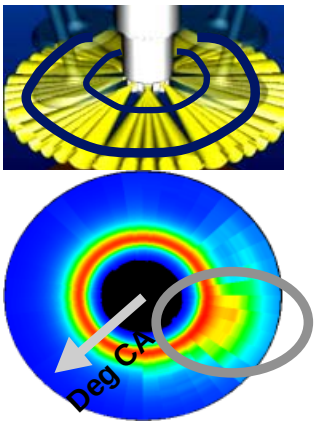


COMBUSTION MEASUREMENT TECHNOLOGIES

GASOLINE ENGINES MPFI

MIXTURE FORMATION FOR BEST COMBUSTION STABILITY

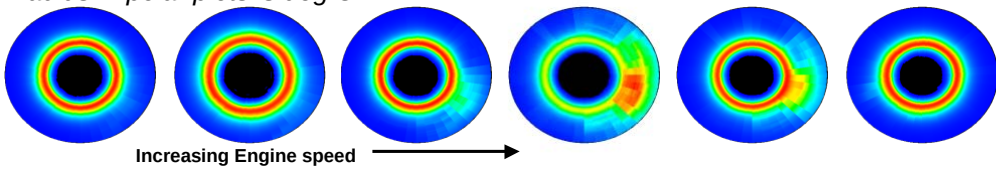
Evaluation of Mixture Formation Quality in Standard Engine Operation

Task / Challenge:
Higher than usual IMEP fluctuations in part load, insufficient transient response, soot emissions at tip-in operation

Possible Root Cause:
One cause for this behavior is found in mixture formation irregularities: substantial fractions of the fuel can attach to the combustion chamber surface and thus result in lean mixture until the deficit is compensated by increased fuel injection. This results in poor combustion stability, in delayed transient response and in increased engine out emissions.

Test Procedure
Mixture formation irregularities are detected by means of flame pattern analysis. Perfect homogeneous mixture results in premixed combustion; wall film fuel shows bright, local diffusion flames.

radius in polar plots is deg CA



Pre-mixed flame pattern

Pre-mixed and diffusion flame pattern

The example shows a speed sweep in an MPFI engine. At medium speed, substantial diffusion flame is seen as a result of spray wall film formation in one intake port.

Action: Utilize Visiolution flame pattern analysis for speed / load sweeps, stationary and transient operation
Data: Engine map showing load / speed areas with premixed and diffusion combustion
Result: Identification of operating areas with mixture formation deficit. Advice for improvements of mixture formation (injector selection, timing, targeting)
Action: Check success of calibration efforts with Visiolution Flame Pattern analysis

Benefit in Engine Development Process

- see if injection events are the root cause for combustion fluctuations
- application in stationary and in transient operation
- see immediate effect of injection system variations on premixed / diffusion flame pattern
- evaluate chances for modifications

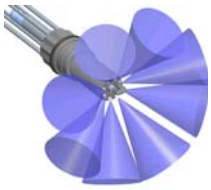
Methodology

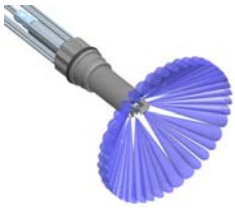
- Visiolution spark plug sensors
- flame cycle pattern evaluation software license

Technical Data

- Visiolution spark plug sensor (8 to 40 optical channels) together with data recording system

8 channel sensor





40 channel sensor for high angular resolution

- Visiolution „Flame cycle pattern“ analysis software
- spark plug sensors applicable in any type of engine configuration on test bed and on chassis dyno
- NA and TC engines
- Synch and Master / Slave operation with indicating system

Project Packages

- spark plug sensor procurement: 2 weeks are on stock, 8 weeks standard types, 10 weeks non standard types
- measurement packages: per week
- documentation and recommendations per measurement variant
- application package for Visiolution system users
- on site AVL measurement service supporting customer engine development projects