Centro Interdipartimentale
per la Ricerca Applicata e i Servizi
nel Settore della Meccanica Avanzata e della Motoristica

InterMech Mo.Re.

Unità Operativa di Ricerca 1.1
AUREUM
AUtomotive REsearch University of Modena

Responsabile

Prof. Ing. Giovanni S. Barozzi

Referenti di Sottotema

Prof. G. Cantore – 1.1A/1.1B

Prof. A. Strozzi – 1.1C

Prof. M. Borghi – 1.1D

Prof. G. Ghermandi – 1.1E

Prof. A. Capra – 1.1F

TEMI UOR 1.1

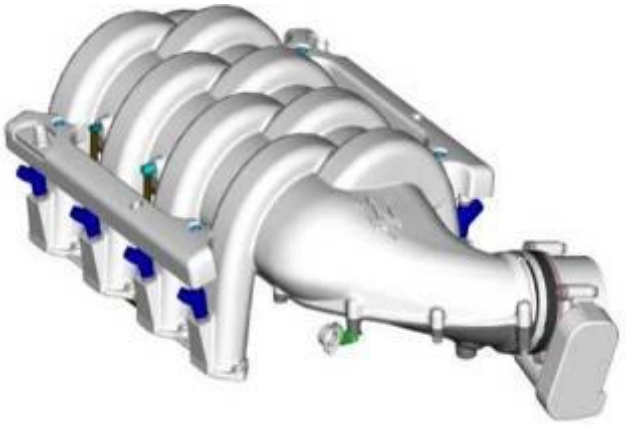
- UOR 1.1A – Analisi e controllo del processo di combustione e delle emissioni inquinanti allo scarico dei motori
- UOR 1.1B – Sperimentazione di combustibili alternativi e di motori multi-fuel
- UOR 1.1C – Analisi termo-meccanica per l'ottimizzazione strutturale dei motori
- UOR 1.1D – Laboratorio di Idraulica del veicolo

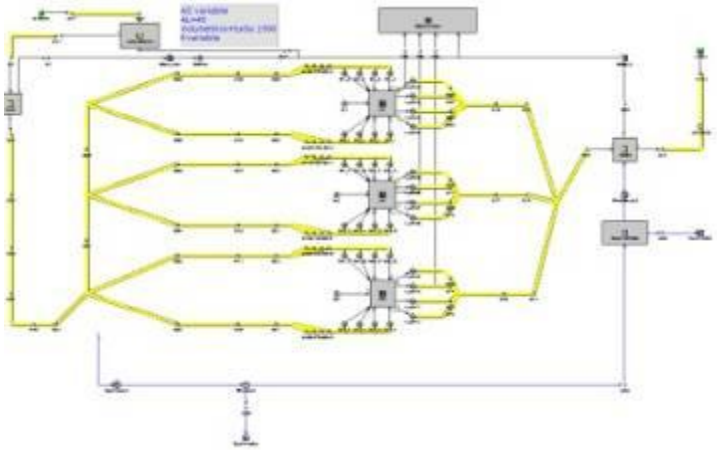
- UOR 1.1E – Valutazione strumentale della concentrazione e distribuzione dimensionale delle polveri fini e ultrafini
- UOR 1.1F – Sistemi GNSS (GPS) in modalità cinematica per sistemi di guida assistita o automatica di veicoli
- UOR 1.1 – Attività di collaborazione industriale inerenti

1.1A – Analisi e controllo del processo di combustione e delle emissioni inquinanti allo scarico dei motori

Engine thermofluids 1

- Full engine system analysis
- Sub-system analysis
- Combustion&turbulence
- Injection systems



