



## PRESENTATION

Barbara Zardin  
Associate Professor in Fluid Machines  
(ING-IND/08) at the Engineering  
Department Enzo Ferrari (DIEF).

DIEF website

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SmartFluidPower Project

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## EDUCATION

Doctor of Philosophy in Mechanical Engineering (“Ingegneria delle Macchine e Sistemi Energetici”) at the University Of Bologna, June 2008 with a thesis: “Modellizzazione Numerica e Caratterizzazione Sperimentale di Macchine e Componenti Oleodinamici”, (Numerical Modelling and Experimental Characterization of Hydraulic Components), Advisor Prof. Ing. Massimo Borghi.

Master of Science in Mechanical Engineering at the University of Modena and Reggio Emilia, October 2003. Area: Fluid Power, thesis concerning numerical modelling of the behaviour of external gear pumps and motors.

## RESEARCH

Research activity has concerned fluid power components and systems for both industrial and mobile applications. Both numerical simulation and experimental analysis have been developed through the years.

**Fluid power systems: the main aspects analyzed have been the complete definition of the system, its duty cycles and the fuel consumption; identification of the more dissipative parts or components; analysis of alternative and more efficient components and architectures.** Some examples of applications below:

-Study of the dynamic behaviour of excavators, road roller vehicles, tractors, wheel loaders: modelling and simulation of the hydraulic circuits, study and optimization of braking and speed up phases, study of the variable displacement mechanism which enables to change the vehicle speed.

-Study of the energy dissipation of the hydraulic circuit in agricultural tractors, wheel loaders, excavators: these are a typical load sensing multi actuators application, to overcome the limits of this kind of circuit alternative architectures based on independent metering concept and electrically controlled proportional

valves and variable displacement pump have been studied. Hybrid solutions for off road vehicles are also considered in this topic.

-Study of hydraulic press and other industrial machinery circuit layouts and energetic evaluation

**Fluid Power components: the main aspects analyzed have been lubrication, flow forces on valves, dynamic behaviour of pumps and motors.**

-Study of the **lubricating gaps of external gear machines and axial piston swashplate machines**: this aspect is of vital importance for the evaluation of mechanical and volumetric efficiencies, for the optimization and improvement of machine behaviour and in order to raise the power to weight ratio of the machine. Optimal efficiency means lower energy consumption and this aspect is fundamental especially in mobile applications. The research has been conducted developing and using home-made numerical codes which allow to solve Reynolds equation inside the lubricating gaps; a numerical procedure able to find both the pressure distribution and the gaps geometry during machine operation has been developed. The influence of operating and design parameters has been studied enabling to use the code in order to improve the design process of the machines studied. **Analysis of the lubricating gaps in hydraulic servo-cylinders**, exploring the influence of tolerances and operating conditions.

-Study of the **dynamic behaviour of external gears and axial piston swashplate pumps and motors**: lumped parameter models of these kind of machines have been developed: the pressure transients within the machine chambers, the instantaneous flow and torque are the output of these models which enables to study the influence of the main operating and geometric parameters on the machine behaviour. The issue of pressure peaks and cavitation within the volume chambers, influence of the valve plate (axial piston machine) or of the bearing blocks geometry (external gear machine) have been also addressed.

**-Modelling and experimental characterization of proportional directional valves and pressure and flow rate valves**: study of the metering characteristics, energy dissipation evaluation, dynamic response, experimental characterization at the test rig.

The research activities have been conducted using both commercial and “home made” software (Matlab language, OpenModelica, Fortran and C language). Moreover, when possible, also experimental characterization of hydraulic pumps, motors and proportional valves has been realized using hydraulic test rigs and data acquisition devices with Labview and Arduino software interfaces.

Recently, together with the researchers of the fluid power group @DIEF, she founded **SmartfluidPower Project**: development of a complete environment for the dynamic and functional simulation of fluid power systems and components.

## TEACHING @DIEF

- Simulation of fluid power systems and components for mobile applications, Master Degree's Course in Vehicle Engineering, Engineering Department Enzo Ferrari, Università di Modena e Reggio Emilia.

- Automotive Fluid Power Systems, Master Degree's Course in Advanced Automotive Engineering, MUNER, Motorvehicle University of Emilia-Romagna.

