



CORPORATE CURRICULUM

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ERGON RESEARCH

Society data

Full name: Ergon Research s.r.l.

Incorporation date: 23/07/2008

Fiscal code: 05877940485

N° Business Register: 05877940485 – registration date 08/08/2008

Mission

Ergon Research is a consulting and research firm in the mechanical and energetic engineering field. The mission of the corporation is the supply of highly specialized capabilities to develop and design innovative products, components and systems.

Its mainstay is the integration between theoretical aspects and the most innovative simulation and experimental techniques in the thermo-fluid-dynamic field.

Ergon Research operates in an highly skilled engineering environment as link between the research and the industrial communities bringing into action all the experience of its founders.

The use of the most innovative simulation and experimental tools allows to offer consulting and design solutions in the energetic and mechanical field: turbomachinery, aerospace, automotive, fire safety engineering, energy management, energy rating.

Simulation

3D Thermo-fluid-dynamic simulations and structural analysis (CFD, FEA) in the field of: heat transfer, aerodynamic and aero-acoustics, combustion and waste-to-energy systems.

Development of tailored tools for the design and the test of energy system components.

Experiments

Design and manufacturing of test rigs, experimental tools and measurements systems.

Data acquisition and post-processing software.

Field-testing of Industrial processes.

Research

Development of innovative solutions, procedures and products.

Specific training courses on in house developed software and in the energy conversion field.

Members

Dr. Lorenzo Tarchi:

- 2007 PhD in Energy Engineering and Innovative Industrial Technologies
- 2003 Master degree in Mechanical Engineering

Dr. Riccardo Da Soghe:

- 2010 PhD in Energy Engineering and Innovative Industrial Technologies
- 2006 Master degree in Mechanical Engineering

Dr. Mirko Micio:

- 2011 PhD in Energy Engineering and Innovative Industrial Technologies
- 2006 Master degree in Mechanical Engineering

Dr. Cosimo Bianchini:

- 2011 PhD in Energy Engineering and Innovative Industrial Technologies
- 2007 Master degree in Mechanical Engineering

Dr. Antonio Andreini:

- 2004 PhD in Energy Engineering and Innovative Industrial Technologies
- 2001 Master degree in Mechanical Engineering

Society members background

All the members have a PhD degree in the Energy Engineering field. The members have been actively involved with the University of Florence in the following EU research programs in cooperation with the main European gas turbine manufacturer (AVIO, RRUK, RRD, Snecma, Turbomeca, ITP, MTU):

- AITEB – FP5 (2000-2004)
 - Aerothermal Investigation of Turbine Enwalls and Blades
- AITEB2 – FP6 (2005-2009)
 - Aerothermal Investigation of Turbine Enwalls and Blades
- LOPOCOTEP – FP5 – (2001-2006)
 - LOW POLLUTANT COMBUSTOR TECHNOLOGY PROJECT
- INTELLECT D.M. – FP6 STREP (2004-2008)
 - INTEGRATED LEAN LOW EMISSION COMBUSTOR DESIGN METHODOLOGY
- NEWAC – FP6 (2006-2011)
 - NEW AERO ENGINE CORE CONCEPTS
- MAGPI – FP6 (2006-2010)
 - MAIN ANNULUS GAS PATH INTERACTIONS
- TECC-AE – FP7(2008-2012)
 - TECHNOLOGIES ENHANCEMENT FOR CLEAN COMBUSTION IN AERO-ENGINES
- ERICKA – FP7 (2009-2013)
 - ENGINE REPRESENTATIVE INTERNAL COOLING KNOWLEDGE AND APPLICATIONS
- KIAI – FP7 (2009-2012)
 - KNOWLEDGE FOR IGNITION, ACOUSTICS AND INSTABILITIES
- FACTOR – FP7 (2010-2013)
 - FULL AERO-THERMAL COMBUSTOR-TURBINE INTERACTION RESEARCH
- FIRST – FP7 (2011-2014)
 - FUEL INJECTOR RESEARCH FOR SUSTAINABLE TRANSPORT
- LEMCOTEC – FP7 (2011-2015)
 - LOW EMISSIONS CORE-ENGINE TECHNOLOGIES

- IMPACT-AE – FP7 (2011-2015)
 - Intelligent Design Methodologies for Low Pollutant Combustors

Past activities

Turbomachinery:

2011 Design of a turbine combustor simulator
Customer: **LEMCOTEC FP7 project**

Ergon research is directly involved in the LEMCOTEC project financed by the EU in the FP7. The aim of the activity is the design and the commissioning of a turbine combustor simulator to be used for the investigation of compact size combustor by means of the most innovative experimental and numerical techniques.