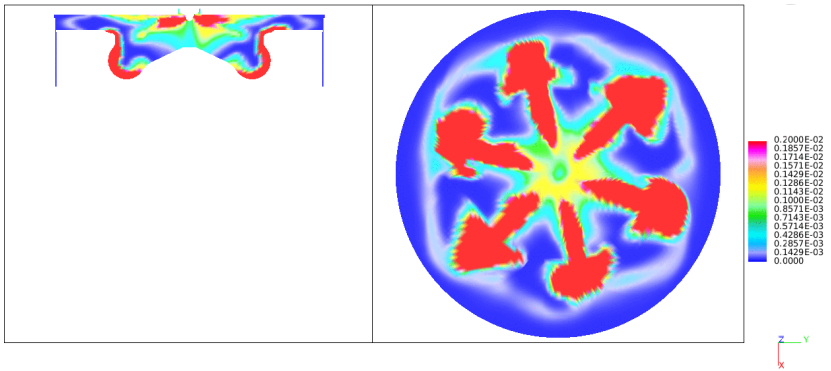




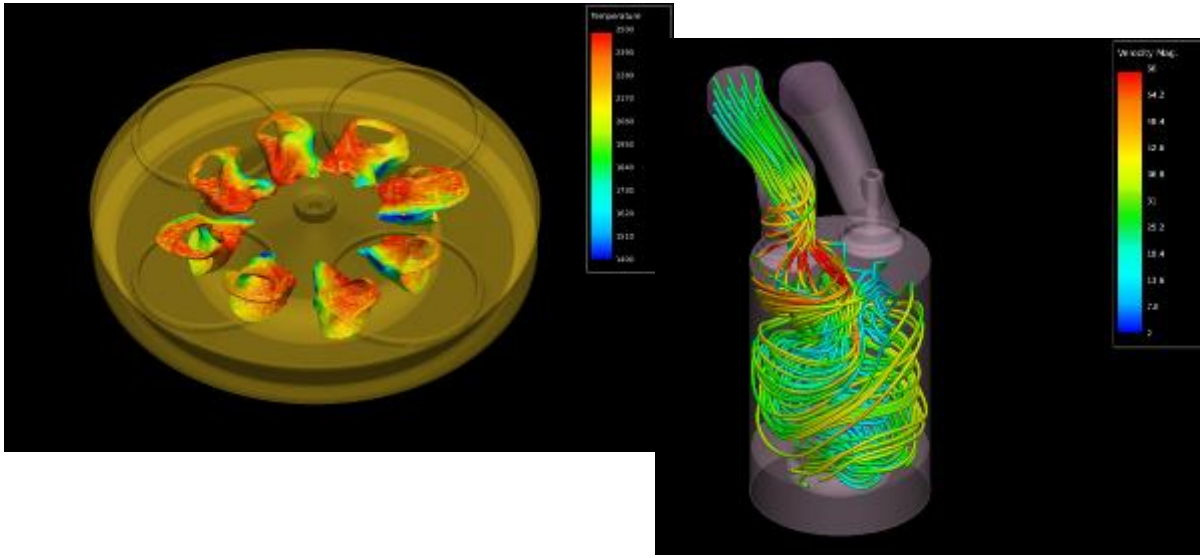
Ferrari Auto e GeS; VM Motori; Ducati; Lombardini; Alfa Romeo; Casappa; CNH
Imperial College (UK); Chalmers University of Technology (SWE)

1.1A – Analisi e controllo del processo di combustione e delle emissioni inquinanti allo scarico dei motori

Engine thermofluids 2



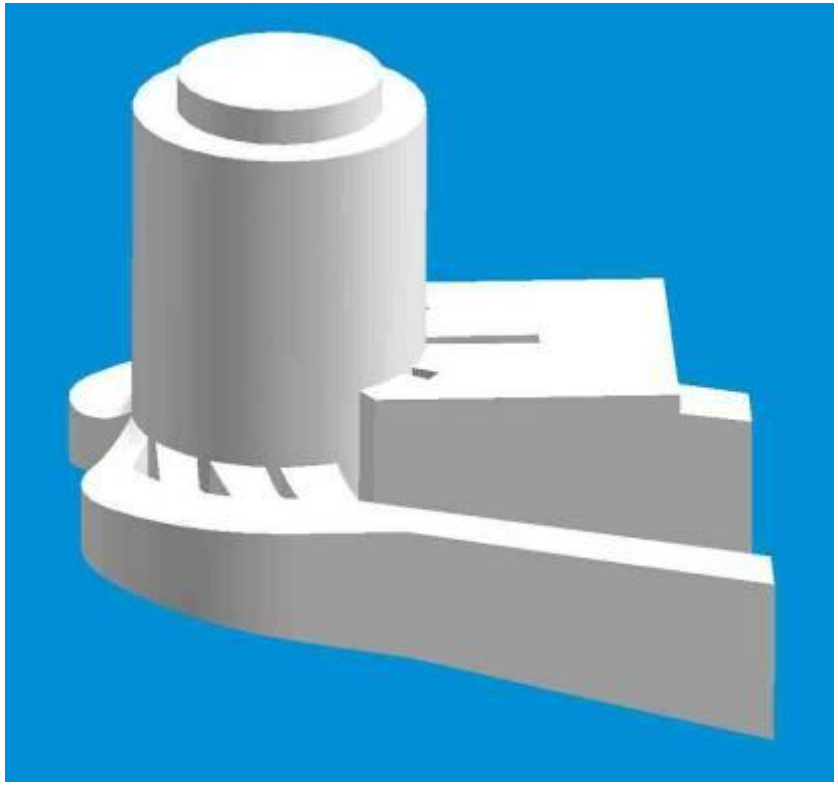
Mixing within the combustion chamber



UOR 1.1B – Sperimentazione di combustibili alternativi e di motori multi-fuel

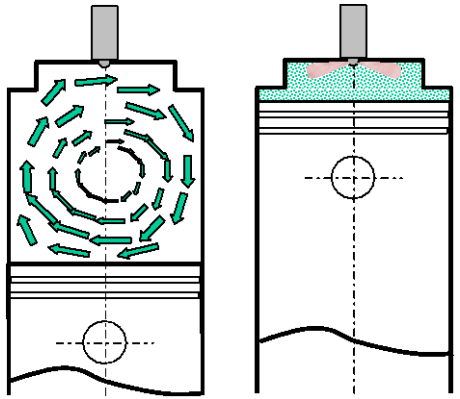
Engine thermofluids 2

Development of a new type of small capacity HSDI (High-Speed Direct Injection) 2-Stroke Diesel engine prototype (HSD_2)



HSD_2 prototype parameters

Number of cylinders	3
Bore [mm] x Stroke [mm]	70 x 91
Total displacement [l]	1.05
Compression Ratio	19.5:1
IPC [CAD ABDC]	62.0
EPC [CAD BBDC]	76.0



