data;
- End-to-end documentation of all calibration processes;
- Suitable for high and low pressure sensors;
- Automated prompt for recalibration in relation to a defined calibration interval based on actual sensor run times;
- Additional administrational information in the sensor database with integrated search engine or data screening.
- Expandable software basis;
- Flexibility;
- Free selection of the calibration process with the IndiCal calibration software: ramp or pressure jump calibration.

3. In your opinion, why must the "calibration of pressure sensors" work step be incorporated in the overall AVL SDM SensorDataManagement?

The consistency of all necessary sub-processes is of decisive importance for an efficient solution.
Different interfaces and user interfaces always mean extra time required in ongoing operation as well as in administration.

To achieve high process reliability, the smooth interaction from calibration and administration in the sensor database to sensor recognition at the measurement amplifier is of prime importance.

4. The high degree of automation in the overall AVL SDM SensorDataManagement solution requires rethinking on the part of the staff. What influence do you think the use of AVL SDM SensorDataManagement will have on the everyday work of your staff?

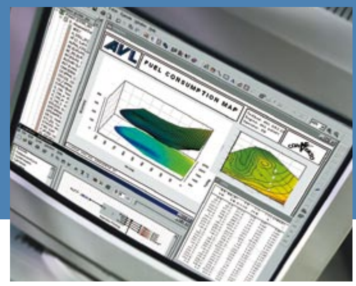
Naturally, the implementation of the new calibration process represents a major change in the handling of measurement requirements as well as in the administration of sensors.
The identification feature already integrated in the sensor, combined with the SID microIFEM technology make handling safer and enable other sequences in the preparation of the unit under test, which then benefits the utilization rate.

Activities shift from previously mainly manual tasks to the handling of data management.
The user is now supported by the system and even automatically prompted to recalibrate.

All-in-all this concept represents a further step towards more efficiency with a simultaneous boost in quality.

AVL SDM SensorDataManagement – a unique solution for sensor recognition



The task

As it has been in the past, in future combustion analysis will be a central process in the striving to achieve better performance and higher environmental compatibility in internal combustion engines. The indicating of all engine cylinders has increasingly become a standard configuration for the reliable verification of even small improvements.
As a consequence, the preparation of the engine for indication requires a high time outlay for the set-up of the measurement chain. For this the connection of the pressure sensors to the amplifier channels must conform with the channel assignment on the indicating device, and attention must be paid to the correct parameterization of the individual channels and the complete measurement chain. However, no matter how much care is taken there is no information as to whether the specification of the pressure sensor can still be maintained or whether the calibration interval has already been exceeded. Therefore all process data are controlled and managed, from the results of the sensor calibration to the use of calibration data in IndiCom.

The solution: AVL SDM SensorDataManagement

AVL SDM SensorDataManagement consists of several inter-coordinated components.

AVL ramp calibration system/IndiCal calibration software
In conjunction with the IndiCal calibration software, the AVL ramp calibration system produces and stores the calibration data necessary for the parameterization of the measurement chain. This is a compact system that is easy to use for both low and high pressure calibration. The calibration data no longer need to be input manually at the test bed, but are transferred automatically to the database by IndiCal and called up from there by IndiCom for parameterization. In addition, the calibration data are collected in a database. This provides the following advantages for the user:

- The stipulated calibration intervals are automatically maintained and monitored.
- A deterioration of the sensor, for example in the form of a rising linearity value, is detected in good time. Alternatively, IndiCal can also support high-precision sensor calibration with a dead weight tester.

AVL sensor identification
One of the main components of the AVL SDM SensorDataManagement system is the temperature-stable SID (Sensor Identification) identification unit that is integrated as a fixed feature in the pressure sensor (Fig. top left). Thus with SID it is no longer possible to mix up the pressure sensors. Also sensors already in use can be backfitted with the identification unit in the piezo input cable as an option.

AVL microIFEM
The central device for the implementation of AVL SDM SensorDataManagement is the microIFEM. The readout print for the SID is integrated in this high-performance 4-channel piezo amplifier with galvanic separation.

AVL IndiCom
In addition to the familiar functionality, AVL IndiCom serves as the central control software for parameterization.