2011 Test rig design of an heat exchanger test bed
Customer: **GE Oil&Gas**

The aim of the activity was to design a test bed for the performance validation of innovative heat exchangers combining both the common practices and exploiting CFD simulations to validate the proposed design.

2010-today Performance analysis of heat exchanger
Customer: **GE Oil&Gas**

Regular support for the design and control of industrial of heat exchanger by means of CFD.

2010-today Research Project: "Study of innovative solutions for a miniaturized turboengine for "on board vehicle power" and trigenerative applications with design and manufacturing of a prototype"
Customer: **Oral Engineering**

The society is responsible for the design from a white paper of a turboengine of small size for electric power generation. The complete dimensioning of the engine has been completed exploiting both in house developed design tools and simulation techniques. A software for estimating engine performance at design and off-design conditions has also been released. The final design of the principal components is performed with detailed CFD analysis. In particular the combustion chamber is verified in terms of combustion process and pollutant emissions by means of reactive computations. The power shaft has been analyzed by means of FEM calculations to point out its flexional and torsional characteristics.

2010-today Performance analysis of scrubber
Customer: **GE Oil&Gas**

Regular support for the design and control of large scale industrial liquid/gas separators by means of CFD.

2010-today Development of design software for turbomachinery – Customer:
GE Oil&Gas

Continuous upgrade of customer's proprietary software for preliminary dimensioning of steam and gas turbine engines introducing new components and implementing different selection criteria.

2010-today In-line probe for vegetable oil quality assessment
Customer: **VS System**

Development of in-line and real time measurement tools for vegetable oil quality during filtering process.

2008-today Study of steam plant layout
Customer: **GE Oil&Gas**

Analysis and design of plant layout for electric power production from biomass, fossil fuels and concentrating solar power based on steam cycles.

2008-today Thermal and structural analysis – Customer: **Quest Global**

Detailed thermal and structural analysis of turbomachinery and plant mechanical components by means of finite elements computational codes (FEM).

HVAC and Ventilation:

2012 Performance characterization of an industrial cold room
– Customer: **ELI LILLY**
Detailed CFD analysis of a large-size cold room for insulin storage. The main aim of the analysis was to reveal the presence of hot spot inside the storage and to optimize the cooling air injection.

Fire safety engineering:

2009-today Research project *“Design and testing of innovative water-mist fire prevention systems for passenger environment and enhancement of current fire extinction system in use on train cars by means of mathematical models”* – Customer: **Trenitalia** – Partner: **Ergon Research, Università degli Studi di Firenze**

The project aims at setting up dimensioning and installation criteria for fire extinction systems on passenger cars exploiting advanced CFD techniques. In particular a first phase is focused on customizing the open-source code FDS for railway applications to exploit the big amount of experimental data available by the customer to characterize employed materials. The second part is instead focused on the set up and realization of realistic experiments involving fires on both mock-up and real scale train cars measuring temperature evolutions, radiative heat transfer and pollutant emissions.

2010-today Fire scenario analysis in commercial, house and office buildings
– Costumer: **ESA Engineering**

Continuous support to fire extinction system design exploiting performance approach and flight simulation for security plan approval. The procedure includes the selection of performance criteria, of fire scenario and the direct simulation of the fire evolution with fire extinction system activation.

Members Publications

International Journals

- 2004 "Gas Turbines Design and Off-design Performance Analysis with Emissions Evaluation"
ASME Journal of Engineering for Gas Turbines and Power vol 126
- 2008 "Correlative Analysis of Effusion Cooling Systems"
ASME Journal of Turbomachinery, vol 130
- 2008 "Experimental Investigation of Innovative Internal Trailing Edge Cooling Configurations with Pentagonal Arrangement and Elliptic Pin Fin"
International Journal of Rotating Machinery, vol 2008
- 2009 "Application of the inverse analysis for boundary condition retrieval"
Inverse Problems in Science and Engineering, vol 17
- 2010 "Adiabatic and Overall Effectiveness Measurements of an Effusion Cooling Array for Turbine Endwall Application"
ASME Journal of Turbomachinery, vol 132
- 2011 "Analysis of gas turbine rotating cavities by a one-dimensional model: Definition of a new discs friction coefficients correlations set"
ASME Journal of Turbomachinery, vol 133
- 2011 "Turbine stator well CFD studies: Effects of coolant supply geometry on cavity sealing performance"