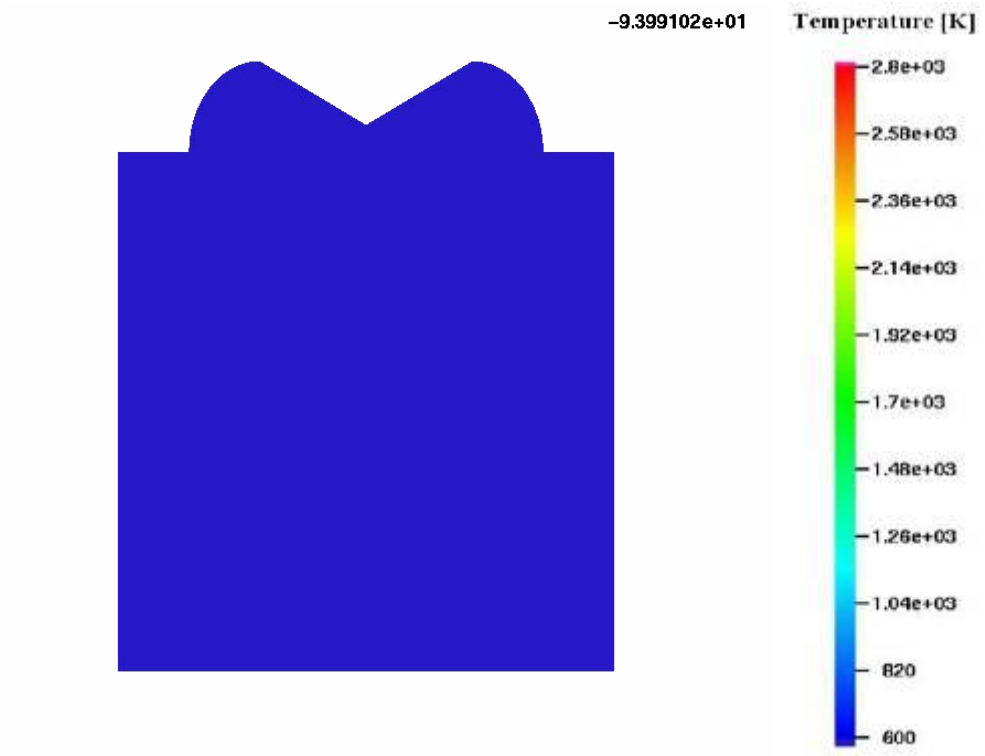
UOR 1.1B – Sperimentazione di combustibili alternativi e di motori multi-fuel

Engine thermofluids 2

enrico.mattarelli@unimore.it

Development of a new type of small capacity HSDI 2-Stroke Diesel engine prototype (HSD_2)

- Full Optimization of the combustion chamber geometry and of the main injection strategies
- Assess the effectiveness of the combustion system
- Predict and compare exhaust gas emissions
- KIVA3V – Rel. 2 3D CFD numerical simulations. Diesel Oil Surrogate (DOS) Model



UOR 1.1B – Sperimentazione di combustibili alternativi e di motori multi-fuel

cantore@unimore.it carloalberto.rinaldini@unimore.it

Engine test bed



- Steady state load test
- Transient load test
- Endurance test
- Fuel consumption test
- Research and development test

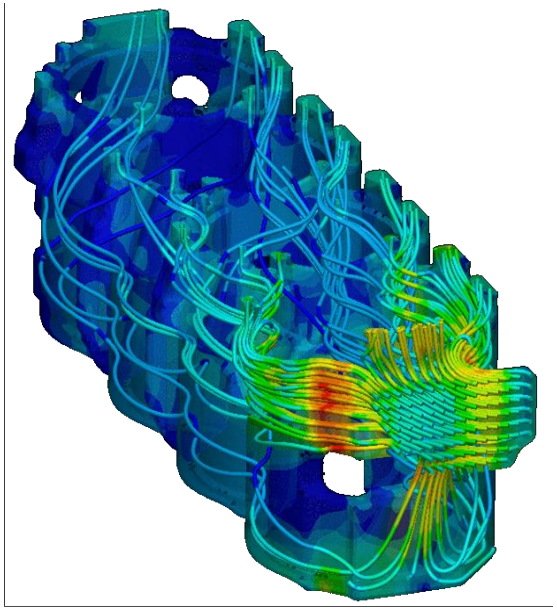
Main components and characteristics:

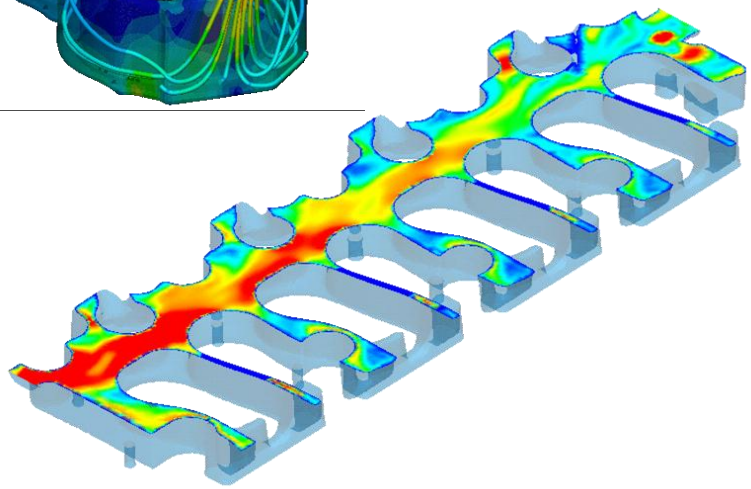
- Soundproof room (6m x 4m x 3m)
- Eddy Current double rotor dynamometer (290 kW – 500 Nm – 13.000 rpm)
- Fuel storage device and automatic feeding system for gasoline and diesel oil controlled with Coriolis flow-meter
- External evaporative cooling tower (500 kW)
- Control units both for Eddy Current dynamometer and throttle actuator and host controlled operation are possible)
- Data acquisition system (rotational speed, torque, power, fuel consumption, combustion air flow, pressures, temperatures, Air to Fuel Ratio, environmental conditions)