AVL sensor database
The linking element between the above-stated components is the sensor database in which all sensor-specific information such as calibration data, running time, number of cycles, etc., is kept up to date.

Sensor database models

As the needs of the sensor database are dependent to a large extent on the number of users, two different models were developed for the database.

Workgroup model

The workgroup model (Fig. 1) is conceived for a small number (up to 5 users) who all have reading and writing authorizations for the sensor database. In this special case, a separate administrator for the database is not necessary. Therefore every access-authorized person can enter new sensors into the database, erase sensors or also input new calibration values into the database. This database version is stored either in a common directory on one of the IndiCom PCs or in a network directory to which all users in the workgroup also have reading and writing authorization.

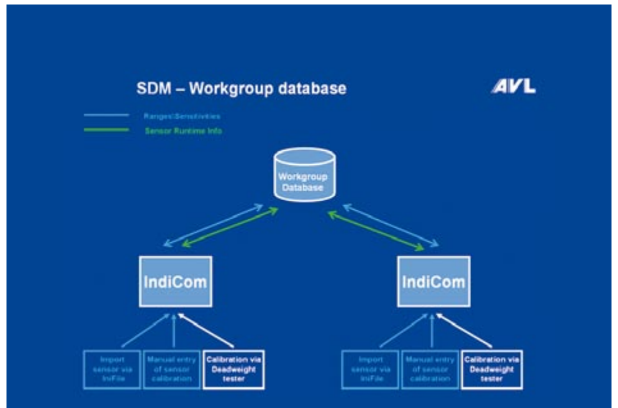


Fig. 1

Test bed facility model

The test bed facility database (Fig. 2) can be used for a test facility with more than five test beds, whereby the test bed users have only reading but not writing authorizations for the calibration database. In this case the database file is stored in a directory on a central test bed facility server. In addition, a second directory is required on the central test bed facility server, to which all users also have writing authorization. In this directory (file server for the sensor running time files) IndiCom stores information such as running time and number of cycles which is transferred automatically to the central sensor database.
The test bed facility model also supports mobile application without direct link to the central database. On every startup of IndiCom in the network, a copy of the central database is deposited on the notebook; this can then be used as the local copy in offline operation as long as no network is available. Thus the information concerning the achieved running time and number of cycles will be stored in a local IndiCom directory. When the notebook is back on the network and IndiCom restarted, the information concerning running time and the achieved number of cycles is automatically transferred to the data server for the sensor running time files.

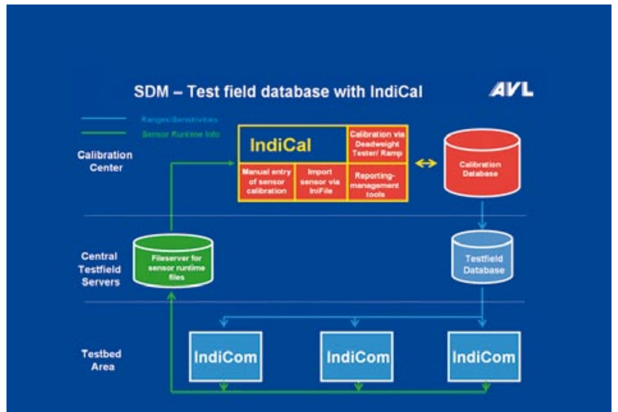


Fig. 2

Summary

AVL SDM SensorDataManagement consists of several components, each of which provides an enormous advantage for measurement reliability, however the full benefit for process control is only available when they are used together. Support for the process begins with data recording during calibration and ends with the allocation and administration of the sensor-specific information in the database and in the measurement file following successful measurement. This results in comprehensive documentation concerning the conditions under which the measurement values were collected. All sensor-specific information is available at the touch of a key and thus simplifies validation of the implemented measurements.

Indicating and Visiolution modules easily combined for the most comprehensive measurement tasks

The end user expects combustion measurement technologies to guide his ECU calibration with reliable data on engine thermodynamics and with information on actuator status. Easy and ready-to-use modules are a must for implementation within a measurement platform providing the whole chain from data acquisition to signal evaluation and archiving.

