Daniele Bortoluzzi

Curriculum Vitae

Personal data and career summary

- Full Professor in the Academic Discipline Applied Mechanics at the Department of Industrial Engineering of the University of Trento since October 1st 2021.
- Associate Professor in the Academic Discipline Applied Mechanics at the Department of Industrial Engineering of the University of Trento since March 1st 2011, confirmed on March 1st 2014.
- Assistant Professor in the Academic Discipline Applied Mechanics at the Department of Mechanical and Structural Engineering of the University of Trento from January 7th 2004 (confirmed on January 7th 2007) to February 2011.
- Post-Doc, University of Trento, from 2002 to 2004. Research topic: development of Drag-Free technologies for space missions.
- Intern, Harley-Davidson Motor Company – Product Development Center (Milwaukee, Winsconsin USA), 2001. Research topic: New Methodology For The Measurement Of Front End Inertia And Damping.
- External collaborator, Ingegneria Ricerca Sistemi (IRS) Padova. Research topic: fluid-dynamic study of an electrostatic filter for a large thermo-electric power plant, 1998.

Education

- Ph.D. in the Academic Discipline Applied Mechanics at the University of Brescia, XIV cycle, February 2002.
- Master's Degree in Mechanical Engineering at the University of Padova, 110/110 cum laude, April 1998.

Summary of the scientific research activity

I earned the Master's Degree in Mechanical Engineering – specialization in Design of Machines – at the University of Padova (Italy) on April 2nd 1998, 110/110 with honours, discussing the thesis "Fluid-dynamic study of the intake manifolds of internal combustion engines in presence of acoustic resonators".

The background in fluid-dynamics allowed me to collaborate from September to December 1998 with the research company I.R.S. (Padova, Italy) for the study of an electrostatic filter for a large French thermo-electric power plant. I also contributed to a research project with Hiross S.p.A. (Padova, Italy) from September 1999 to February 2001 for the experimental and theoretical study of the vibration and acoustic behaviour of an industrial air conditioner, aiming at reducing the noise.

I earned the Ph.D. in Applied Mechanics at the University of Brescia (Italy) in the XIV cycle (1998-2001) on February 14th 2001, with the dissertation "Experimental and theoretical study of two wheeled vehicles manoeuvrability, handling and stability for safety improvement". The research activity was both experimental, with the development of specific measurement systems and methods for motorcycles, and theoretical, with the validation of mathematical models and the interpretation of the experimental results.

In the frame of the Ph.D. course I performed an internship at Harley-Davidson Motor Company (Milwaukee, Wisconsin, USA), where I developed a new methodology for the measurement of some mechanical (geometric, inertial and tribological) properties of the motorcycle which affects the vehicle stability. Working in the Product Development Center of a large company allowed me to understand the main aspects, methods and issues of technological innovation in industry.

From February 15th 2002 to January 6th 2004 I was assigned a Post-Doc grant at the University of Trento (Italy), concerning the "Development of Drag-Free technologies for space missions". Such a grant was issued

in the frame of the LISA (Laser Interferometer Space Antenna) project, which is a joint National Aeronautics and Space Administration (NASA) and European Space Agency (ESA) space mission aiming at the in-flight detection of gravitational waves ("The Gravitational Universe" – white paper by the LISA consortium). It involves a wide international scientific and technological collaboration of Universities, research institutes, industrial partners and space agencies in the effort to observe gravitational waves in space. The detection of gravitational waves is an outstanding scientific task: it can verify a fundamental aspect of Einstein's General Relativity Theory, but also give information on black holes, supernovae and binary star systems and in general on the evolution of the Universe from its early formation.

The European Space Agency realized a technology demonstration mission, LISA Pathfinder, to provide in-flight verification of some of the LISA key technologies. Such technologies were integrated in the LISA Technology Package (LTP), the scientific payload, which tested functionalities and performances of the technological solutions implemented.

The university of Trento plays a relevant role in the LISA project, since it was assigned the responsibility of Principal Investigator (Prof. Stefano Vitale) together with the University of Hannover (Prof. Karsten Danzmann) of the scientific payload of the LISA Pathfinder mission, the LISA Technology Package. Such an activity was financed by ESA, Italian Space Agency (ASI) and the Istituto Nazionale di Fisica Nucleare (INFN) and involved interdisciplinary aspects of Physics and Engineering. In the Principal Investigator team the activities I was involved in were ruled by specific contracts and performed in the frame of a research project fitted into a space mission schedule. As a consequence, the research activity was organized according to the project standards, in collaboration with consortiums of Universities and industrial partners.

I was involved in project activities concerning different aspects of the development of the LISA Pathfinder mission and the design and testing of the LISA Technology Package, which may be grouped in three areas. The first concerns the design of the LISA Technology Package, the set of experiments to be performed in flight in order to test the developed technologies, the scientific requirements and methodologies for their verification, the interfaces to the spacecraft and in general the architecture and the system engineering of the LISA Technology Package instrument. The second area concerns the definition of the requirements and the design of the attitude and orbit Drag-Free control system of the spacecraft, which must guarantee a nanometre-level tracking error of the semi-inertial reference masses inside the LISA Technology Package. In this frame I supported the Drag-Free design teams of the two industrial bidders (EADS Casa Espacio and former Astrium GmbH) for the mission implementation phase. The third area concerns the design, development and verification of the Gravitational Reference Sensor (GRS), which constitutes inside the LISA Technology Package the instrument which realizes the semi-inertial reference system, as it is free of disturbance forces in excess of ten femto-Newton, and contemporarily supplies position measurements at the nanometre level. The realization of such a low disturbance level requires a strict surveillance of any potential noise source and the definition of control protocols of the gravitational and magnetic fields generated by the spacecraft; at the same time, such tight accuracy levels require advanced manufacturing and assembling technologies.