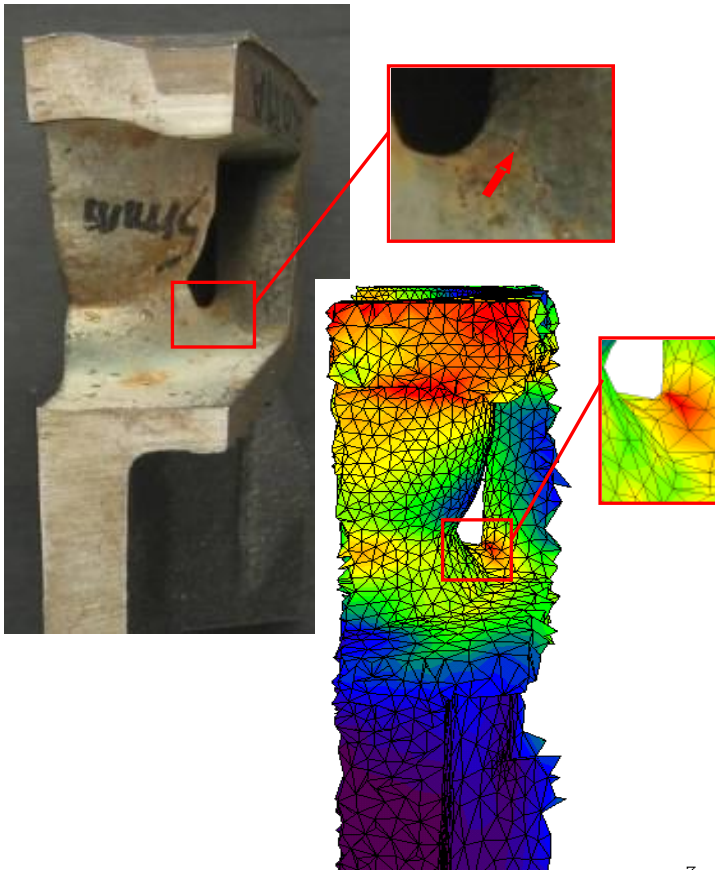
UOR 1.1C – Analisi termo-meccanica per l'ottimizzazione strutturale dei motori

Matteo.Giacopini@unimore.it

Thermomechanics



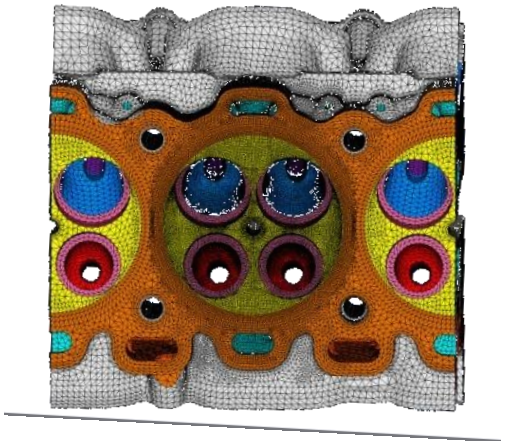




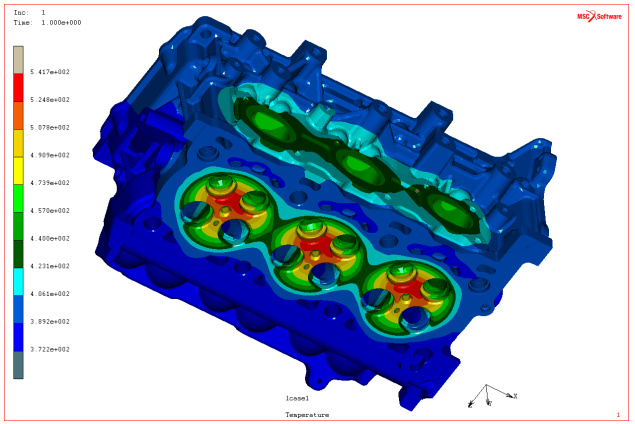
Experiment vs. FEM for crack prediction in the cooling circuit

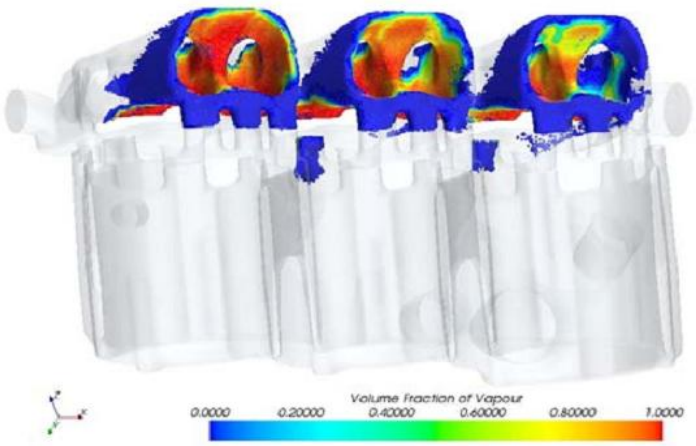
UOR 1.1C – Analisi termo-meccanica per l'ottimizzazione strutturale dei motori.

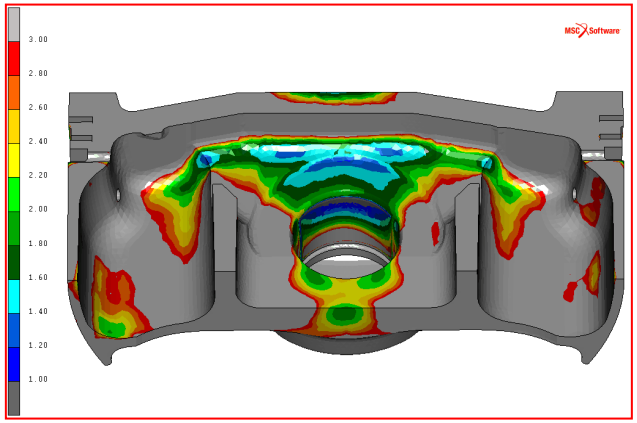
Thermomechanics



Head of a four valve combustion chamber. Both stress and temperature affect the material