- Fluid power components and systems, (part of the course together with Prof. Massimo Borghi) Master Degree's Course in Mechanical Engineering, Engineering Department Enzo Ferrari, Università di Modena e Reggio Emilia.

# PUBLICATIONS last ten years

(complete and detailed list: <http://personale.unimore.it/rubrica/pubblicazioni/bzardin>)

## 2020 - [A study on PVD coatings for reduction of friction and wear of swashplate axial piston pumps and motors](#)

Sola, R.; Veronesi, P.; Zardin, B.; Borghi, M

## 2020 - [Analysis of the flow force compensation in relief valves with conical poppet](#)

Fornaciari, A.; Zardin, B.; Borghi, M.; Ceriola, M.

## 2020 - [Modelling of hydraulic locking balancing circumferential grooves for servo-cylinders' piston](#)

Natali, E.; Zardin, B.; Cillo, G.; Borghi, M.

## 2020 - [The Hydraulic Power Generation and Transmission on Agricultural Tractors: Feasible architectures to reduce dissipation and fuel consumption-Part 2](#)

Casoli, P.; Zardin, B.; Ardizio, S.; Borghi, M.; Pintore, F.; Mesturini, D.

## 2020 - [The Hydraulic Power Generation and Transmission on Agricultural Tractors: Feasible architectures to reduce dissipation and fuel consumption-Part 1](#)

Gaiola, A.; Zardin, B.; Casoli, P.; Borghi, M.; Mazzali, F.; Pintore, F.; Fiorati, S.

## 2019 - [DESIGN AND MODELLING OF A CARTRIDGE PRESSURE AMPLIFIER](#)

Zardin, Barbara; Cillo, Giovanni; Zavadinka, Peter; Hanusovsky, Juraj; Borghi, Massimo

## 2019 - [Evaluation of the hydro - Mechanical efficiency of external gear pumps](#) Zardin, B.; Natali, Emiliano; Borghi, M.

## 2019 - [Modelling of hydrostatic bearings for servo-cylinders](#)

Zardin, B.; Natali, E.; Cillo, G.; Borghi, M.

## 2018 - [Fluid-dynamic analysis of an in-line water piston pump](#)

Borghi, Massimo; Zardin, Barbara; Materi, Sergio; Argentino, Pierluigi

## 2018 - [Modelling and Simulation of a Cartridge Pressure Amplifier](#)

Zardin, Barbara; Cillo, Giovanni; Borghi, Massimo; Zavadinka, Peter; Hanusovsky, Juraj

## 2018 - [Modelling and Simulation of a Hydrostatic Steering System for Agricultural Tractors](#)

Zardin, Barbara; Borghi, Massimo; Gherardini, Francesco; Zanasi, Nicholas

**2017 - [Design Of Two-Stage On/Off Cartridge Valves For Mobile Applications](#)**

Zardin, Barbara; Borghi, Massimo; Cillo, Giovanni; Rinaldini, Carlo Alberto; Mattarelli, Enrico

**2017 - [Design and experimental development of a compact and efficient range extender engine](#)**

Borghi, Massimo; Mattarelli, Enrico; Muscoloni, Jarin; Rinaldini, Carlo Alberto; Savioli, Tommaso; Zardin, Barbara

**2017 - [Development of a 2-Stroke GDI Engine](#)**

Savioli, Tommaso; Zardin, Barbara; Borghi, Massimo

**2017 - [Development of a RANS-Based Knock Model to Infer the Knock Probability in a Research Spark-Ignition Engine](#)**

D'Adamo, Alessandro; Breda, Sebastiano; Iaccarino, Salvatore; Berni, Fabio; Fontanesi, Stefano; Zardin, Barbara; Borghi, Massimo; Irimescu, Adrian; Merola, Simona

**2017 - [Pressure Losses in Multiple-Elbow Paths and in V-Bends of Hydraulic Manifolds](#)**

Zardin, Barbara; Cillo, Giovanni; Borghi, Massimo; D'Adamo, Alessandro; Fontanesi, Stefano

**2017 - [Pressure losses in hydraulic manifolds](#)**

Zardin, Barbara; Cillo, Giovanni; Rinaldini, Carlo Alberto; Mattarelli, Enrico; Borghi, Massimo

**2016 - [A parametric CAD-based method for modelling and simulation of positive displacement machines](#)**

Gherardini, Francesco; Zardin, Barbara; Leali, Francesco

**2015 - [Axial Balance of External Gear Pumps and Motors: Modelling and Discussing the Influence of Elastohydrodynamic Lubrication in the Axial Gap](#)**

