Giorgio Zamboni

Associate professor

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Education and training

1997
PhD in Fluid Machines Engineering
University of Genoa - Genoa - IT

1990
Degree in Mechanical Engineering
110/110 cum laude
University of Genoa - Genoa - IT

Academic experience

2017 - 2020
Fixed term assistant professor
University of Genoa - Genoa - IT

2001 - 2017
Technician
University of Genoa - Genoa - IT

1999 - 2000
Post-doctoral fellow
University of Genoa - Genoa - IT

1997 - 1998
Research assistant
University of Genoa - Genoa - IT

1993 - 1996
PhD student
University of Genoa - Genoa - IT

Teaching activity

Lecturer in charge of the unit Energy and Environmental Systems, Degree in Industrial and Management Engineering.
Lecturer in charge of the unit Advanced Propulsion Systems for Low Environmental Impact, Master Degree in Energy Engineering.
Lecturer in charge of the unit Machines and Systems for Transport and

Logistics, Master Degree in Safety Engineering.

Postgraduate research and teaching activity

PhD committees membership

Currently, member of the Teaching Board for the PhD Course in Sciences and Technologies for the Sea - Machines and Energy Systems for the Sea. Member of the Teaching Board for the PhD Course in Modeling, Machines and Systems Engineering for Energy, Environment and Transportation (XXXIV course).

Research interests

Current research projects

- Experimental studies on Diesel ICEs control.

In a first step, the research activity has been addressed to the optimization of engine components and subsystems and of the relevant control strategies, to improve engine performance and reduce fuel consumption (and, consequently, CO2 emission) and exhaust emissions. Engine investigations have been focused on the development of theoretical simulation methodologies and optimization tools and on the characterization of different subsystems, especially for turbocharged Diesel engines. As regards these topics, studies were developed on turbocharging and exhaust gas recirculation systems, while in a second phase activities were focused on the optimization of common rail fuel injection systems control. In particular, different multiple injection strategies were compared, taking into account timing and injected quantities for pilot and after injections aiming at fuel consumption and emissions reduction.
Recent investigations have been developed on an automotive turbocharged Diesel engine, focusing on the development of a prototype low-pressure exhaust gas recirculation system. On-engine application was matched to existing turbocharging and high pressure EGR systems, being the first fitted with a variable nozzle turbine. The integrated control strategies allow to reduce NOX emissions and fuel consumption, improving turbocharger compressor and turbine operating conditions, with a reasonable increment of soot emissions. Including the common rail fuel injection equipment among the controlled systems (referring in particular to injection pressure) allowed to compensate for soot increase, extending the validity of proposed control strategies.
A further topic is related to the analysis of combustion parameters obtained from pressure diagrams and curves of rate of heat release and their relationship with engine operating, energy and environmental quantities. This methodology was developed and first applied to the extended investigation on integrated control of fuel injection, turbocharging and EGR systems. Then it was used for the analysis of the influence of blends with high content of used cooking oil methyl esters on engine behavior, described in the following point.

- Investigations on bio-fuels application to engines.

In a first phase, a diesel CFR engine was deeply modified to enlarge its operating field, enhancing speed and load control and to make measurements of the main parameters, aiming at the comparison of different renewable fuels. A grid of selected experimental conditions was defined, in which fuel consumption, exhaust emissions and in-cylinder pressure diagrams were recorded, giving extended information on fuels/blends, together with the standard evaluation of Cetane Number allowed by the CFR engine.
Experimental campaigns involving different renewable fuels were made, focusing on the influence of biodiesel content in tested blends on brake thermal efficiency, NOX and soot emissions. The comparison of observed trends with literature results proved that the facility is a suitable tool for investigation on renewable fuels, despite the use of a pre-chamber engine fitted with a mechanical pump for fuel injection.
Recently, an extended investigation on the application of blends between diesel oil and used cooking oil methyl esters (UCOME) was developed on the automotive turbocharged diesel engine previously mentioned. Two commercial diesel oils were considered as reference fuels, the first with the conventional content of biodiesel (7%), the second with a larger amount (15%). Then, increased levels of UCOME were added, on a volumetric basis (20%, 40%, 55 or 60%), to analyze the influence of biodiesel content on engine behavior. Three part load engine operating conditions were selected for tests. The availability of an open electronic control unit allowed for a proper management of the exhaust gas recirculation circuit, variable nozzle turbine and injection parameters.
Results allowed to identify an optimal UCOME content (40%), leading to the highest values of efficiency and lowest levels of NOx emissions, while soot emissions were always reduced when increasing biodiesel content.
The large set of combustion parameters processed starting from the indicated pressure diagrams, allow to deepen in-cylinder phenomena, outlining the counteracting effects involved in NOx formation and explaining trends of this pollutant. Finally, interactions between tested blends and engine management system were observed, suggesting that compensation strategies have to be considered for adapting engine control according to the characteristics of renewable fuels.

- Road vehicles exhaust emissions and fuel consumption evaluation under real driving conditions.