UOR 1.1D – Laboratorio di Idraulica del veicolo

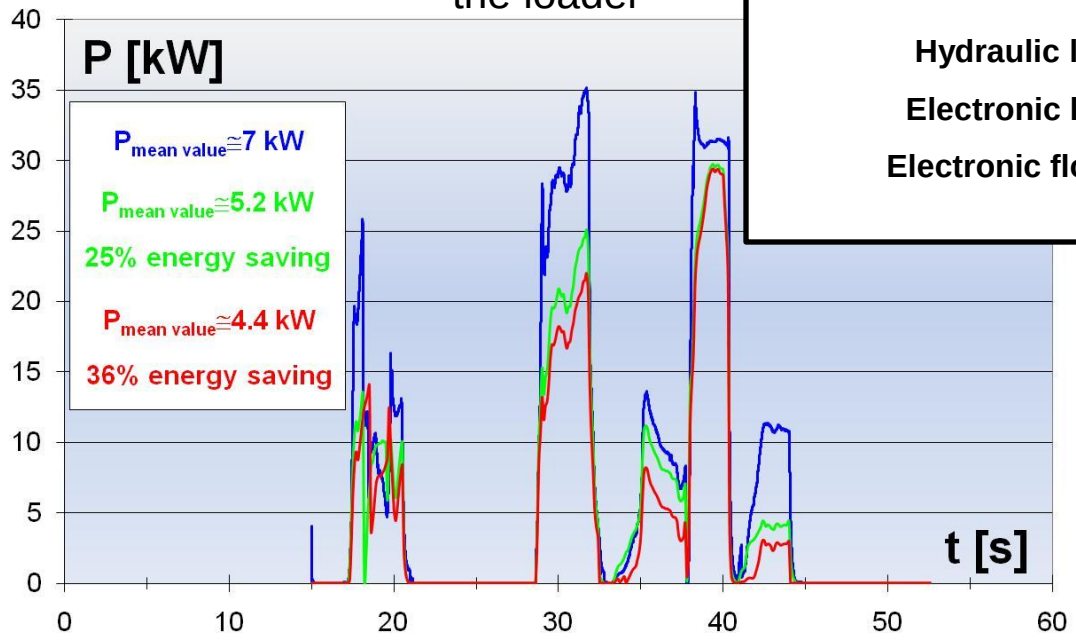
off road

massimo.borghi@unimore.it

Energy Saving in Mobile Hydraulics→alternative architectures to manage auxiliary utilities in agricoltural tractor vs. hydraulic load sensing



Lift and tilt of the loader



36% Of Power Saved for Electronic Flow Matching Independent Metering Arch.
25% Of Of Power Saved for Electronic Load Sensing Independent Metering Arch.

Partners: PRIN07-CRF-CNH-EATON

Load the loader

Unload the loader, lower and tilt it to initial configuration

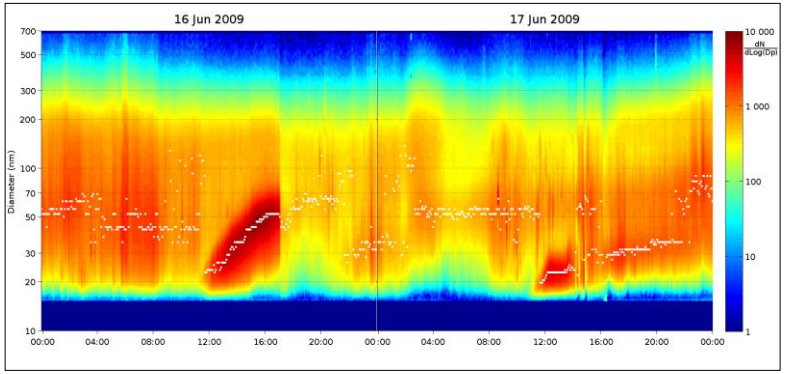
UOR 1.1E – Valutazione della concentrazione delle polveri fini e ultrafini

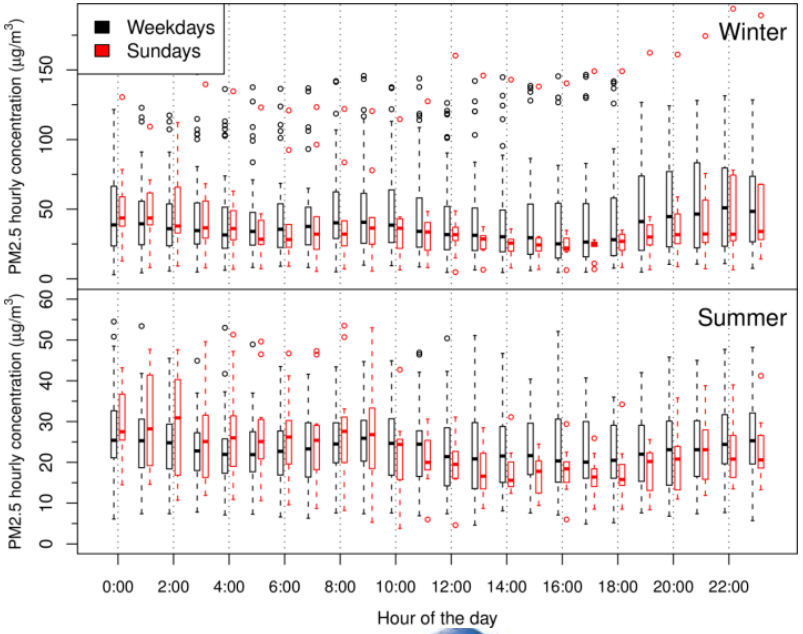
grazia.ghermandi@unimore.it

Environmental pollution: direct measurement of nanoparticles in air or combustion fumes