In engine series development, there is growing demand for testing an engine's operational limits. Here, utmost fexibility in reliable signal recording and the utilization of combustion pressure signals as evaluation and control parameters are criteria that are being increasingly applied in the selection of sensor technology and instrumentation.

Quite often, an engine's operational limits can only be tested within the complete engine or vehicle system. This puts the focus on systematic planning of engine tests exceeding the routine tasks of combustion pressure analysis. In a comprehensive network of combustion measurment technologies, such specialised tasks must smoothly fit into the framework of regular indicating techniques.

For this, the user has at his disposal a selection of sensors, signal acquisition facilities and user interfaces that make his work with combustion measurement technologies a straightforward, reliable and intuitive job. Together with conventional data on combustion performance, he accesses visual image data on mixture and flame distribution as well as continuous, time resolved flame evaluation signals within the framework of AVL's Visiolution technologies.

"Indicating and Visiolution instruments record the same combustion process! So it can be expected that any results are also precisely ascribed to the same combustion event" is a requirement that, although it could be met with skillfully synchronised system handling, is now offered in user-friendly handling quality with the improved signal acquisition and the IndiCom user interface.

"If a fuel spray or a flame situation is acquired in an endoscopic recording, then it must also be expected that in a results analysis the signal cursor can be moved through the cycle sequence and the respective images will be visible. Naturally the image sequence, indicating and Visiolution signals must reflect the cycle and be precisely assignable to the crankshaft position." Up until now this cause-and-effect representation was the territory of specialists who had to combine the appropriate equipment and correlate their measurement signals and results.

Here, too, refinements in data transfer between indicating, Visiolution and VisioScope devices enable easy, synchronous utilization of system functions. Work with the measurement results is carried out with the normal IndiCom functions that access the data in the corresponding devices.

An example from a gasoline engine: the single-shot display of a gasoline flame, the flame kernel and the corresponding pressure sequence is represented in Figure 1. On a cycle by cycle basis, the data sequence supports the systematic search for flow effects on flame kernel motion. Together with combustion pressure, this yields comprehensive input for a cause-and-effect evaluation of engine variants. Such results analysis is supported by the graphic and statistics functions of the AVL CalcGraf algorithms.

The benefit for the user? As soon as a cause-and-effect relationship between injection sequence, pressure development and emissions formation is precisely comprehensible, it is immediately obvious as to whether the engine's development potential has been fully exploited, or at which point improvement is still achievable.

A particularly challenging measurement task is the tracing of causes for sporadically occurring irregular combustion processes. Here, too, the networking of indicating and Visiolution measurement techniques provides the ideal platform for the reliable recording of combustion events. An irregular combustion event initiated by glowing residues is shown in Figure 2. Understanding its cause is supported by data showing the "mega-knock" events, the cycles preceding this event and settling down – or escalation in ensuing combustion cycles. This test technology is described at length in the issue dated 1/2005 of this Combustion Measurement Newsletter.

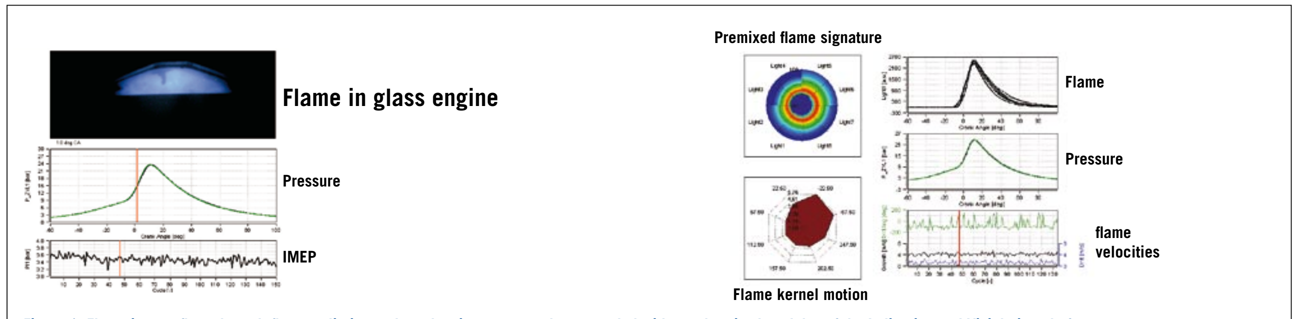


Figure 1: Flame image, flame kernel, flame radiation and combustion pressure data recorded with synchronised modules of the Indicating and Visiolution platform.