On January 7th 2004 I have been enrolled as researcher in Applied Mechanics (Ing-Ind/13) at the Department of Mechanical and Structural Engineering of the School of Engineering of the University of Trento, in the Mechatronic group. My research activity focused itself on a LISA Pathfinder (and potentially LISA) mission critical phase, which is the injection of the inertial reference masses into the geodesic trajectory inside the GRS, with tight requirements on position accuracy and residual velocity. Once that the criticality of the mission was identified, it was agreed to improve the knowledge of the physical and engineering issues involved in this phase in the frame of the design and development of the GRS. To this purpose, I was assigned the responsibility of Work Packages dedicated to the experimental study of the injection phase and the dedicated mechanism. I was also assigned the responsibility of a full research contract with Alcatel Alenia Space to study the injection phase performed by the grabbing positioning and release mechanism and I started to involve master and PhD students in the specific research activity in the laboratory of Mechatronics at the Department of Mechanical and Structural Engineering, where an experimental facility was initially assembled.

On January 7th 2007 I was confirmed in the role of researcher in Applied Mechanics (Ing-Ind/13).

On March 1st 2011 I was enrolled as Associate Professor in Applied Mechanics (Ing-Ind/13) at the Department of Mechanical and Structural Engineering of the School of Engineering of the University of Trento. The research activity in the LISA Pathfinder mission was focused on the improvement of the injection experiment representativeness of the in-flight conditions and lastly providing the qualification of a mechanism engineering unit. The project was co-financed by EADS Astrium GmbH under my responsibility. The research activity required a dedicated laboratory – Laboratory of Space Applications – which was created under my responsibility in the Department of Industrial Engineering. This allowed me to involve students, collaborators and col-

leagues in the research activity, which required a growing effort and dedicated resources, especially on the experimental side.

On March 1st 2014 I was confirmed in the role of Associate professor in Applied Mechanics (Ing-Ind/13).

Approaching the launch date (December 3rd 2015) the activities evolved towards the preparation to the mission operation and the realization of the in-flight scientific and technological experiments to be performed by the LTP. The mission was extended and this made it possible to realize dedicated experiments by means of the injection mechanism, which required an intense characterization activity. The perspective is to exploit the LISA Pathfinder heritage for the LISA mission, maximizing the knowledge gained by the science team and the industrial partners who joined such a challenging project.

On October 1st 2021 I was enrolled as Full Professor in Applied Mechanics (Ing-Ind/13) at the Department of Industrial Engineering of the University of Trento.

Acoustic and fluid-dynamics

Master's thesis

[1] D. Bortoluzzi, "Studio fluidodinamico dei condotti di aspirazione di motori a combustione interna in presenza di risuonatori acustici", Master Degree in Mechanical Engineering, supervisor Prof. V. Cossalter, co-supervisor Prof. A. D. Martegani, University of Padova, April 1998.

Proceedings of International peer-reviewed conferences

[2] D. Bortoluzzi, V. Cossalter, A. Doria, "The effect of tunable resonators on the volumetric efficiency of an engine", 1998 Motorsports Engineering Conference, 16-18 November 1998, Dearborn (Michigan, USA), SAE paper 983045, Proceedings Volume 2: Engines and Drivetrains-P-340/2. SAE 1998 Transactions - Journal of Engines-V107-3.

[3] D. Bortoluzzi, A. Doria, "Analysis and simulation of engine tuned intake systems", 5th High-tech cars and engines international conference, 3-4 June 1999, Modena, organized by University of Modena and Reggio Emilia (Italy) and the Service Center for Industrial Automation Democenter, **Presenting author**.

Selected technical notes:

[4] A. Doria, D. Bortoluzzi, V. Cossalter, "Riduzione dell'emissione acustica del condizionatore HIMOD UNDER SMALL per mezzo di risonatori di Helmholtz"

[5] A. Doria, D. Bortoluzzi, V. Cossalter, "Experimental study of the effect of resonator arrays"

VEHICLE DYNAMICS AND CONTROL

PhD dissertation

[1] D. Bortoluzzi, "Studi sperimentali e teorici sulla manovrabilità, maneggevolezza e stabilità di veicoli a due ruote per il miglioramento della sicurezza", Ph.D. dissertation, Supervisor Prof. V. Cossalter, University of Brescia, February 2002.

Published papers in international peer-reviewed journals

[2] F. Biral, D. Bortoluzzi, V. Cossalter, M. Da Lio, "Experimental study of motorcycle transfer functions for evaluating handling", Vehicle System Dynamics, 2003, v.39, n.1, p.1-25.