***PARTNERSHIPS**:*
ISAC-CNR
LGGE - Université de Grenoble
GEES - University of Birmingham





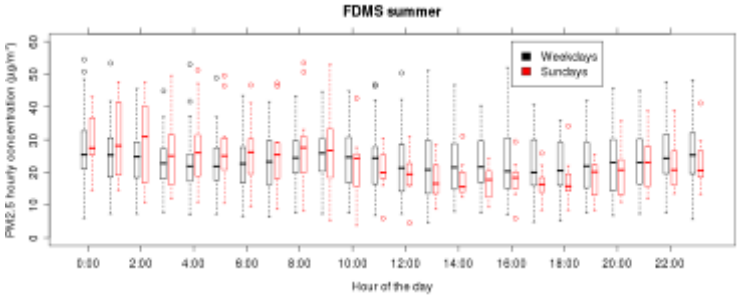
***ACTIVITY**:*
Number size distribution for 10 – 700 nm particles with a 120 sec temporal resolution
Multielemental analysis for segregated particles with diameters ranging 0.04 – 10 µm
Volatiles-corrected on-line mass concentration (PM_1,$PM_{2.5}$ and PM_{10}) by TEOM-FDMS

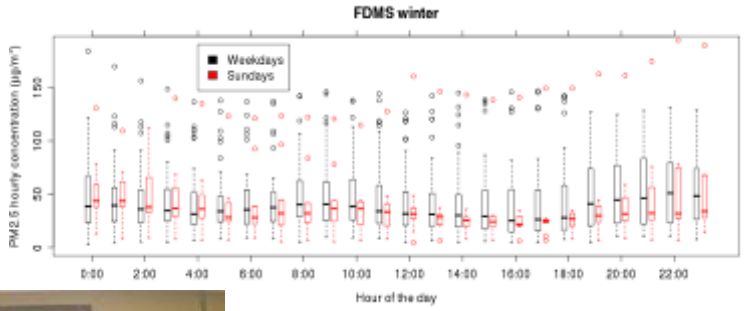
UOR 1.1E – Valutazione della concentrazione delle polveri fini e ultrafini

Experimental monitoring of:

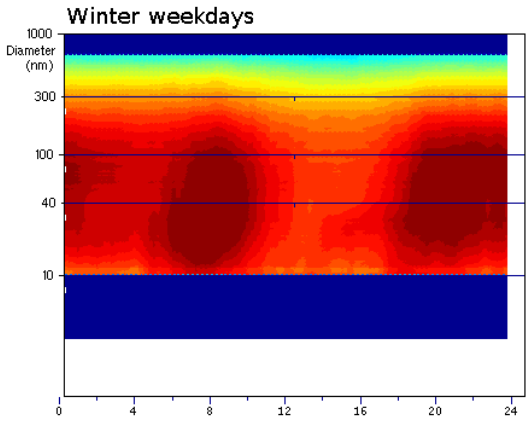
- particle mass concentration (PM1, PM2.5 and PM10), by TEOM with FDMS
- total concentration of particles and particle size distribution, in the diameter range 10 -700 nm, by Differential Mobility Analyzer (DMA).

  The aim of the research is to verify removal and accumulation processes, condensation of finer particles and particle generation by nucleation of gaseous components









UOR 1.1F – Sistemi GNSS (GPS) per sistemi di guida assistita o automatica di veicoli



alessandro.capra@unimore.it

Figura 1: configurazione strumentale nei test di navigazione terrestre con sistema integrato: GPS a basso costo (TruRover Leica), GPS geodetico doppia frequenza (Trimble 5700); MEMS-IMU con magnetometro integrato (MTi Xsens).



Figura 2: mappa estratta da Google Earth per la visualizzazione del percorso per i test di navigazione terrestre con sistema integrato GPS/magnetometro.

UOR 1.1F – Sistemi GNSS (GPS) per sistemi di guida assistita o automatica di veicoli



Figura 1: test di simulazione traiettorie in applicazioni agricole: configurazione strumentale (sopra) con ricevitore GPS a basso costo (TruRover Leica) e ricevitore GPS doppia frequenza (Leica Serie 1200). Immagine Google Earth del campo test: traiettorie parallele e rettilinee (sotto).

UOR 1.1 – Attività di collaborazione industriale

giovanni.barozzi@unimore.it

Thermofluid dynamics

Numerical and experimental research

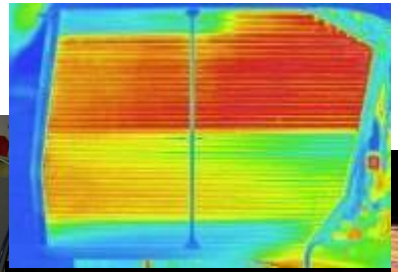
- Navier-Stokes RANS simulation of vehicle, vehicle subsystems and fluid circuits
- Time resolved High frequency Stereo PIV and conventional fluid dynamic analyses
- IR thermography studies