- 2011 **ASME Journal of Turbomachinery, vol 133**
 "Numerical study of aerodynamic losses of effusion cooling holes in aero-engine combustor liners"
ASME Journal of Engineering for Gas Turbines and Power vol 133
- 2012 "Numerical characterization of aerodynamic losses of jet arrays for Gas Turbine applications"
ASME Journal of Engineering for Gas Turbines and Power vol 134
- 2012 "Numerical and experimental investigation of turning flow effects on innovative pin fin arrangements for trailing edge cooling configurations"
ASME Journal of Turbomachinery
- 2012 "Numerical Characterization Of Pressure Drop Across The Manifold Of Turbine Casing Cooling System"
ASME Journal (Transaction of IGTI)
- 2012 "Some Improvements in a Gas Turbine Stator-Rotor System Core-Swirl Ratio Correlation"
International Journal of Rotating Machinery
- 2012 "Numerical benchmark of non conventional RANS turbulence models for film and effusion cooling"
ASME Journal (Transaction of IGTI)

International Conferences and Symposiums

Combustors

- 2004 "RANS Analysis of Turbulent Premixed Flames Using a Level Set Flamelet Method"
Joint Meeting of the Italian and Greek Section of Combustion Institute
- 2005 "Numerical study of radiation and cooling on the upper part of a gas turbine combustor liner"
Numerical Heat Transfer Conference EURO THERM82
- 2005 "Numerical Heat Transfer Analysis Of An Innovative Gas Turbine Combustor: Coupled Study Of Radiation And Cooling In The Upper Part Of The Liner"
ASME Turbo Expo GT2005-68365
- 2005 "Combustor Liner Cooling: Numerical Analysis Of Impingement Geometries"
Numerical Heat Transfer Conference EURO THERM82
- 2005 "NOx Emissions Reduction In An Innovative Industrial Gas Turbine Combustor (GE10 Machine): A Numerical Study Of The Benefits Of A New Pilot-System On Flame Structure And Emissions"
ASME GT2005-68364
- 2005 "Impingement cooling for modern combustors: experimental analysis and preliminary design"
ASME Turbo Expo GT2005-68361

- 2006 "Correlative analysis of effusion cooling systems"
ASME Turbo Expo GT2006-90405
- 2006 "Advanced Liner Cooling Numerical Analysis For Low Emission Combustors"
International Congress Of The Aeronautical Sciences ICAS
- 2006 "Fuel Flexibility Test Campaign On A Ge10 Gas Turbine: Experimental And Numerical Results"
ASME Turbo Expo GT-2006-90510
- 2008 "A post processing procedure for the evaluation of adiabatic and overall effectiveness of effusion cooling geometries"
Symposium on Measuring Techniques in Turbomachinery
- 2008 "Modeling Of Turbulent Combustion And Radiative Heat Transfer In A Object-Oriented CFD Code For Gas Turbine Application"
ASME Turbo Expo GT2008-51117
- 2008 "Development And Validation Of A 1-D Tool For Thermoacoustic Instabilities Analysis In Gas Turbine Combustors"
ASME Turbo Expo GT2008-51248
- 2009 "Investigation Of Circular And Shaped Effusion Cooling Arrays For Combustor Liner Application - Part 1: Experimental Analysis"
ASME Turbo Expo GT2009-60047
- 2009 "Investigation of circular and shaped effusion cooling arrays for combustor liner application - Part 2: numerical analysis"
ASME Turbo Expo GT2009-60038
- 2009 "Dual investigations on the improvement of effusion cooling by shaped holes"
World Conference on Experimental Heat transfer Fluid mechanics Thermodynamics
- 2009 "Assessment Of A Set Of Numerical Tools For The Design Of Aero Engines Combustors: Study Of A Tubular Test Rig"
ASME Turbo Expo GT2009-59539
- 2010 "Combined Effect Of Slot Injection, Effusion Array And Dilution Hole On The Heat Transfer Coefficient Of A Real Combustor Liner - Part 1 Experimental Analysis"
ASME Turbo Expo GT2010-22936
- 2010 "Combined effect of slot injection, effusion array and dilution hole on the heat transfer coefficient of a real combustor liner Part 2: numerical analysis"
ASME Turbo Expo GT2010-22937
- 2010 "Numerical study of aerodynamic losses of effusion cooling holes in aero-engine combustor liners"
ASME Turbo Expo GT2010-22942
- 2011 "Assessment of numerical tools for the evaluation of the acoustic impedance of multi-perforated plates"
ASME Turbo Expo GT2011- 46303
- 2011 "Experimental Investigation On The Effects Of A Large Recirculating Area On The Performance Of An Effusion Cooled Combustor Liner"
ASME Turbo Expo GT2011-46458

