



Josef Božek Research Centre Overview - Competences

Josef Božek Centre of Vehicles for Sustainable Mobility is a part of Faculty of Mechanical Engineering. It provides research and development of vehicle powertrains and complete vehicles, namely

- **spark ignition engines** (gasoline, gas, alternative fuels) and **diesel engines** (including heavy fuels): **thermodynamics, aerodynamics, turbo/supercharging and chargers, emissions, cooling, engine/powertrain control (mechatronics, model-based predictive and adaptive control),**
- alternative thermal engines,
- vehicle transmissions design and optimization (mechanical, hydraulic, **electrical powertrains, hybrids**),
- vehicle body/chassis design (including NVH and **active mechatronic elements** and their control).



CHASSIS DYNO 4WD



Producer: MAHA-AIP GmbH & Co. KG
Model: AIP-ECDM 48L-4mot





Josef Božek Centre Overview - Organisation and European Projects

Centre of Vehicles for Sustainable Mobility is a part of the FME, Czech Technical University in Prague (CVUT). It links by common projects (e.g., Josef Božek Competence Centre of Automobile Industry, JBCC, TA ČR TE01020020) relevant research workers and postgraduate students from **Faculties of Mechanical, Electrical and Transport Engineering of CVUT**, Technical University in Brno, Technical University of Liberec, School of Mines in Ostrava, TÜV Süd Czech (the member of TÜV Süddeutschland Group), Ricardo Prague, Škoda Auto, TATRA Trucks, CZ a.s., Honeywell, spol. s r.o., Brano a.s., Motorpal, ADW .

CVUT members of JBCC have elaborated **European projects of FP6 and FP7, currently H2020 (next slide):**

- New Integrated Combustion system for future car Engines NICE,
- Roads to Hydrogen Communities Roads2HyCOM,
- GREen Heavy Duty ENGINE GREEN,
- **VEHICLE CONcept Modelling VECOM (Marie Curie ITN Project),**
- **Integrated Gas Engine Powertrain InGAS,**
- **Large-Eddy and System Simulation to Predict Cyclic Variability LESSCCV**
- **POWERtrain of FUTURE Light-duty vehicles POWERFUL**
- **Integration and Management of Performance and ROAD Efficiency of Electric Vehicle Electronics IMPROVE**



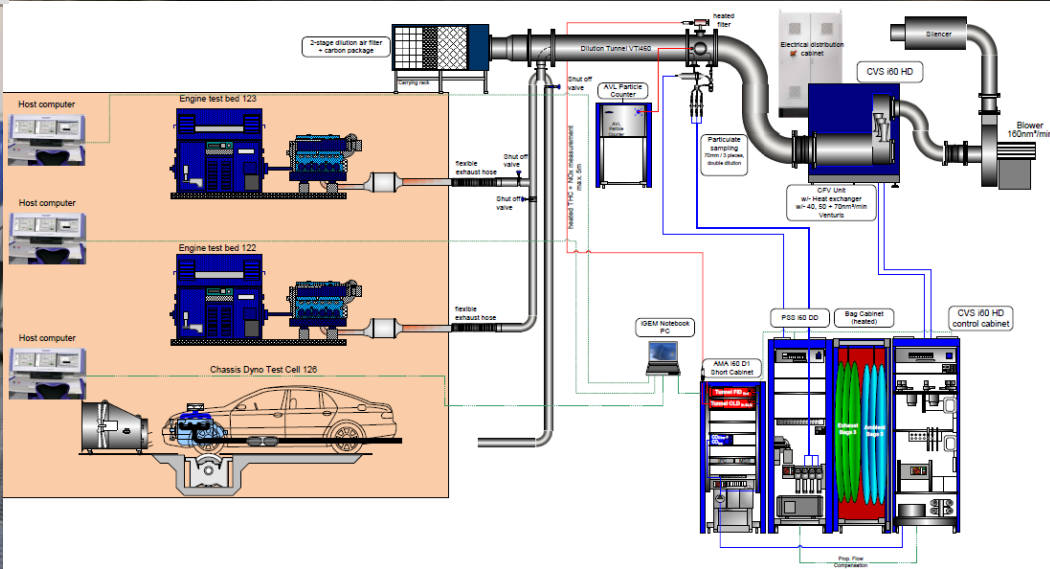
Josef Božek Centre Overview - Current European Projects FP7 and H2020

Josef Božek Centre of Vehicles for Sustainable Mobility is a member of European Automotive Research Partners Association EARPA and European Green Vehicle Initiative Association EGVIA. It takes part in activities of technological platform European Road Transport Advisory Committee ERTRAC.

All of them are more and more taken into account during European strategies planning.

CVSM members are linked to **European projects of H2020, focused on powertrains and control:**

- **Gas-Only Internal Combustion Engines GasOn 2014-2018 #652816**
- **REal World Advanced Technologies foR Diesel Engines REWARD 2014-2018 #636380**
- **IMplementation of Powertrain control for Economic, low Real driving emIssions and fuel ConsUMption IMPERIUM 2016-2019 #2016-2019 #713 783**
- **Future Research, Advanced Development and Implementation Activities for Road Transport Future Radar 2017-2020 #723970**
- **ADvancing user acceptance of general purpose hybridized Vehicles by Improved Cost and**
- **Efficiency ADVICE 2017 – 2020 #724095**



