

Marco Leonardi

Curriculum Vitae

Chemical propulsion engineer with a solid background in propulsion systems design and analysis, accustomed to operate in challenging scenarios, seeking efficient solutions by rigorous application of analytical thinking.

Experience

9/2018 – present **HE-Space for ESA, TEC-MPC, ESA-ESTEC Noordwijk, The Netherlands**
Chemical Propulsion Engineer

- Technical support to Orion-MPCV
 - Responsible of equipment high TRL level (qualification): Valves (ABIV, RBIV, MLIV), Thrusters (RCS, AUX) and Pressure Transducers. Monitoring of testing, analysis, integration and verification activities. Coordinated four qualification reviews, from RIDs issuing up to the resolution of main criticalities preventing qualification. Technical responsible for non-conformances discussion (NRB) and for the review of deviations impacting level 0 requirement (RFD/Ws) for this equipment
 - Support to the development phase for ESM3+ equipment (MLIV 1FT, RCS pods, BMV). Participate in the definition of the development test plan, review of development test results, formulation and assessment of critical development requirements in preliminary and critical design reviews.
 - Support to VCB (Verification Control Board) for closure of level 0 propulsion requirements
 - Responsible for numerical analysis at system level (EcosimPro)
 - Support to engine test campaign definition and execution at both engine and propulsion qualification module level
- Technical support to VEGA-E development programme and responsible for the development activities of the four propellant. Oversee the development of the valves for the methane-oxygen fuelled M10 engine. Identify the critical development issues and participate in their resolution. Evaluate the severity of development criticalities and minimize their impact on the project continuation. ESA PoC in principal design reviews up to review closeout and to development test phases.
- Technical responsible of two R&D activities assessing medium term needs for propulsion system: Electric Pump for green propellant in upper stage application and advanced journal bearings for rocket turbo-pumps. Main responsibilities include: oversee industry activities to verify evolution of the projects, organize reviews, discuss design criticalities and development issues, identify optimal technical solutions and evaluate their programmatic impact.
- Support phase A/B1 activities of the Cis-Lunar Transfer Vehicle (CLTV): definition of system level requirements in accordance with ECSS and NASA standards, formulation of mission scenarios and assessment of the scenarios impact on the propulsion subsystem, identification of technological limits of existing propulsion systems and of technology development opportunities based on main mission requirements.
- Support phase A/B1 of first ESA service mission for active debris removal, ClearSpace-1. Propulsion expert in charge of the activities for the development and implementation of the propulsion sub-system from its definition up to the final implementation
- Propulsion responsible of five CDF studies: THESEUS, RETURN, COMET INTERCEPTOR, CLTV, LCNS
- Propulsion system numerical analysis PoC for TEC-MPC section. Support to activities for spacecraft, launcher and CubeSat propulsion
- Promoted the utilization of the lesson learned tool. Bridged relations with the knowledge management department and initiated an alpha-test phase of a learning tool within the section, aimed at disseminating propulsion lessons learned internally and across the agency.

5/2016 – 8/2018 **Sapienza University of Rome, Italy**
Post-Doc Researcher in Rocket Engine propulsion

- Provided technical support to an ESA contract for the technological development of the cooling system of the methane-fuelled M-10 engine for VEGA-E. Assessment of the criticalities of Additive Layer Manufacturing techniques when applied to thrust chambers
- Extended the Ph.D. research with studies on propulsion architectures for green propellants (methane) by investigating the feasibility of novel methane-fueled expander bleed system architecture for upper stage applications
- Led a multi-departmental team to submit a successful joint proposal for a €300K funding to recover activities in the Italian spaceport near Malindi, Kenya. Author of the procurement plan, statement of work, cost evaluation and manpower organization for the 18 months of the project.
- Acted as employer representative in bilateral meetings with national and international agencies (ESA, CASC)
- Tutored two Master's courses in rocket propulsion. Responsible for solid rocket motor and liquid rocket engine systems seminars. Tailored lessons on a teamwork approach, dynamically integrating students' ideas to enhance problem solving skills (avg. class 50 people). Conducted interviews in exams
- Mentored six Master's thesis, suitably adapting coaching methods to maximize individual results

7/2014 – 7/2016

Sapienza University of Rome, Rome, Italy
Contractor - European Space Agency technical and research programmes
Propulsion Engineer Consultant