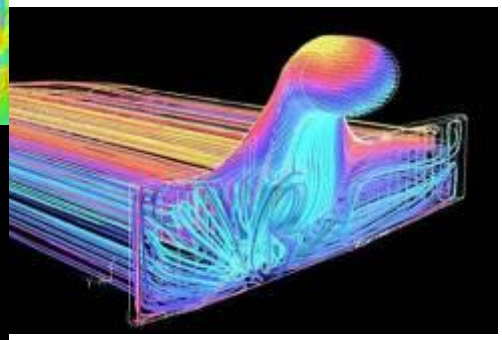


F1 lubrication circuit: numeric analysis









F1 heat exchanger: IR termography and numeric simulations

UOR 1.1 – Attività di collaborazione industriale

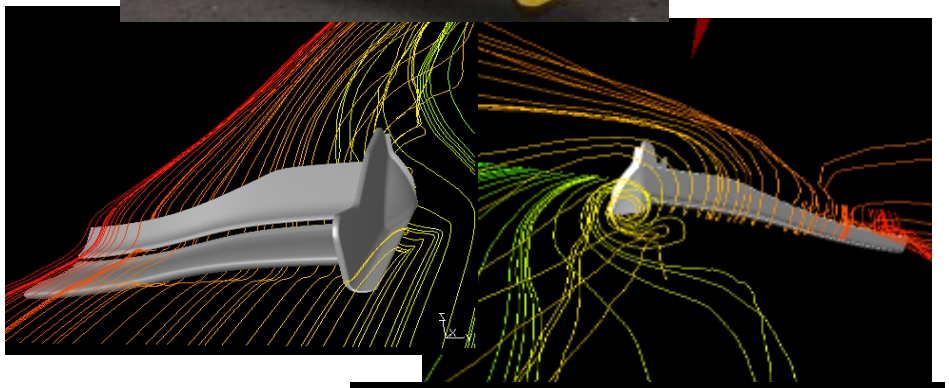
Aerodynamics and Fluid Flow aspects

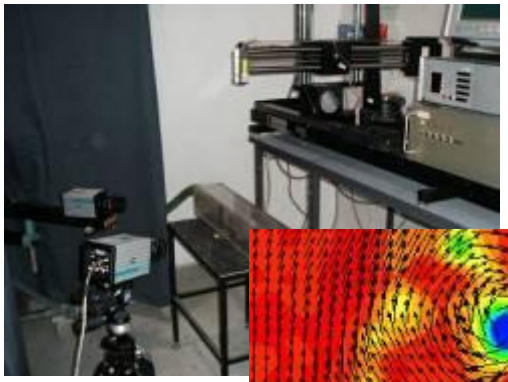
Numerical and experimental studies

- Navier-Stokes RANS and LES aerodynamic simulation
- PIV, anemometry and pressure experiments

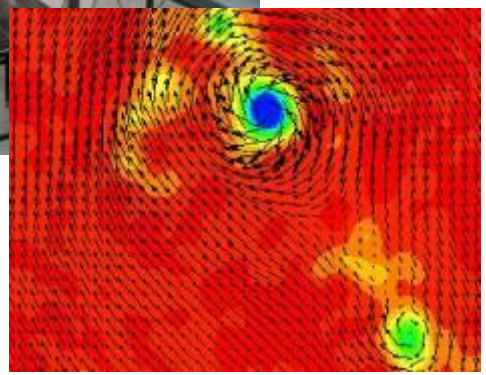


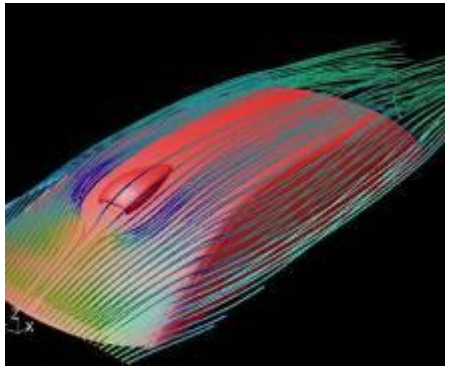
TATUUS F Renault front wing: CFD analysis

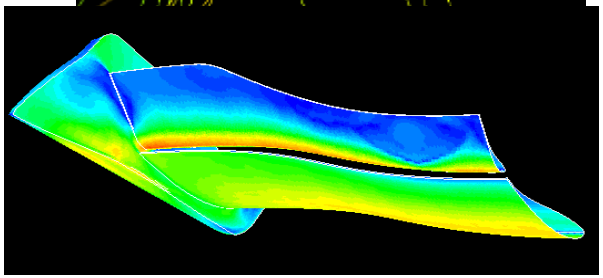




High Frequency Stereo PIV: apparatus and velocity field reconstruction







CFD analysis of a Rally car intake opening

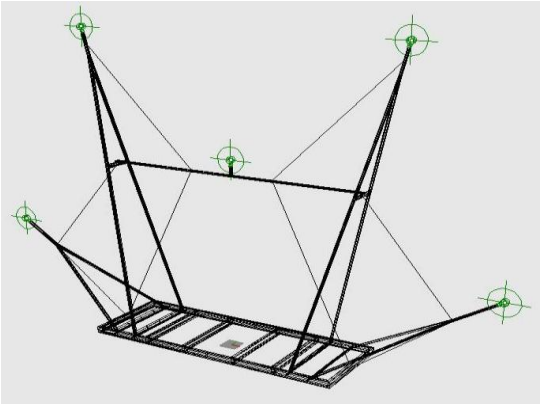
UOR 1.1 – Attività di collaborazione industriale

Concept, Design, Construction And Testing Of An Experimental Facility For Multi-Point Longitudinal Airflow Measurements In Tunnels