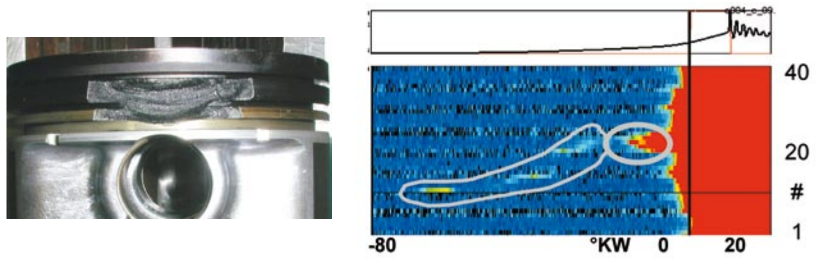


Figure 2: "Wild ping" phenomenon, set off by glowing residues. The causes are precisely identifiable thanks to combustion measurement technology.

With VisioMech, moving engine parts are made easily visible – even at the hottest places in the engine.

Observing periodically moved components exactly at that point in time when the weak points of their function are visible? That is precisely the task of stroboscopes that can freeze rapid rotations of any desired speeds by timed illumination with a flash lamp, or, even better, make them directly visible in slow-motion.

The key to engine development is provided by an angle encoder. This delivers a parameterizable trigger signal that programs a camera precisely with the recording rhythm of the rotational movement.

The implementation of these requirements is realized in the AVL VisioMech device. Thanks to a wide range of additional technologies, utilization is user-friendly and thus permits recording with the video camera of every component, irrespective of how inaccessible it is. In the simplest case this is a freely accessible drive shaft. Here, a lighting lamp, camera and objective are all that are required. But what happens when the component is in the interior of an exhaust turbocharger and only experiences proper motion when the engine is operated under high load? Inaccessible, hot and often also under high gas pressure: these are precisely the ambient conditions where cooled endoscopes and highlyresistant endoscope windows come into operation.

The exhaust flow in a turbocharger forces the wastegate valve open. The valve movement is directly visible with the cooled endoscope, even under the highest engine loading.

Precise and cycle-relevant calibration of diesel engines in transient operation.

You want to precisely identify those cycles and cylinders responsible for the highest contribution to soot emissions in a fast load cycle sequence?

Precisely here is where emission evaluation with the AVL diesel flame sensor comes into its own: the emission contribution of a combustion cycle is indicated directly from the light signal of the diesel flames in the combustion chamber.

In combination with additional measurement values, the developer can determine swiftly in which cycles injection, booster pressure and EGR must be coordinated very precisely with each other in order to be able to comply quickly and accurately with specifications for emission tests.

With a diesel flame sensor, VisioFEM and indicator the emission contribution from every individual cycle can be evaluated. This creates the basis for the precise, cycle-relevant calibration of transient engine tests.

CONCERTO 3.8

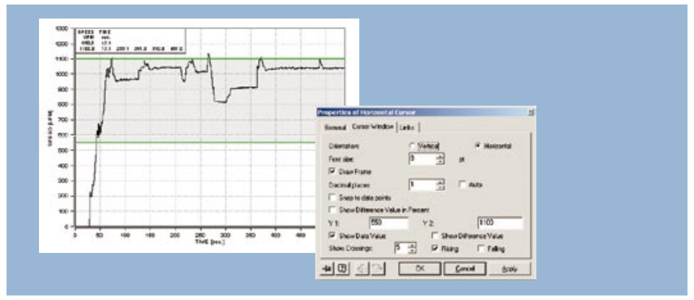
Optimum performance in data post-processing

Performance:
A highlight of the new release Concerto 3.8 is the further boost in performance which will enable a time-saving of up to 50%, particularly regarding calculation speed for formulae as well as the import/export speed of ASAM transfer files (ATFs).