[3] Plebe, A., Da Lio, M., "On Reliable Neural Netweork Sensorimotor Control in Autonomous Vehicles", IEEE Transactions on Intelligent Transportation SystemsVolume 21, Issue 2, Pages 711 – 722, February 2020 Article number 8643729

[4] Da Lio M., Bortoluzzi D., Rosati Papini G., "Modelling longitudinal vehicle dynamics with neural net-

works", Vehicle System Dynamics, Volume 58, Issue 11, Pages 1675 - 16931 November 2020

[5] Rahimi, M., Bortoluzzi, D., Wahlstrom, J., "Input parameters for airborne bake wear emission simulations: A comprehensive review", Atmosphere, Vol. 12, Issue 7, July 2021, n. 871.

Invited talks

[6] D. Bortoluzzi, "Manovrabilità, maneggevolezza e stabilità di veicoli a due ruote per il miglioramento della sicurezza", seminar at the Department of Mechanical Engineering, University of Padova, 8th March 2002. **Presenting author**

Procedings of International peer-reviewed conferences

[7] D. Bortoluzzi, A. Doria, R. Lot, "Experimental Investigation and Simulation of Motorcycle Turning Performance", 2000 International Motorcycle Conference, 11-12 September 2000, Munich, organized by Institut fur Zweiradsicherheit e.V. – Essen, Conference Proceedings, IFZ Research Publication Series, edited by Reiner Brendicke. **Presenting author**.

[8] D. Bortoluzzi, R. Lot, N. Ruffo, "Motorcycle Steady Turning: the significance of geometry and inertia", 7th International Conference and Exibition ATA 2001 (23-35 May 2001), paper 01A1025, proceedings, Firenze

[9] Bortoluzzi D., Biral F., Bertolazzi E., Bosetti P., Zendri F., "Influence of vehicle model complexity in autonomous emergency manoeuvre planning", Proceedings of IMECE 2008 2008 ASME International Mechanical Engineering Congress and Exposition October 31 – November 6, 2008, Boston, Massachusetts, USA. **Presenting author**

[10] Biral F., Bertolazzi E., Bortoluzzi D., Bosetti P., "Development and testing of an autonomous driving module for critical driving conditions", Proceedings of IMECE 2008 2008 ASME International Mechanical Engineering Congress and Exposition October 31 – November 6, 2008, Boston, Massachusetts, USA

[11] Various authors, Bortoluzzi D., "Autonomous vehicle architecture inspired by the neurocognition of human driving", VEHITS 2018 - Proceedings of the 4th International Conference on Vehicle Technology and Intelligent Transport Systems, Volume 2018-March, Pages 507 - 5132018

Contribution to invited talks

[12] F. Biral, D. Bortoluzzi, M. Da Lio, "The Optimal Menuver Method: Realistic Driver Models and Vehicle Robust Design". Contribution to "Lecture on Motorcycle Dynamics", Harley Davidson Headquarters, Milwaukee Wisconsin, USA, 10 May 2002

[13] Biral F., Bortoluzzi D., Bosetti P., "Combining minimum time criterion and driving skills in the Optimal Maneuver Method. Towards an advanced driver model for motorcycle", Harley Davidson Motor Company Product Development Center, Milwaukee, Wisconsin, 10th November 2006

Other contributions

[14] D. Bortoluzzi, "New Methodology For The Measurement Of Front End Inertia And Damping", Internal Report, Harley-Davidson Chassis Systems Department, Engineering Division, Product Development Center, Milwaukee, Luglio 2001.

LISA Project

Research grants

- Rider to “LISA Technology Package Architect”, in response to ESA ITT AO/1-3915/01/NL/NB, ESTEC contract No.15580/01/NL/HB Prime Contractor University of Trento, in collaboration with the University of Birmingham, Carlo Gavazzi Space, Max Planck Institut für Gravitationsphysik (Albert Einstein Institut) Hannover, the Space Research Organisation Netherland, SRON-Utrecht and the University of Glasgow, 2003. Role of WP manager.
- “Inertial Sensor Ground Testing and Noise Model for LISA” in response to ESA RFQ/3-10687/03/NL/AG, ESTEC contract No.18223, Prime Contractor University of Trento, in collaboration with Albert Einstein Institut Hannover, EADS Astrium GmbH and Carlo Gavazzi Space, 2004. Role of WP manager.
- Alcatel Alenia Space Italia, “Experimental support to the design and conceptual testing of the release-dedicated subsystem Grabbing Positioning and Release Mechanism” to the Department of Mechanical and Structural Engineering, University of Trento, 2006. Role of Principal Investigator and project manager.
- Airbus Defence and Space (formerly EADS Astrium GmbH Friedrichshafen), “LTP Caging Mechanism Assembly – qualification of the flight unit of the release mechanism” to the Department of Industrial Engineering, 2014. Role of Principal Investigator and project manager.
- Italian contribution to LISA/LISA Pathfinder Program, University of Trento and INFN in response to Agenzia Spaziale Italiana ASI-RFQ-prot-3883, contract I/029/05/0 Prot 0001757-08/06/2005. Role of WP manager, scientific requirements and related analyses, 2005
- LISA PF – Scientific support to the development, E2 phase and data analysis”, University of Trento in response to Agenzia Spaziale Italiana prot-003730, contract ASI I/044/07/0. Role of work package manager, scientific requirements, noise model and analyses, 2007
- LISA PF – Scientific support to the development, University of Trento contract with Agenzia Spaziale Italiana ASI I/035/11/0, 2011. Role of work package manager of the verification of the test mass release to free-fall.
- Addendum to ASI I/035/11/1, 2014. Role of work package manager of the verification of the test mass release to free-fall.
- Agenzia Spaziale Italiana, Agreement n.2017-29-H.0 CUP F62F17000290005 “Phase A activity for LISA mission”, 2017. Role of WP manager LISA Gravitational Reference Sensor mechanism definition and technology development.
- Agenzia Spaziale Italiana, Agreement n.2017-29-H.1 “Phase A activity for LISA mission”, 2020. Role of WP manager LISA Gravitational Reference Sensor mechanism definition and technology development.