- 2011 "Measurements of the Cooling Performances of a Real Combustor Liner with Air and CO₂ Injection Through a Slot and an Array of Effusion Cooling Holes"
ATI 155
- 2012 "LES For The Evaluation Of Acoustic Damping Of Effusion Plates"
ASME Turbo Expo GT2012-68792
- 2012 "Experimental Survey On Heat Transfer In A Trailing Edge Cooling System: Effects Of Rotation In Internal Cooling Ducts"
ASME Turbo Expo GT2012-68792
- 2012 "Measurement Of Thermal Contact Conductance Of A Heatshield For Gas Turbine Combustors In A Realistic Test Rig Setup"
ASME Turbo Expo GT2012-68410
- 2012 "Density Ratio Effects On The Cooling Performances Of A Combustor Liner Cooled By A Combined Slot/ Effusion System"
ASME Turbo Expo GT2012-68263

Internal Heat Transfer

- 2004 "Pedestal and endwall contribution in heat transfer in thin wedge shaped trailing edge"
ASME Turbo Expo GT2004-53152
- 2004 "Heat Transfer Analysis Of A Wedge Shaped Duct With Pin Fin And Pedestal Arrays: A Comparison Between Numerical And Experimental Results"
ASME Turbo Expo
- 2005 "Combined Use Of Turbulators And Enlarged Pedestals In Trailing Edge Cooling Systems: An Experimental And Numerical Analysis"
European Turbomachinery Conference 078_04/94
- 2008 "Experimental Investigation of Innovative Internal Trailing Edge Cooling Configurations with Pentagonal Arrangement and Elliptic Pin Fin"
ISROMAC12-2008-20089
- 2008 "Investigation of Innovative Trailing Edge Cooling Configurations with Enlarged Pedestals and Square or Semicircular Ribs. Part 1 - Experimental Results"
ASME Turbo Expo GT2008-51047
- 2009 "Experimental Investigation Of Turning Flow Effects On Innovative Trailing Edge Cooling Configurations Based On Circular And Oblong Pin Fins"
European Turbomachinery Conference ETC-170
- 2009 "Experimental Investigation Of Turning Flow Effects On Innovative Trailing Edge Cooling Configurations With Enlarged Pedestals And Square Or Semicircular Ribs"
ASME Turbo Expo GT2009-59925
- 2010 "Experimental survey on heat transfer in an internal channel of a trailing edge cooling system"
ATI

- 2011 "Numerical analysis of the heat transfer in a trailing edge cooling duct in stationary and rotating conditions"
European Turbomachinery Conference ETC
- 2011 "Flow field analysis of a trailing edge internal cooling channel"
ASME Turbo Expo GT2011-45724
- 2011 "Heat Transfer Measurements and Effects of Rotation in a Trailing Edge Cooling System"
ATI 154
- 2012 "Heat Transfer Measurements In A Leading Edge Geometry With Racetrack Holes And Film Cooling Extraction"
ASME Turbo Expo GT2012-69581
- 2012 "Conjugate Heat Transfer Calculations on GT rotor blade for industrial applications. Part I: Equivalent Internal Fluid Network Setup and Procedure Description"
ASME Turbo Expo GT2012-69846
- 2012 "Conjugate Heat Transfer Calculations on GT rotor blade for industrial applications. Part II: improvement of external flow modeling"
ASME Turbo Expo GT2012-69849
- 2012 "Unsteady CFD analysis of turbulent flow and heat transfer in a gas turbine blade trailing edge subjected to rotation"
ASME Turbo Expo GT2012-69903

External Heat Transfer

- 2005 "Film Cooling System Numerical Design: Adiabatic And Conjugate Analysis"
ASME Heat Transfer Conference
- 2007 "Different Manufacturing Solutions of Fan-Shaped Film-Cooling Holes - Part I: Experimental Analysis"
International Gas Turbine Congress IGTC2007-ABS-56
- 2010 "Heat Transfer Performance Of Fan-Shaped Film Cooling Holes. Part I: Experimental Analysis".
ASME Turbo Expo GT2010-22808
- 2010 "Heat transfer performances of fan-shaped film cooling holes. Part II - numerical analysis"
ASME Turbo Expo GT2010-22809

Heat Transfer: General Interest

- 2005 "Nucleate Boiling Heat Transfer Modelling for Applications to Internal Combustion Engines Cooling Systems"
Numerical Heat Transfer Conference EURO THERM82
- 2007 "Application of the Inverse Analysis for Boundary Condition Retrieval"
Inverse Problems, Design and Optimization Symposium IPDO-028

