



MAN B&W Diesel

## Hercules Task 2.2 Status and Progress, March 2006



### **General objective:**

To develop numerical models on the formation of engine emissions

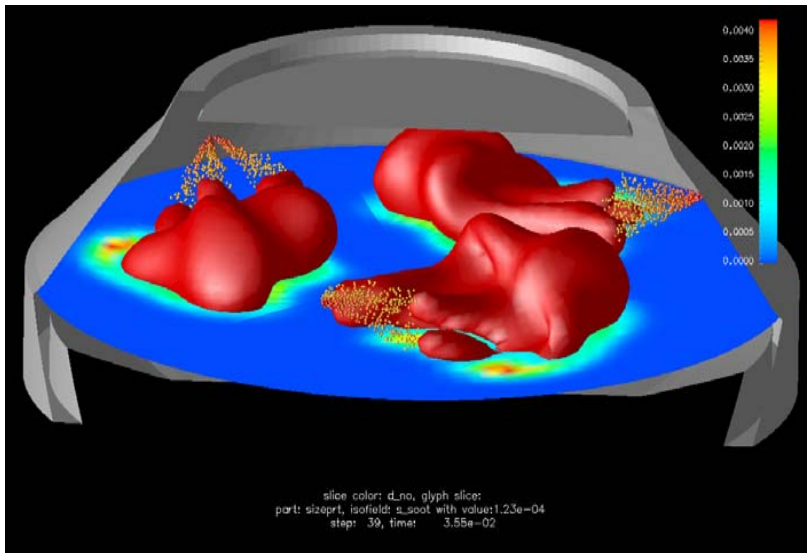
### **Detailed objectives:**

- Numerical description of in-cylinder flow
- Chemical description of combustion and emission formation
- Implementation and integration of sub-models
- Validation and evaluation against measurements
- Application to engine conditions

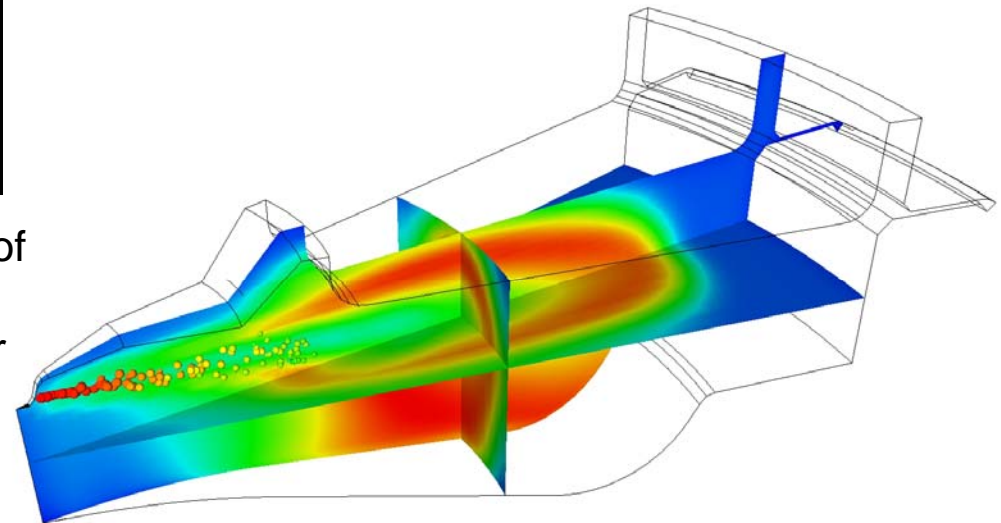


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# Three-dimensional modeling of in-cylinder processes



Simulation of two-stroke engine. Iso-surface of predicted soot and color-encoded NOx concentration on plane across the cylinder



CFD simulation for four-stroke engine on sector mesh showing one spray and temperature distribution along three planes



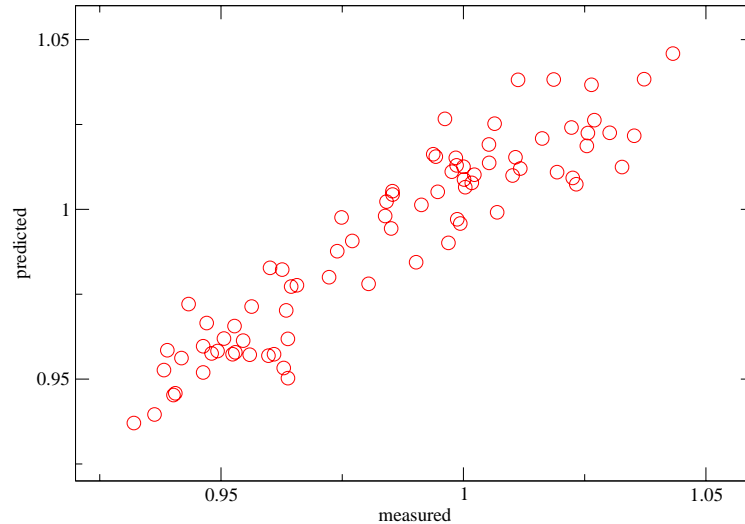
# Comparison of results with engine test data



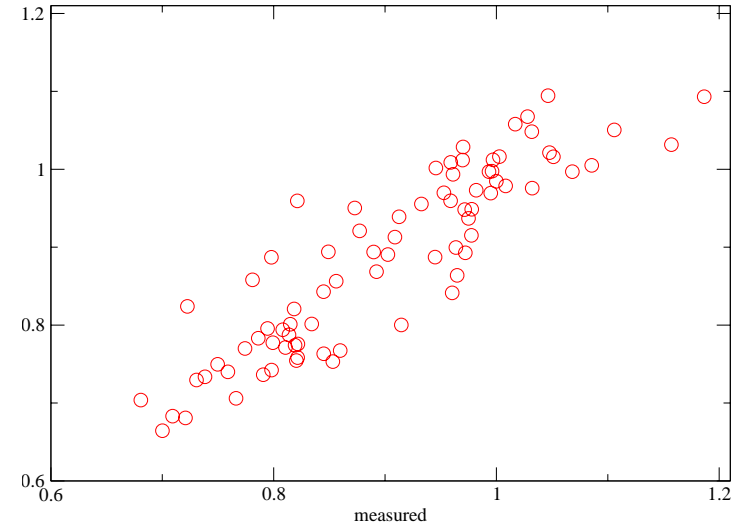
## MAN B&W Diesel test engine 4T50ME-X:

### 75 % Load, Variation of:

- Compression volume, pressure and temperature
- Fuel injection nozzles
- Fuel injection profiles



relative indicated fuel efficiency



relative engine-out NOx formation



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### Technical status, 3 years after start



- Practically all technical activity finalized
- Model results often surprisingly good with regard to SFOC, NO<sub>x</sub> and ignition delay
- Soot prediction improving thanks to flamelet based soot model, however still considerable problems
- Influence of fuel type on performance often correctly predicted
- Results depend heavily on correct boundary and initial conditions:
  - Fuel injection, timing, geometry, droplet sizes, ...
  - initial velocity (swirl) and charge temperature
  - Detailed studies on both fuel injection and swirl generation in progress
- Further experimental data needed, in particular local data from the combustion chamber interior
- Significant progress in reporting