Payload Architecture and System Engineering

Published papers in international peer-reviewed journals

[1] Bortoluzzi D., Carbone L., Cavalleri A., Da Lio M., Dolesi R., Hoyle C. D., Hueller M., Vitale S., Weber J. W., "Measuring random force noise for LISA aboard the LISA Pathfinder mission". Classical and quantum gravity, 2004, v. 21, p. 573-579.

[2] Bortoluzzi D. et alii, "The LTP experiment on the LISA Pathfinder mission". Classical and quantum gravity, 2005, v. 22, p. 125-138.

[3] Armano M., Bortoluzzi D., Hoyle C. D., Vitale S., "Gravitational compensation for the LISA pathfinder". Classical and quantum gravity, 2005, v. 22, pt. S, p. 501-507.

[4] Various authors, Bortoluzzi D., “LISA Pathfinder: the experiment and the route to LISA”, Classical and quantum gravity, 26 (2009) 094001

[5] Various authors, Bortoluzzi D., “The first mock data challenge for LISA Pathfinder”, Classical and quantum gravity, 26 (2009) 094004

[6] Various authors, Bortoluzzi D., “Data analysis for the LISA Technology Package”, Classical and quan-

tum gravity, 26 (2009) 094003

[7] Various authors, Bortoluzzi D., “The LISA Pathfinder interferometry – hardware and system testing”, Classical and quantum gravity, 28 (2011), 094003

[8] Various authors, Bortoluzzi D., “LISA Pathfinder: mission and status”, Classical and quantum gravity, 28 (2011) 094001

[9] Various authors, Bortoluzzi D., “From laboratory experiments to LISA Pathfinder: achieving LISA geodesic motion”, Classical and quantum gravity, 28 (2011) 094002

[10] Various authors, Bortoluzzi D., “LISA Pathfinder data analysis”, Classical and quantum gravity, 28 (2011) 094006

[11] Various authors, Bortoluzzi D., “The LISA Pathfinder mission”, Classical and quantum gravity, 29 (2012) 124014

[12] Various authors, Bortoluzzi D., “Constraints on LISA Pathfinder’s self-gravity: design requirements, estimates and testing procedures”, Classical and quantum gravity, 33(2016)235015(14pp)

Proceedings of International peer-reviewed conferences

[13] Various authors, Bortoluzzi D., “Bayesian statistics for the calibration of the LISA Pathfinder experiment”, Journal of Physics: Conference Series 610 (2015) 012027

[14] Various authors, Bortoluzzi D., “In-flight thermal experiments for LISA Pathfinder: Simulating temperature noise at the Inertial Sensors”, Journal of Physics: Conference Series 610 (2015) 012023

[15] Various authors, Bortoluzzi D., “Free-flight experiments in LISA Pathfinder”, Journal of Physics: Conference Series 610 (2015) 012006

[16] Various authors, Bortoluzzi D., “Disentangling the magnetic force noise contribution in LISA Pathfinder”, Journal of Physics: Conference Series 610 (2015) 012024

[17] Various authors, Bortoluzzi D., “The LISA Pathfinder Mission”, Journal of Physics: Conference Series 610 (2015) 012005

[18] Various authors, Bortoluzzi D., “A noise simulator for eLISA: Migrating LISA Pathfinder knowledge to the eLISA mission”, Journal of Physics: Conference Series 610 (2015) 012036

Spacecraft dynamics and control

Published papers in international peer-reviewed journals

[1] Bortoluzzi D., Da Lio M., Dolesi R., Weber J. W., Vitale S., "The LISA Technology Package Dynamics and Control". Classical and quantum gravity, 2003, v. 20, n. 10, p. 227-238.

[2] Bortoluzzi D., Bosetti P., Carbone L., Cavalleri A., Ciccolella A., Da Lio M., Danzmann K., Dolesi R., Gianolio A., Heinzel G., Hoyland D., Hoyle C. D., Hueller M., Nappo F., Sallusti M., Sarra P., Te Plate M., Tirabassi C., Vitale S., Weber J. W., "Testing LISA drag-free control with the LISA technology package flight experiment". Classical and quantum gravity, 2003, v. 20, n. 10, p. 89-97.

[3] Da Lio M., Bortoluzzi D., Vitale S., "Multibody model for spacecraft drag-free control of the laser interferometer space antenna technology demonstration mission smart - 2". Space Technology, 2004, v. 24, n. 1, p. 57-71

[4] Fichter W., Gath P., Vitale S., Bortoluzzi D., "LISA pathfinder drag-free control and system implications". Classical and quantum gravity, 2005, n. 22, pt. S, p. 139-148.