Display objects/functions:
The wide range of display possibilities has been further extended in Concerto 3.8 with several new objects (circle/ellipse, pV-diagram for absolute volumina, movie object) and functions (transparent mode for all diagrams, tables and texts, display of all channel names to a Y-axis, free positioning of the X-axis, etc.).

Intelligent logical combination of differing datasets:
The combination of datasets with differing baselines (in respect of the measurement resolution and also the measurement range) is easily possible in Concerto 3.8 for a common display within one diagram, as well as for common processing in formulae.

Cursor functions:
The range of available cursor types was completed with horizontal cursors (e.g. for the checking of limit violations). The additional possibilities for the adaptation of the content of a cursor window as well as the cursor search functions provide the user with optimum convenience in data analysis.



INDICOM 1.5

Combustion analysis platform under continuous development

Performance:
Two to three times faster processing of online calculations, formulae and scripts in IndiCom 1.5 significantly speeds up the measurement system, particularly with complex measuring tasks.

Optical combustion analysis:
Thanks to the incorporation and synchronization of video objects, Visio-Scope data can now be directly evaluated together with indicating data in IndiCom.

National Instruments M series DAQs:
In addition to the E series, the IndiCom driver software for NI data acquisition modules now also supports the M series, thus making available a wide range of cost-effective acquisition modules in PCI, PCMCIA and USB versions.

Cumulative measurement:
Measurement mode for the IndiMaster Advanced 671, particularly for racing engines. A series of measurements is carried out in rapid succession and the data only transferred to the PC at the end of the series, thus reducing measurement time and stress on the engine.

Hardware extensions:
IndiCom 1.5 now supports up to three medium speed recorder cards. Thus, 24 time-based 12-bit/5 kHz channels can be recorded synchronously to the crank angle based channels.
It is now possible to reset all amplifiers or read out the sensor data (SDC/SID) via mouse-click or script command. In addition, up to 30 microIFEM amplifiers are supported on one device.

Display:
The extended display functions from Concerto 3.8 are also available in IndiCom.

Information depth grows thanks to AVL GCA Gas Exchange and Combustion Analysis

The Gas Exchange and Combustion Analysis (GCA) software option for AVL indicating devices provides detailed analysis of the gas exchange and combustion process directly on the test bed.

With GCA the user can select either a 1- or 2-zone combustion model in which the measured pressure curves, valve lift curves, flow coefficients, fuel parameters and engine-specific values can be applied as marginal conditions. The combustion analysis module delivers results such as rate of heat release, energy and thermal balance. The gas exchange analysis module is used for the calculation of the gas exchange parameters. These particularly include the mass flows via the valves for the further determination of the volumetric efficiency and the residual gas content. Thus results that are technically unobtainable by measurement are acquired by close correlation between measurement and simulation.

With gasoline engines nowadays the goal is to achieve optimum content in exhaust gas recirculation (EGR) in order to reduce the fuel consumption and NO_x emission at part load with limited p_i-variation. Thanks to AVL's CBR (Controlled Burn Rate) concept combustion process with port deactivation and system optimization can be performed considerably faster with the findings of the residual gas content in the cylinder.
Figure 1 shows a schematic diagram of a twin-port intake manifold with port deactivation system.

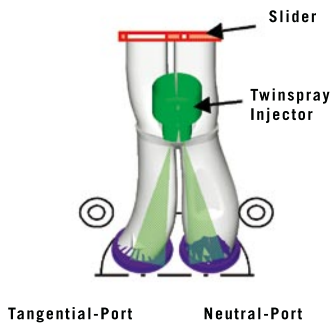


Figure 1: Twin-port intake manifold in a CBR engine

Applied purposively and systematically, the determination of the content of the EGR using the GCA combustion process systems enables allocation and differentiation according to AGR compatibility.

An example of an application of GCA is represented by a gasoline engine developed by AVL with camshaft actuators. The variation parameter is "exhaust valve timing against crankshaft". The later the exhaust valve closes, and thus the greater the valve overlapping time, the higher the EGR rate. Every single operating point is verified by means of GCA, Figure 2.