P. Levoni, D. Angeli, E. Stalio, G.S. Barozzi, M. Cipollone

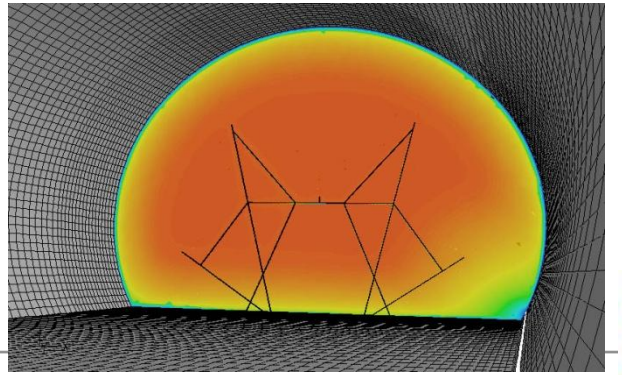
Tunnel Mont Blanc (TMB) – Italian gate





Concept and design of the experimental facility

CFD preliminary aerodynamic tests on the influence experimental facility



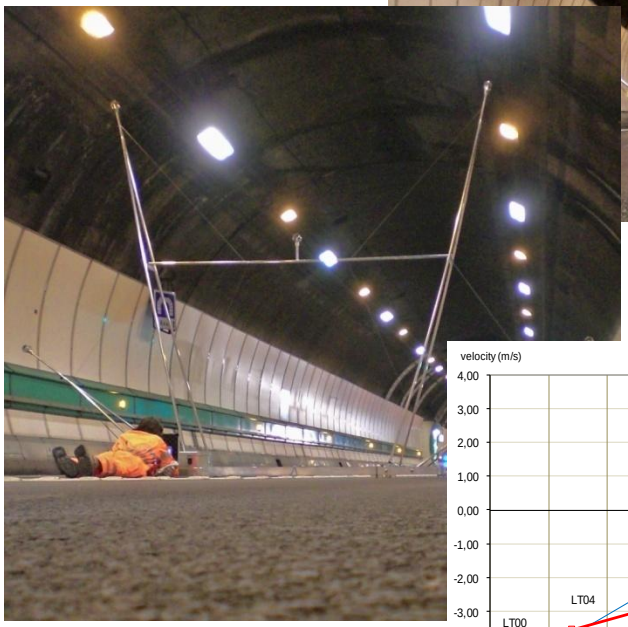
mimesis
fluid dynamics & energy

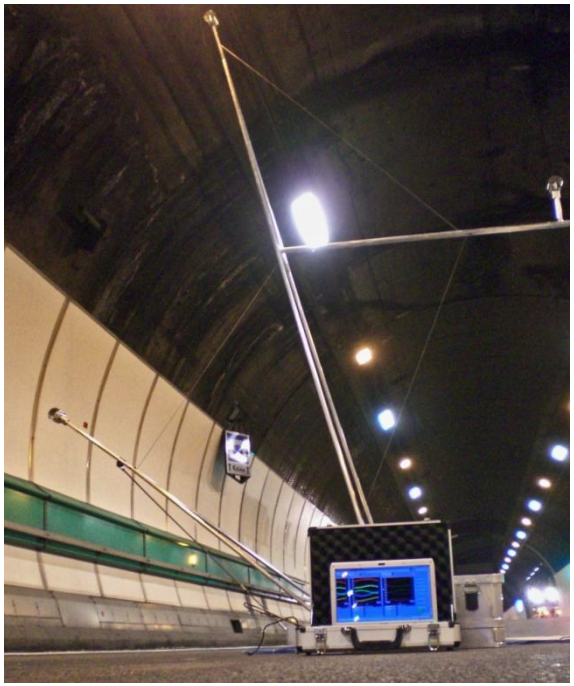
GEIE TMB

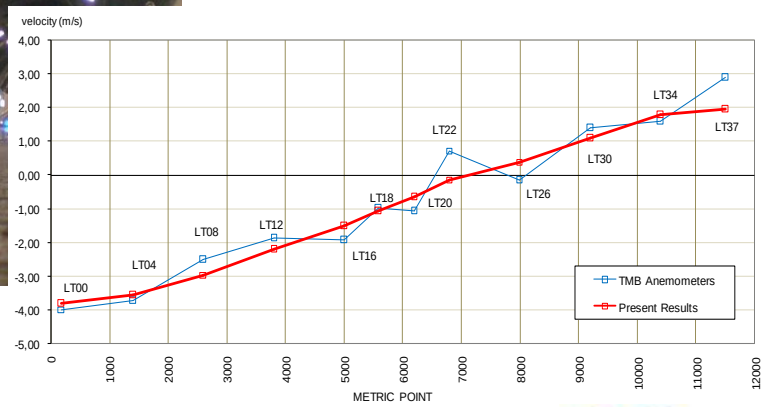
UOR 1.1 – Attività di collaborazione industriale

Measurements inside the Tunnel Mont Blanc (TMB)









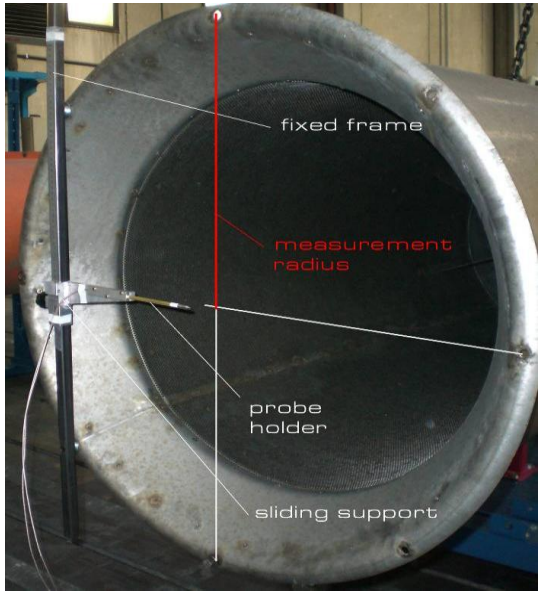
mimesis
fluid dynamics & energy

GEIE TMB

UOR 1.1 – Attività di collaborazione industriale

Experimental Characterization Of A Tunnel Jet Fan By Direct Measurement Of The Velocity Components At The Inflow And Outflow Section

P. Levoni, D. Angeli, E. Canepa, G.S. Barozzi, M. Cipollone







Testing facility for the fan *Howden APR 710/330*

mimesis
fluid dynamics & energy

GEIE TMB

Grazie per l'attenzione