[5] Various authors, Bortoluzzi D., “Calibrating the System Dynamics of LISA Pathfinder”, Phys. Rev. D 97, 122002, 15 June 2018

[6] Various authors, Bortoluzzi D., “LISA Pathfinder platform stability and drag-free performance”, Phys. Rev. D 99, 082001, 16 April 2019

Proceedings of International peer-reviewed conferences

[7] Da Lio M., Bortoluzzi D., "Symbolic derivation of open-loop dynamic models of multibody mechatronic systems for control purpose. A case study: The LISA Technology Package", ESA Special Publication, ESA SP 516, p. 517-526, "5th International ESA Conference on Spacecraft Guidance Navigation and Control Systems", Frascati, 22-25/10, 2002.

[8] Bortoluzzi D., Da Lio M., Oboe R., Vitale S., "Spacecraft high precision optimized control design for free-falling test mass tracking in Lisa-Pathfinder Mission". Advanced Motion Control AMC 2004 Conference Proceedings, Kawasaki (Japan): IEEE Press, 2004, March 25-28, 2004 **Presenting author**

[9] Bortoluzzi D., Gath P., Fichter W., Ziegler T., Montemurro F., Schleicher A., "Feedback controller design for the basic science mode of the LISA Pathfinder Mission". In: IFAC Proceedings Volumes, Volume 37, Issue 6, Pages 839-844, Proceedings of 16° IFAC Symposium on Automatic Control in Aerospace", Saint-Petersburg, Russia, 14-18 June, 2004

[10] Fichter W., Schleicher A., Brandt N., Vitale S., Bortoluzzi D., "Control tasks and functional architecture of the LISA pathfinder drag-free system", ESA Special Publication, ESA SP 606, p. 691-697, 6th International ESA Conference on Guidance, Navigation and Control Systems, Loutraki, 17 October 2005 - 20 October 2005

[11] Various authors, Bortoluzzi D., “A Strategy to Characterize the LISA-Pathfinder Cold Gas Thruster System”, Journal of Physics: Conference Series 610 (2015) 012026, 10th International LISA Symposium (LISAX), University of Florida, Gainesville, Florida USA, May 18 - May 23, 2014

National conferences

[12] Bertolazzi E., Biral F., Bortoluzzi D., Da Lio M., “Il ruolo del MBD nell’unità di ricerca di Trento”, 1° workshop sulla dinamica dei sistemi multibody, 27-28 aprile 2006, Paestum (SA) **Presenting author**

Gravitational Reference Sensor design, development and verification

Published papers in international peer-reviewed journals

[1] Dolesi R., Bortoluzzi D., Bosetti P., Carbone L., Cavalleri A., Cristofolini I., Da Lio M., Fontana G., Fontanari V., Foulon B., Hoyle C. D., Hueller M., Nappo F., Sarra P., Shaul D., Sumner T., Weber J. W., Vitale S., "Gravitational Sensor for LISA and its Technology Demonstration Mission". Classical and quantum gravity, 2003, v. 20, n. 10, p. 99-108.

[2] Various authors, Bortoluzzi D., “Capacitive sensing of test mass motion with nanometer precision over millimeter-wide sensing gaps for space-borne gravitational reference sensors”, Phys. Rev. D 96, 062004 — 26 September 2017

[3] Various authors, Bortoluzzi D., “Precision charge control for isolated free-falling test masses: LISA Pathfinder results”, Phys. Rev. D 98, 062001 – 11 September 2018

[4] Various authors, Bortoluzzi D., “Analysis of the accuracy of the actuation electronics in the laser interferometer space antenna pathfinder”, Rev. Sci. Instrum. 91, 045003 (2020), 9 April 2020

Proceedings of International peer-reviewed conferences

[5] Weber J. W., Bortoluzzi D., Carbone L., Cavalleri A., Da Lio M., Dolesi R., Fontana G., Hoyle C. D., Hueller M., Vitale S., "Position sensors for flight testing of LISA drag-free control". Proceedings of SPIE – The International Society for Optical Engineering, Vol. 4856, p. 31-42, 2002. Proceedings of Gravitational wave Detection, Astronomical Telescopes and Instrumentation Conference", Waikoloa, Hawaii, USA, August 22-28, 2002

Space mechanism design, development, qualification and in-flight performance

Published papers in international peer-reviewed journals

[1] Benedetti M., Bortoluzzi D., Da Lio M., Fontanari V., "The influence of adhesion and sub-Newton pull-off forces on the release of objects in outer space". Journal of Tribology Transactions of the ASME, 2006, v. 128, n. 4, p. 828-840.

[2] Benedetti M., Bortoluzzi D., Vitale S., "A Momentum Transfer Measurement Technique Between Contacting Free-Falling Bodies in the Presence of Adhesion", Journal of applied mechanics, published quarterly by the American society of mechanical engineers, 2008, v. 75, n. 1, p. 011016-1-011016-13, DOI: 10.1115/1.2755104

[3] Bortoluzzi D., De Cecco M., Vitale S., Benedetti M., "Dynamic Measurements of Impulses Generated by the Separation of Adhered Bodies under Near-Zero Gravity Conditions", Experimental mechanics (2008) 48: 777-787, DOI: 10.1007/s11340-007-9115-z

[4] Bortoluzzi D., Baglivo L., Benedetti M., Biral F., Bosetti P., Cavalleri A., Da Lio M., De Cecco M., Dolesi R., Lapolla M., Weber W., Vitale S., "LISA Pathfnder test mass injection in geodesic: status of the on-ground testing", Classical and quantum gravity, 26 (2009) 094011.