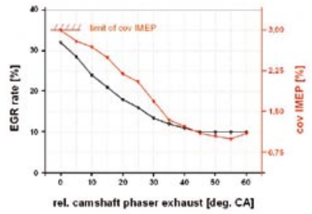


Figure 2: AGR rate and p_i-variation as a function of "cam phasing".

With this engine a compatibility of EGR content was achieved where n = 2000 min^{-1} and BMEP = 2 bar to 32% (mass related), as the p_i-variation reached its permitted limit value. The residual gas content result is available during the test immediately after every operating point.

The complete valve timing can also be checked quickly and easily using GCA. The influence of the valve timing determined on the power unit test bed on the proportion of the respective gas masses in the combustion chamber and therefore subsequently the residual gas content can thus be determined directly on the test bed.

"Wrong" valve timing actually causes differences in the cylinder pressure curve between measurement and calculation, as shown in Figure 3, left. In the calculation, the valve timing stated in the model results in a higher pressure level in the "exhaust open" range. There's something wrong here!

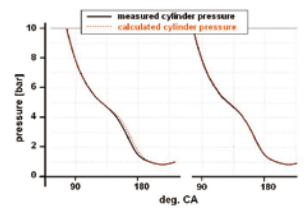


Figure 3: "Measurement-calculation" comparison of the cylinder pressure behavior in the exhaust phase left: wrong/right: correct

An adaptation of the "valve opening" behavior carried out by GCA directly at the test bed provides a significantly better correlation of measurement and calculation, see Figure 3, right. This improves the quality of the "residual gas content" value, which has a direct influence on setting parameters at the test bed.

The example clearly demonstrates that GCA is particularly suited for checking the measurement data from the power unit test bed under the conditions of the engine test bed directly for their plausibility.

Efficient vehicle application by systematic use of combustion measurement technology

Indication in the vehicle

The application outlay for modern engine and transmission concepts is growing as a result of the increasingly wide variety and complexity of engine and transmission control devices. In addition, falling emission limits and increasing demands on vehicle behavior are met decisively by the optimization of internal engine processes. Therefore indicating measurement technology is used for the verification and optimization of combustion processes in the vehicle. Thus the information acquired on the test bed concerning combustion can be optimally applied throughout the application process.

Vehicle application

Vehicle application generally refers to the adaptation of the engine or transmission control unit to the specific vehicle types. Essentially, a differentiation is made between the following tasks:

- Emission application on the chassis dynamometer;
- Road behavior application;
- Parameterization of correction functions such as for heat, elevation and cold;
- Exhaust aftertreatment application (e. g. diesel particle filter [DPF]);

These applications normally have an influence on the internal engine combustion processes. The known test bed results can therefore be applied only partially for evaluation of the application. The following example should cast more light on this topic.

Regeneration parameterization of a diesel particle filter

The modern high-torque, low-consumption diesel engine has been the focus of considerable criticism due to the health hazard of its particle emissions. In order to achieve the high temperature necessary for particle burn-off (up to 650°C), several phases have to be run through in relation to the available engine operational point. If the temperature of the oxidation catalytic converter is too low for satisfactory HC conversion, then in the first phase the catalytic converter temperature has to be raised to such a level by means of internal engine measures so that the additional HC introduced in the next phase can be burnt on the catalytic converter surface for heat generation. This exothermal reaction ultimately results in the required regeneration temperature.
In principle, particle filter regeneration systems can be divided into two types:

- Regeneration with nitrous dioxide (NO_2); and
- Regeneration with oxygen (O_2).