Borghi, Massimo; Zardin, Barbara

**2015 - [Dynamic Modelling of an Off-Road Vehicle for the Design of a Semiactive, Hydropneumatic Spring-Damper System](#)**

Panetta, Giuseppe; Mancarella, Francesco; Borghi, Massimo; Zardin, Barbara; Pintore, Francesco

**2015 - [Energy Saving in the Hydraulic Circuit for Agricultural Tractors: Focus on the Power Supply Group](#)**

Borghi, Massimo; Zardin, Barbara; Pintore, Francesco

**2014 - [Energy Savings in the Hydraulic Circuit of Agricultural Tractors](#)**

BORGHI, Massimo; ZARDIN, Barbara; PINTORE, FRANCESCO; BELLUZZI, FRANCESCO

**2014 - [MODELLING AND SIMULATION OF THE HYDRAULIC CIRCUIT OF AN AGRICULTURAL TRACTOR](#)**

Pintore, Francesco; Borghi, Massimo; Morselli, Riccardo; Benevelli, Alessandro; Zardin, Barbara; Belluzzi, Francesco

**2014 - [Sperimentazione e simulazione nell'analisi del circuito idraulico di una trattrice agricola](#)**

Borghi, M.; Zardin, B.; Zanasi, N.; Pintore, F.; Belluzzi, F.

**2013 - [Banco prova per analisi e test di componenti oleodinamici](#)**

Borghi, Massimo; Zardin, Barbara; Pintore, Francesco; Benevelli, Alessandro

**2012 - [Fluid power supply unit for agricultural tractors: towards energy saving through simulation](#)**

Pintore, Francesco; Zardin, Barbara; Borghi, Massimo

**2012 - [Hydraulic Circuit in Agricultural Tractors, a Step Forward for Energy Saving](#)**

Borghi, Massimo; Zardin, Barbara; Pintore, Francesco; Belluzzi, Francesco

**2012 - [Independent metering architectures for agricultural tractors auxiliary utilities.](#)**

Benevelli, Alessandro; Zardin, Barbara; Borghi, Massimo

**2012 - [MISSION PROFILE FOR AGRICULTURAL TRACTORS: A FOCUS ON HYDRAULIC CIRCUIT](#)**

Borghi, Massimo; Zardin, Barbara; Belluzzi, Francesco; Lanzoni, Luca

**2011 - [Analisi di macchine oleodinamiche a pistoni assiali a piatto inclinato](#)** Borghi, Massimo; Zardin, Barbara; Specchia, Emiliano; Pintore, Francesco

**2011 - [Displacement Control in Variable Displacement Axial Piston Swashplate Type Pumps](#)**

Borghi, Massimo; Zardin, Barbara; Specchia, Emiliano; Pintore, Francesco; E., Corradini

**2011 - [Modellazione di una pompa duocentric e riduzione delle emissioni sonore](#)**

Pintore, Francesco; Lorenzelli, Marco; Zardin, Barbara; Specchia, Emiliano

2011 - [Simulazione integrata per macchine a pistoni assiali](#)

Zardin, Barbara; Specchia, Emiliano; Pintore, Francesco

2011 - [Soluzioni innovative per la riduzione del consumo energetico di circuiti idraulici per trattori agricoli](#)

Borghi, Massimo; Zardin, Barbara

2010 - [Energy Consumption of the Hydraulic Circuit of a Mid-Size Power Tractor](#)

Borghi, Massimo; Zardin, Barbara; Mancarella, Francesco; Specchia, Emiliano

2010 - [Energy dissipation of the hydraulic circuit of remote auxiliary utilities of an agricultural tractor](#)

Borghi, Massimo; Mancarella, Francesco; Zardin, Barbara

2010 - [Numerical Analysis Of The Dynamic Behaviour Of Piston Journal Bearing In Axial Pist on Pumps And Motors](#)

Specchia, Emiliano; Zardin, Barbara; Borghi, Massimo

2010 - [Remote actuation hydraulic circuit of agricultural tractors: alternative architectures for reducing energy consumption.](#)

Borghi, Massimo; Zardin, Barbara; Mancarella, Francesco

[REDACTED], Italy, 15/12/2021

Barbara Zardin

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