The main investigations developed in this field were focused on:

- definition of hot and cold exhaust emission factors for pollutants (CO, HC, NOX, NO2, CO2 and PM) referred to different vehicle categories (passenger cars, light and heavy duty vehicles, buses, motorcycles, mopeds, waste collection vehicles).
- Application of emission factors and activity data for the evaluation of road vehicles exhaust emissions through the development of a model (PROGRESS).

- Definition of motorcycles and mopeds behavior in cold start and hot conditions. This theme was developed in collaboration with the Istituto Motori of the National Research Council of Italy.
- Definition of fuel consumption and exhaust emissions of heavy-duty vehicles through the application of the PHEM model using specific driving patterns measured in urban and port areas. This theme was developed in co-operation with the Laboratoire Transports et Environnement (LTE) of Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux (IFSTTAR).

Recently, the Progress model has been updated with the most recent ad future legislation classes and to allow the comparison of conventional,

Editorial activity

Reviewer for international journals/engineer societies (Applied Energy, Energies, Atmosphere, SAE International, etc.).
Selected publications for the topic on Diesel ICEs control:

1. Zamboni G., Capobianco M. Effects of rail pressure control on fuel consumption, emissions and combustion parameters in a turbocharged diesel engine. Cogent Engineering, 7:1, 1724848, 2020, doi: 10.1080/23311916.2020.1724848
2. Zamboni G. Influence of Fuel Injection, Turbocharging and EGR Systems Control on Combustion Parameters in an Automotive Diesel Engine. Applied Sciences 2019, 9(3), 484; doi: 10.3390/app9030484
3. Zamboni G. A study on combustion parameters in an automotive turbocharged diesel engine. Energies 2018, 11(10), 2531; doi: 10.3390/en11102531
4. Zamboni G., Moggia S., Capobianco M. Effects of a Dual-Loop Exhaust Gas Recirculation System and Variable Nozzle Turbine Control on the Operating Parameters of an Automotive Diesel Engine. Energies 2017, 10(1), 47; doi: 10.3390/en10010047
5. Zamboni G., Moggia S., Capobianco M. Hybrid EGR and turbocharging systems control for low NOX and fuel consumption in an automotive diesel engine. Applied Energy, 165, 2016, doi:10.1016/j.apenergy.2015.12.117.
6. Zamboni G., Capobianco M. Influence of high and low pressure EGR and VGT control on in-cylinder pressure diagrams and rate of heat release in an automotive turbocharged diesel engine. Applied Thermal Engineering, 51, 2013, doi:10.1016/j.applthermaleng.2012.09.040.
7. Zamboni G., Capobianco M. Experimental study on the effects of HP and LP EGR in an automotive turbocharged diesel engine. Applied Energy 94, 2012, doi:10.1016/j.apenergy.2012.01.046.

Selected publications for the topic on the use of biofuels in engines:

1. Zamboni G., Capobianco M. Experimental Analysis of the Influence of Diesel-Used Cooking Oil Methyl Ester Blends on Efficiency, Emissions and Combustion Process in a Diesel Engine. EUBCE 2020, 28th

European Biomass Conference and Exhibition, 2020.
2. Zamboni G., Marelli S., Marmorato G., Capobianco M. An experimental apparatus for testing biodiesels based on a CFR engine – Setup and validation with different methyl ester blends. International Journal of Green Energy, 13-5, 2016, doi:10.1080/15435075.2014.977439.
3. Zamboni G., Marelli S., Marmorato G., Capobianco M. Experimental comparison of different diesel-biodiesel blends in a CFR engine. ASME 2012 Int. Mechanical Engineering Congress & Exposition, paper IMECE2012-86298.

Selected publications for the topic on the evaluation of road vehicles exhaust emissions and fuel consumption:

1. Zamboni G., Dressino L., Boileau H. A tool for the assessment of the potential benefits of electric and hybrid cars for emissions reduction in urban areas. International Journal of Environmental Studies 2020, doi: 10.1080/00207233.2020.1736845
2. Zamboni G., André M., Roveda A., Capobianco M. Experimental evaluation of Heavy Duty Vehicle speed patterns in urban and port areas and estimation of their fuel consumption and exhaust emissions. Transportation Research Part D: Transport and Environment, 35, 2015, doi:10.1016/j.trd.2014.11.024.
3. Zamboni G., Malfettani S., André M., Carraro C., Marelli S., Capobianco M. Assessment of heavy-duty vehicle activities, fuel consumption and exhaust emissions in port areas. Applied Energy, 111, 2013, doi:10.1016/j.apenergy.2013.06.037.
4. Prati M. V., Zamboni G., Costagliola M. A., Meccariello G., Carraro C., Capobianco M. Influence of driving cycles on Euro 3 scooter emissions and fuel consumption. Energy Conversion and Management 52, 2011, doi:10.1016/j.enconman.2011.06.004.
5. Zamboni G., Carraro C., Capobianco M. On-road instantaneous speed measurements on powered two-wheelers for exhaust emission and fuel consumption evaluation. Energy 36, 2011, doi:10.1016/j.energy.2010.12.004.
6. Zamboni G., Capobianco M., Daminelli E. Estimation of road vehicle exhaust emissions from 1992 to 2010 and comparison with air quality measurements in Genoa, Italy. Atmospheric Environment, 43, 20