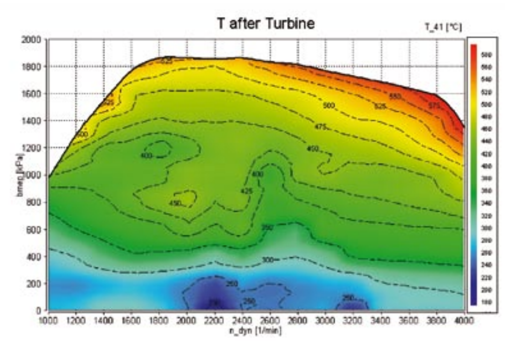


Figure 1: Temperature downstream of turbocharger

Considering the temperature before the filter in the engine operating parameter map (Figure 1), then it is clear that there is only a very narrow range at high load and high speed in which thermal regeneration can take place without additional measures. However, for vehicle operation this range is frequently irrelevant. In order to also ensure thermal regeneration in other parameter ranges, additional measures such as afterinjections are necessary. As a result of the propagation of shock waves in the injection system or injector diffusion, these afterinjections can have pronounced effects on combustion. The following diagram illustrates the occurring variations or fluctuations in the individual cylinder pressures (Figure 2).

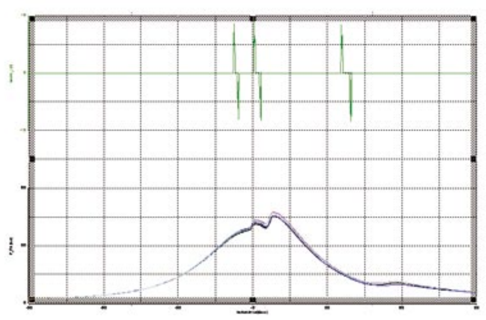


Figure 2: Fluctuations in the cylinder pressures

In this application case, indication in the test vehicle demonstrates the effects on the combustion (stability of the cylinder) and how this undesirable phenomenon is countered by applicative measures. Thus the time specification in the application can only be met with mobile indication.

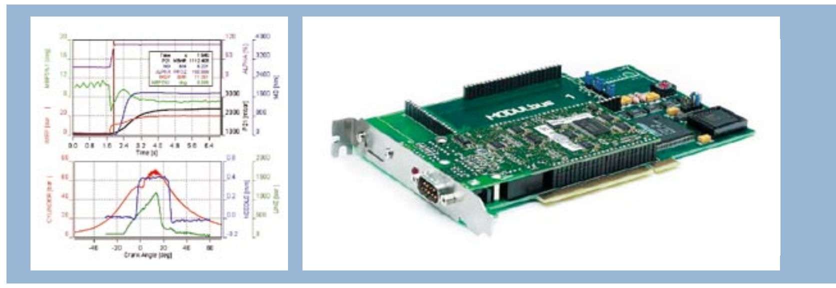
ECU interface Analysis of cause and effect between ECU and combustion processes

Area of application
Particularly in the fine-tuning of combustion and emission strategies in the vehicle, the correlation between engine control and the combustion processes are the key to success. The intelligence of IndiCom in the correlation of data with differing bases provides the ideal basis for analysis and optimization for the implementation of the test bed results in the actual vehicle.

ECU interface: the technology
IndiCom offers two possibilities for interfacing ECU signals:

- ASAM MCD3 interface for linking to the ECU via an application system;
- PC CAN cards in PCI and PCMCIA versions for linking to the CAN bus.

Recording and result output
In addition to recording CAN bus signals, with 2-channel PC CAN cards it is possible to output the IndiCom calculation results on the CAN bus. Thus the characteristic combustion values are also available to other systems for recording or for control processes.



Always the right angle
4CA1 crank angle calculator

Angle multiplication as a basis for high quality results

In addition to precise sensor technology and signal conditioning or data acquisition, the precise ascertainment of the crank angle is of prime importance in vehicle indication.
Only in very rare cases is there a possibility of installing a crank angle encoder in the test vehicle, so that the available crank angle signal of the crankshaft (normally 60–2) is employed and multiplied by means of a crank angle calculator. Here it is not sufficient to precisely represent the multiplication in stationary operation, but much more a question of recording or partially forecasting the dynamic effects (speed variations) using an intelligent system and processing the angle information for the data recording unit accordingly.
Thanks to an integrated intelligent algorithm, the new AVL crank angle calculator will meet this requirement to a high degree. The functional qualities of the device are rounded off by its compact design (9.5" * 1HU), the wide temperature range (-25°C...+65°C) and the wide-range power supply (9.5V...36VDC).