- 2007 "Development and validation of a c++ object oriented CFD code for heat transfer analysis"
ASME Thermal Engineering and Summer Heat Transfer Conference AJ-1266
- 2007 "Heat transfer applications in turbomachinery"
Openfoam International Conference
- 2008 "Conjugate heat transfer analysis of an internally cooled turbine blade – subsonic and transonic tests"
OpenSource CFD International Conference
- 2008 "Adiabatic and Overall Effectiveness Measurements of an Effusion Cooling Array for Turbine Endwall Application"
ASME Turbo Expo GT2008-50826
- 2009 "Conjugate heat transfer analysis of an internally cooled turbine blades with an object oriented CFD code"
European Turbomachinery Conference ETC
- 2009 "Hole Spacing Effect On Adiabatic Effectiveness Of Effusion Cooling Arrays For Turbine Endwall Application: Experimental And Numerical Analysis"
European Turbomachinery Conference ETC-121
- 2010 "Endwall Effusion Cooling System Behavior Within A High-Pressure Turbine Cascade. Part 2: Heat Transfer And Effectiveness Measurements"
ASME Turbo Expo GT2010-22932
- 2011 "Discharge Coefficient Characterization of Jet Array Impingement Holes for an Active Clearance Control System"
European Turbomachinery Conference ETC-252
- 2011 "Heat Transfer and Effectiveness Evaluation of Multiple Impingement Jet Arrays for an Active Clearance Control System".
ISAIF10-58
- 2012 "Experimental and Numerical Analysis of Multiple Impingement Jet Arrays for an Active Clearance Control System"
ASME Turbo Expo GT2012-68791
- 2012 "Heat Transfer And Pressure Drop Analysis Of A Turbine Casing Impingement Cooling System"
ASME Turbo Expo GT2012-68793

Cavities and Seals

- 2008 "Analysis of gas turbine rotating cavities by a one-dimensional model"
ISROMAC12-2008-20161
- 2008 "Development of numerical tools for stator-rotor cavities calculation in heavy-duty gas turbines"
ASME Turbo Expo GT2008-51268
- 2008 "Turbine stator well CFD studies: Effects of cavity cooling air flow"
ASME Turbo Expo GT2008-51067
- 2010 "Numerical Benchmark of Turbulence modelling in Gas Turbine Rotor-Stator System"

- 2010 **ASME Turbo Expo GT2010-22627**
"RANS modeling of flow in rotating cavity system"
- 2010 **ECCOMAS**
"1D Tool For Stator-Rotor Cavities Integrated Into A Fluid Network Solver Of Heavy-Duty Gas Turbine Secondary Air System"
- 2011 **ASME Turbo Expo GT2010-22203**
"Analysis of gas turbine rotating cavities: Estimation of rotor disc pumped mass flow rate"
- 2011 **ASME Turbo Expo GT2011-46225**
"Benchmark numérique des écoulements de Couette-Taylor turbulents"
- 2011 **17° Congrès Français de Mécanique**
"Numerical predictions of flow field in closed and opened Taylor-Couette cavities"
- 2011 **EUCASS**
"Experimental investigation of the influence of clearance on leakage flow in a straight through labyrinth seal"
- 2011 **European Turbomachinery Conference ETC- 268**
"Experimental Investigation on Leakage Loss and Heat Transfer in a Straight Through Labyrinth Seal"
- 2011 **ASME Turbo Expo GT2011-46402**
"Experimental Investigation on Leakage Losses and Heat Transfer in a Non Conventional Labyrinth Seals"
- 2012 **ASME Turbo Expo GT2011-46403**
"An Investigation Into Numerical Analysis Alternatives For Predicting Re-Ingestion In Turbine Disc Rim Cavities"
- ASME Turbo Expo GT2012-68592**

Fire Engineering

- 2011 "Pyrolysis modeling and numerical simulation of rail carriage fire scenarios for the safe design of a passenger train"
Seventh Mediterranean Combustion Symposium
- 2011 "Fire scenarios modelling for the safe design of a passenger rail carriage"
World Congress on Railway Research

Other Fields

- 2005 "PNEUMA, PNEumatic Uninterruptible MACHine System: an Uninterruptible Pneumatic Power Generator. Part 1: Technical Analysis of a Compressed Air Based Power Backup System"
ISIE
- 2005 "Integration of environmental parameters into decision making within the pneuma project".
LCM - 2nd International Conference on Life Cycle Management

- 2006 "Characterization of Commercially Available Turbochargers for Possible Application in the Ups System Scenario"
ASME Turbo Expo GT2006-90442
- 2010 "Heavy duty gas turbine simulation: a compressor IGV airfoils off-design characterization"
ASME Turbo Expo GT2010-22628
- 2011 "Large eddy simulation for train aerodynamic noise predictions"
World Congress on Railway Research