- ESA-TRP: *“Development and implementation of software tools to predict the behavior of components within propulsion system studies”*
 - Developed a numerical code for the analysis of bi-phase fluids behavior to be included in the ESPSS library for the system analysis software EcosimPro
 - Acted as representative in official meetings with ESA management, corroborating in technical and strategic choices and facilitating advancement of the programme
 - Negotiated prime contractor's requests by proposing solutions to preserve physical coherence of the software minimising impact on the infrastructure
 - Updated technical and reference documentation in compliance with the European Cooperation for Space Standardization (ECSS)
- ESA-EXPRO: *“Feasibility Study of Expander Bleed Engine”*
 - Proved the feasibility of an expander bleed cycle defining main characteristics of subcomponents and characterizing valve sequencing for numerical simulations of transient phases (start-up, shut-down, idle mode)
 - Developed an in-house numerical procedure for faster steady state design analyses of the propulsion system

8/2013 – 4/2014

European Space Agency (ESA), Noordwijk, The Netherlands
Internship - NPI

- Researched and implemented numerical schemes for reacting fluids, suitably modified to fit rocket engines modelling and analysis of internal reacting flows

Education

2012 – 2016

Sapienza University of Rome, Italy
Ph.D. in Aeronautical and Space Technology, Co-sponsored by ESA's NPI

Thesis on: *“Numerical Modelling of Liquid Rocket Engine Components for System Analysis”*.

Classification: Excellent

Performed thorough analyses of LRE systems and subsystems, with intensive development of CFD codes. Application of the developed tools to study the impact on the whole system of specific phenomena at component level, such as:

- Combustion chamber heat transfer and related influence of chemical reactions
- Cooling channels design and optimisation
- Low frequency combustion instabilities at system level (chugging)
- Two-phase flow applied to both transients (water hammer, priming) and steady phenomena

Analysis were performed by means of numerical codes developed during thesis and validated against experimental and numerical data collected from open literature

2009 – 2012

Sapienza University of Rome, Italy

MSc in Space Engineering,

Thesis on: Combustion instabilities analysis through analytical models for liquid propellant rockets

Score: 110/110 Summa cum Laude

Teaching

2016 to 2020

Course on Propulsion Systems Design and Analysis

Master in Space Transportation systems, "La Sapienza" University of Rome

2015

Course on Fortran programming language applied to numerical schemes for fluid dynamic computations

Master in Space Transportation systems, "La Sapienza" University of Rome

Computer skills

- Programming: Matlab, Fortran, C++, Bash, Python
- Computational Fluid Dynamic: In-house codes, CFD-ACE, CFD-GEOM
- Parallel computation: MPI, OpenMP
- Propulsion analysis tool: EcosimPro, TDK (Two Dimensional Kinetic), CEA
- CAD software: AutoCAD, CATIA
- Others: NIST-REFPROP

Additional info

- Presented 12 researches in 8 international conferences, published 3 papers in peer-reviewed journals
- Supervised the organization of three yearly NASA student events to disseminate space culture (250 annual attendees)
- Ph.D. students' representative in the university educational board
- Graduated in professional photojournalism, focused on research projects on gender, environmental and political issues. Published in 3 magazines and a collective exhibition
- GMAT 690, IELTS 8.0

Languages

English (C1), French (B1)

Selected publications

M., Leonardi, M. Pizzarelli, and F. Nasuti(2019). "Analysis of thermal stratification impact on the design of cooling channels for liquid rocket engines". *International Journal of Heat and Mass Transfer*, 135, 811-821, 2017

M., Leonardi, F. Nasuti, F. Di Matteo, and J. Steelant. "A methodology to study the possible occurrence of chugging in liquid rocket engines during transient start-up." *Acta Astronautica* 139 (2017): 344-356.

M. Leonardi , F. Nasuti, and M. Onofri. "Basic analysis of a lox/methane expander bleed engine". In European Conference for Aeronautics and Space Sciences (EUCASS), Milan, Italy, July 2017.

M. Leonardi , F. Di Matteo, and F. Nasuti. "Parametric study of an expander bleed engine performance". *Aerotecnica Missili & Spazio*, 96(1):32-43, 2017.

M. Leonardi , F. Di Matteo, J. Steelant, F. Nasuti, and M. Onofri. "Modelling chug instabilities by variable time lag approach". In Space Propulsion Conference, Rome, Italy, May 2016.

10/12/20