[5] De Cecco M., Bortoluzzi D., Baglivo L., Benedetti M., Da Lio M., "Measurement of the momentum transferred between contacting bodies during the LISA test-mass release phase – uncertainty estimation", Meas. Sci. Technol. 20 (2009) 055101

[6] Bortoluzzi D., Benedetti M., Baglivo L., Vitale S., "A new perspective in adhesion science and technology: testing dynamic failure of adhesive junctions for space applications", Experimental Mechanics (2010) 50: 1213-1223

[7] Bortoluzzi D., Foulon B., Garcia Marirrodriga C., Lamarre D., "Object injection in geodesic conditions: in-flight and on-ground testing issues", Advances in Space Research, 45 (2010) 1358-1379

[8] Bortoluzzi D., Mausli P.A., Antonello R., Nellen P.M., "Modeling and identification of an electro-mechanical system: the LISA grabbing positioning and release mechanism case", Advances in Space Research, 47 (2011) 453-465

[9] Benedetti M., Bortoluzzi D., Baglivo L., Vitale S., "An optimal two-input approach for impulse measurements in the nanoNs range produced by contact forces", Mechanical Systems and Signal Processing, 25 (2011) 1646-1660.

[10] Bortoluzzi d., Benedetti M., Baglivo L., De Cecco M., "Measurement of momentum transfer due to adhesive forces: on-ground testing of in-space body injection into geodesic motion", Rev. Sci. Instrum. 82, 125107 (2011)

[11] Benedetti M., Bortoluzzi D., Zanoni C., "Non-linear mechanical behaviour of metallic micro-wires under dynamic axial loads", Experimental Mechanics (2012) 52:215-228

[12] Bortoluzzi D., Conklin J.W., Zanoni C., "Prediction of the LISA-Pathfinder release mechanism in-flight performance", Advances in Space Research Vol. 51 Issue 7, p. 1145-1156, 1 April 2013

[13] Bortoluzzi D., Benedetti M., Conklin J.W., "Indirect measurement of metallic adhesion force as a function of elongation under dynamic conditions", Mechanical Systems and Signal Processing, Volume 38, Issue 2, Pages 384 - 39820 July 2013

[14] Bosetti P., Biral F., Bortoluzzi D., "Design, manufacturing, and performance verification of a Roberts linkage for inertial isolation", Precision Engineering, Volume 38, Issue 1, Pages 138 – 147, January 2014

[15] Bortoluzzi D., Zanoni C., Vitale S., "Improvements in the measurement of metallic adhesion dynamics, Mechanical Systems and Signal Processing, Volume 52-53, Issue 1, Pages 600 - 6132015

[16] Zanoni C., Bortoluzzi D., "Experimental-analytical qualification of a piezoelectric mechanism for a critical space application, IEEE/ASME Transactions on Mechatronics, Volume 20, Issue 1, Pages 427 – 437, February 2015, Article number 6858022

[17] Bortoluzzi D., Zanoni C., Conklin J.W., "On-ground testing of the role of adhesion in the LISA-Pathfinder test mass injection phase, Advances in Space Research, Volume 59, Issue 10, Pages 2572 – 258215, May 2017

[18] Bortoluzzi D., Zambotti A., Favia N., "A vibration mode-based adhesion impulse characterization technique, Mechanical Systems and Signal Processing, Volume 145, November - December 2020 Article

number 106952

[19] Bortoluzzi D., AA. VV., “In-flight testing of the injection of the LISA Pathfinder test mass into a geodesic, Advances in Space Research, Open Access, Volume 67, Issue 1, Pages 504 - 5201 January 2021

[20] Zanoni C., Bortoluzzi D., “Estimation of the electrostatic effects in the LISA-Pathfinder critical test mass dynamics via the method of moments, IEEE/ASME Transactions on Mechatronics, Open Access, in press 2021

[21] Bortoluzzi D., Vignotto D., Dalla Ricca E., Mendes J., “Investigation of the in-flight anomalies of the LISA Pathfinder Test Mass release mechanism, Advances in Space Research, in press 2021

Invited talks

[22] Daniele Bortoluzzi, M. Benedetti, R. Antonello, L. Baglivo, J. W. Conklin, M. De Cecco, C. Garcia Marirrodriga, I. Koeker, P. Nellen, R. Sporri, S. Vitale, C. Zanoni, "Releasing the LISA Pathfinder test mass into a geodesic: a challenge between physics and engineering". Invited seminar at Stanford University California, USA, 11th June 2012. **Presenting author**

[23] D. Bortoluzzi, C. Zanoni, S. Vitale, “Test Mass Caging and Release Mechanism for LISA Pathfinder”, Workshop on experimental gravitation in space, February 2014, Huazong University of Science and Technology, Wuhan, China. **Presenting author**