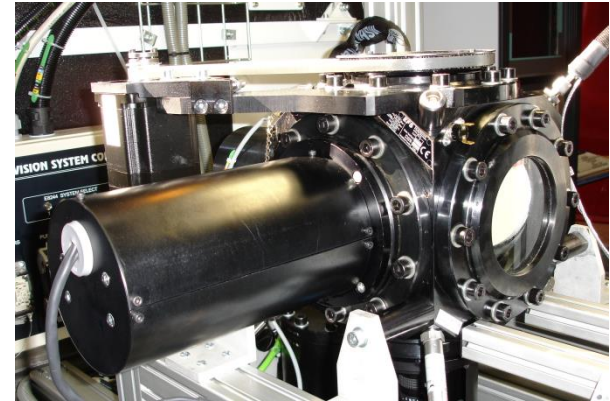


FIE LABORATORY

EFS ITB 240 RC-V injection system test bench - INJETVISION

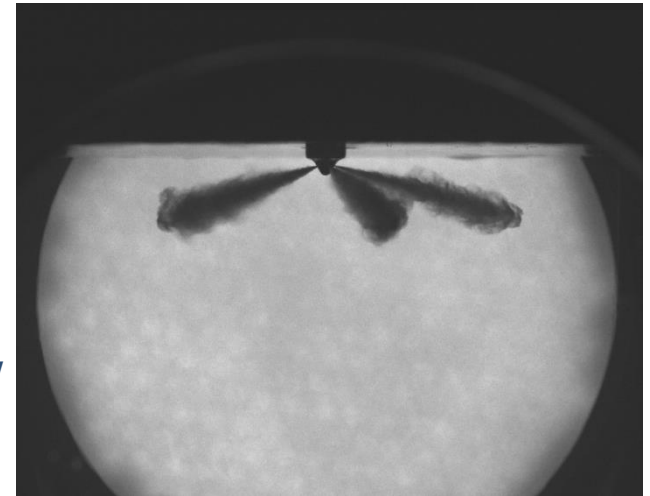
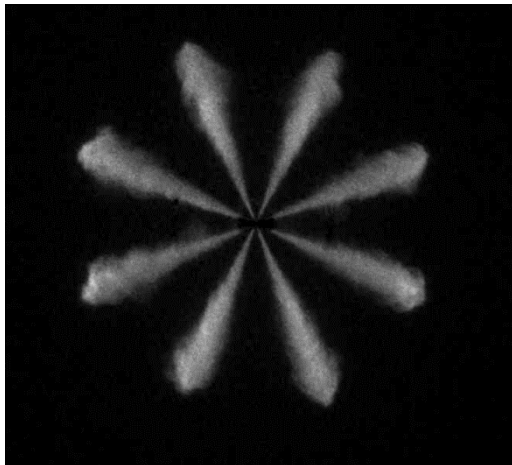
➤ InjetVision System

- possibility to observe and study jets from high pressure diesel injectors
- alfa and lambda view
- inert atmosphere (N_2 or CO_2) up to 50 bars
- fog extraction



Example results

- Jet penetration percentage
- Jet opening angle
- Jet surface
- Jet volume
- Symmetry
- Spray cone angle in lambda view
- Angle λ of a jet in lambda view
- Statistical analysis





Josef Božek Centre Overview – Current Goals, Topics and Tools

Current Important Goals

- in-time assessment of innovative concepts and short time-to-market of selected feasible configurations
- design of vehicles, power trains and prime movers of reduced fossil fuel consumption and CO₂ emissions (Well-To-Wheels) and environment-friendliness (EURO 6+)
 - offering top level of safety, comfort and fun2drive for users of different age and habits,
 - reacting to changing demands in a flexible way and at being competitive even at emerging markets.
- design of ICE and gas turbines for non-automotive purposes



Josef Božek Research Centre Overview – Industry-based Activities

Current or past contract-based collaboration with VW, Škoda Auto, Daimler, Renault, Ford Motor Company, John Deere, Ricardo, Gamma Tech. Inc. (official partner for GT Suite/GT Power), Michigan Technological University, University of Michigan etc.

Member of EARPA (European Automotive Research Partners Association).

Activities at SAE - SAE Int. - Czech branch established 2006.

Collaboration with AVL List Graz, IFPEN Paris, FEV Aachen, **TÜV-Süd Czech, Ricardo Prague, mbTech Bohemia, Porsche Engineering Services Praha.** The collaboration with Czech branches of research companies is based on direct research contracts and sharing of **students education in projects** (3 half-year projects at Master level + diploma thesis) and **during PhD education.**

The student award competitions are organized by PES, Siemens, Škoda and other companies.



Josef Božek Centre Overview – Current Goals, Topics and Tools

Equipment is important but competent and motivated team is decisive for good results

- 50 FTE researchers (65 persons)
- combination of experienced senior researchers with young postdocs and PhD. students (average age of researchers 40 years)
- selection of future researchers based on projects during master studies
- international experience



Competences of the CTU Team Members Potentially Interesting for the current project

1. engine thermodynamical and mechanical testing and simulations (SAE 2002-2017); overall optimization of engines coupling thermodynamics, mechanics and transmission/vehicle or other load (propeller) impacts
2. turbocharger simulation based on experiments and focused on turbocharger matching and control for optimum fuel consumption, emissions and driveability turbocharged ICE – in-house codes - algebraic central streamline models suitable for high pressure ratios with nozzle choking and twin-scroll, GT Suite module use for turbine unsteady simulation, AVL FIRE 3D models (SAE 2002, 2008, 2009, 2015)
3. low-cycle and thermal fatigue of turbocharger casings and rotors
4. engine model-based control (SAE 2006, 2016)
5. predictive and adaptive model-based and route-based control for electric powertrains (in-house results from EU IMPROVE project), currently control of hybrid vehicles is optimized inside IMPERIUM (HD vehicles) and ADVICE (LD vehicles) using the same principles developed at CTU (SAE 2016)

