#### **Gas Exchange in Internal Combustion Engines**





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Accurate determination of important gas exchange parameters directly at the test bed based on existing measured values

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**AVL List GmbH** 

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## AVL GCA : Working Principle and Motivation





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#### **AVL GCA : Working Principle and Motivation** At the test bed In the simulation Highly relevant, non-measurable in-cylinder parameters are made available (e.g. internal AGR). - Accuracy high þ - Calibrating effort low þ - Calculation time low b Reduced AVL BOOST Model . IB2 MP3 Intake pressure curve Combustion analysis Cylinder pressure curve /Exhaust pressure curve

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#### AVL **AVL GCA : the Virtual Sensor** 0,51200 113532 107191 - Hustike (1995) وتعالى Alberta E MARY BUUNC F F 1964 0.58 ∕₽A GCA. ла (Ра 01079 -0.48 161.7 1.1-1 Measurements FIL WORK Δ6 0.010 12. 12.271 -0,41655 004 0002 43,044004 -70208 FLEL DERICA -7 0078 -0.02 -0112-2-21.525 -11 17/50 Automatical transfer of the ₹17÷°n $\{i \neq 0 \}$ Extract and display measuring data to the 21,7125 of results in IndiCom single cylinder-model 1,1,50 10.85 0,7500 0,0025 0,2750 ONLINE at the test ce 405 2041 - 451 - 495 - 271 - 571 - 51 625 2.00 O 2003/2008 MR. List Greent Advanced Contouriest Analysis Bullings C1 MP4 MP3 IB2 IB1 .... Thermodynamic MP6 MP5 calculation boost

#### Workflow





#### **Combustion Analysis**





### Gas Exchange Analysis





#### Loss Analysis





#### Ideal engine

Real charge

**Combustion position** 

Unburned

Burn profile (ROHR)

**Mixture properties** 

Wall heat

Blow by

Ideal gas exchange

**Real gas exchange** 







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#### **Results at speed** 2000 rpm, BMEP = 2 bar, $\lambda = 1$



#### Increasing valve overlaping means:

- Increase of total mass and residual gas at IVC
- Lower amount of fresh charge
- Increase of residual gas content
- Lower specific fuel consumption
- Increase of efficiency



#### **Solution: Loss Analysis**





Mixture properties Wall heat Efficiency +2%

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#### Wall Heat Loss





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#### **Mixture Properties**





#### Conclusion



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