Contribution to invited talks

[24] P. Bosetti, F. Biral, D. Bortoluzzi, “Design, Manufacturing and Performance Verification of a Roberts Linkage for Inertial Isolation”. Invited seminar at Stanford University, California, USA, November 2013

Proceedings of International peer-reviewed conferences

[25] Bortoluzzi D., Bosetti P., Da Lio M., "Tribology Aspects in Scientific Experiment “LISA” (Laser Interferometer Space Antenna) for the Detection of Gravitational Waves". Conference proceedings of "AITC (AIMETA Tribology International Conference) 2002", Vietri sul mare (SA), 18-20/9, 2002. URL : http://www.aitc2002.unisa.it/

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[43] Zanoni C., Bortoluzzi D., Conklin J.W., Koeker I., Marirrodriga C.G., Nellen P.M., Vitale S., "Testing the injection of the LISA-Pathfinder test mass into geodesic conditions", 15th European Space Mechanism and Tribology Symposium, Noordwijk, The Netherlands – 25th-27th September 2013

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Gainesville, 18 May 2014 - 23 May 2014 **Presenting author**

[46] Bortoluzzi D., Seutchat Tcheungang B., Gambini L., Zanoni C., Giacomozzi F., "Microscale analysis of adhesive contacts between rough ductile metals", 42nd Leeds-Lyon Symposium on Tribology, Lyon, 7-9 September 2015

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[48] Bortoluzzi D., Zambotti A., Vitale S., Zanoni C., Gambini L., Rozemeijer H., Conklin J.W., Johlander, B., Koeker, I., Marirrodriga, C. G., Nellen, P., "Testing the LISA Pathfinder test mass uncaging and injection into a geodesic", The 14th European Conference on Spacecraft Structures, Materials and Environmental Testing (ECSSMET), 27-30 September 2016, Toulouse, France

[49] Bortoluzzi D. on behalf of the LISA Pathfinder collaboration, "In-flight testing of the injection of the LISA Pathfinder test mass into a geodesic, 12th International LISA Symposium, Chicago IL, 8-13 July 2018 **Presenting author**

[50] Bortoluzzi D., various authors, "Ground testing of a critical mechanism for object injection into geodesic orbit", 4th International Conference and Exhibition on Satellite and Space Missions, June 18-20 2018, Rome **Presenting author**

[51] Various authors, Bortoluzzi D., "Object release into free-fall: a technological challenge for in-space gravity wave detection", 4th International Conference and Exhibition on Satellite and Space Missions, June 18-20 2018, Rome

[52] Bortoluzzi D. on behalf of the LISA Pathfinder Collaboration, Vignotto D., Zambotti A., Köker I., Rozemeijer H., Mendes J., Sarra P., Moroni A., Lorenzi P., "Analysis of the in-flight injection of the LISA Pathfinder test-mass into a geodesic", 18th European Space Mechanism and Tribology Symposium, Munich, Germany, 18th-20th September 2019 **Presenting author**

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National conferences

[55] Benedetti M., Bortoluzzi D., "Esperimento per la Misura della Quantità di Moto Trasferita alla Separazione di Corpi in Presenza di Adesione ed in Condizioni di Microgravità", 26° Convegno Nazionale AIAS, Ischia, 4-8 September 2007

[56] Bortoluzzi D., Baglivo L., Benedetti M., Vitale S., De Cecco M., "Micro-nano impulse estimation with laser interferometer displacement measurements. An optimal filter application", XVII AIVELA National Meeting, Ancona, 26-27th November 2009

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Other contributions

[58] Bortoluzzi D., Eiden M., Durrant S., Yorck M., Sciacovelli D., Baldesi G., Graham A., De Rooij T., Fertin D., Tirabassi C., Sallusti M., Garcia C., Devoldere D., Vitale S., Benedetti M., Koeker I., "Lisa Pathfinder test mass release task group report", S2-EST-RP-3019 Draft8, 2005, Reference project: Test mass release Task Group

National awards

A. Capocaccia 2008 "Esperimento per la misura della quantità di moto trasferita alla separazione di corpi in presenza di adesione e in condizioni di microgravità", Associazione Italiana per l'Analisi delle Sollecitazioni (AIAS), October 3rd 2008

LISA Pathfinder scientific and technological exploitation

International awards

LISA Pathfinder team, 2017 Space Technology Award of the American Astronautical Society

Published papers in international peer-reviewed journals

[1] Various authors, Bortoluzzi D., “Sub-Femto-g Free Fall for Space-Based Gravitational Wave Observatories: LISA Pathfinder Results”, Physical Review Letters, Volume 116, Issue 237 June 2016 Article number 231101

[2] Various authors, Bortoluzzi D., “Charge-Induced Force Noise on Free-Falling Test Masses: Results from LISA Pathfinder”, Physical Review Letter Volume 118, Issue 1726 April 2017 Article number 171101

[3] Various authors, Bortoluzzi D., “Experimental results from the ST7 mission on LISA Pathfinder”, Physical Review D, Volume 98, Issue 102018 Article number 102005

[4] Various authors, Bortoluzzi D., “Beyond the Required LISA Free-Fall Performance: New LISA Pathfinder Results down to 20 μhz”, Physical Review Letter, Volume 120, Issue 65 February 2018 Article number 061101

[5] Various authors, Bortoluzzi D., “Characteristics and Energy Dependence of Recurrent Galactic Cosmic-Ray Flux Depressions and of a Forbush Decrease with LISA Pathfinder”, Astrophysical Journal, Volume 854, Issue 220 February 2018 Article number 113

[6] Various authors, Bortoluzzi D., “Measuring the Galactic Cosmic Ray flux with the LISA Pathfinder radiation monitor”, Astroparticle Physics, Volume 98, Pages 28 - 37March 2018

[7] Various authors, Bortoluzzi D., “Forbush Decreases and <2 Day GCR Flux Non-recurrent Variations Studied with LISA Pathfinder”, Astrophysical Journal, Volume 874, Issue 21 April 2019 Article number 167

[8] Various authors, Bortoluzzi D., “LISA Pathfinder micronewton cold gas thrusters: In-flight characterization”, Physical Review D, Volume 99, Issue 1228 June 2019 Article number 122003

[9] Various authors, Bortoluzzi D., “Temperature stability in the sub-milliHertz band with LISA Pathfinder”, Monthly Notices of the Royal Astronomical Society, Volume 486, Issue 3, Pages 3368 - 33791 July 2019

[10] Various authors, Bortoluzzi D., “LISA pathfinder performance confirmed in an open-loop configuration: Results from the free-fall actuation mode”, Physical Review Letters, Volume 123, Issue 1111 September 2019 Article number 111101

[11] Various authors, Bortoluzzi D., “Novel methods to measure the gravitational constant in space”, Physical Review D, Volume 100, Issue 620 September 2019 Article number 062003

[12] Various authors, Bortoluzzi D., “Micrometeoroid Events in LISA Pathfinder”, Astrophysical Journal, Volume 883, Issue 120 September 2019 Article number 53

[13] Various authors, Bortoluzzi D., “Spacecraft and interplanetary contributions to the magnetic environment on-board LISA pathfinder”, Monthly Notices of the Royal Astronomical Society, Volume 494, Issue 2, Pages 3014 - 30272020

[14] Various authors, Bortoluzzi D., “Sensor Noise in LISA Pathfinder: In-Flight Performance of the Optical Test Mass Readout”, Physical Review Letters, Volume 126, Issue 132 April 2021 Article number 131103

Keynote lectures in International peer-reviewed conferences

[15] Bortoluzzi D. on behalf of the LISA Pathfinder collaboration, “LISA Pathfinder: a technology demonstra-

tor mission for future in-space gravitational wave detection", 4th International Conference and Exhibition on Satellite and Space Missions, June 18-20 2018, Rome **Presenting author**

Proceedings of International peer-reviewed conferences

[16] Various authors, Bortoluzzi D., "LISA Pathfinder", 28th International Symposium on Lepton Photon Interactions at High Energies, LP 2017, 7 August 2017 - 12 August 2017

Industrial partnerships

- Alcatel Alenia Space, Milano, Italy
- OHB Italia S.p.A., Milano, Italy
- Airbus Defence and Space (formerly EADS Astrium GmbH), Friedrichsafen, Germany
- LEITNER S.p.A., Vipiteno, Italy

Affiliations

- Italian Institute of Nuclear Physics (INFN) - Trento Institute for Fundamental Physics and Applications (TIFPA)
- Gruppo Meccanica Applicata, national scientific association of Applied Mechanics, Italy

Scientific editing, review and organization

Associate Editor

2019 IEEE Intelligent Vehicles Symposium (IV), 9-12 June 2019, Paris.

Reviewer for the following international journals

- IEEE/ASME Transactions on Mechatronics
- Experimental Mechanics (Society of Experimental Mechanics) – Springer
- Classical and Quantum Gravity – Institute of Physics
- Advances in Space Research – Committee on Space Research (COSPAR) – Elsevier
- Measurement – International Measurement Confederation (IMEKO) – Elsevier
- Applied Surface Science - Elsevier
- Vibration – MDPI
- Recent patents on mechanical engineering – Bentham science
- International Journal of Advanced Robotic Systems - SAGE
- Recent Patents on Mechanical Engineering – Bentham Science

Reviewer for the following international conferences

- International LISA Symposium
- ASME International Design Engineering Technical Conference (IDETC) 2017, 2018
- IEEE International Conference on Mechatronics (ICM) 2013
- ASME Engineering Systems Design and Analysis (ESDA) 2010
- IEEE Advanced Motion Control (AMC) 2008
- ASME International Mechanical Engineering Congress and Exposition (IMECE) 2006, 2008
- IEEE 37th Annual Conference of the IEEE Industrial Electronics Society (IECON), 2011

Session organizer

- Dynamic Fracture/Failure, SEM 2014 Annual Conference and Exposition on Experimental and Applied Mechanics, 2-5 June 2014, Greenville, South Carolina, USA

Bibliometric indices

According to scopus: H-index 20, 1702 citations.

Institutional activity

- Coordinator of the Master Course in Mechatronics Engineering of the Department of Industrial Engineering, University of Trento, since 2015
- Adjoint coordinator of the Double degree programme of the European Institute of Technology (EIT) in Autonomous Systems at the Department of Industrial Engineering, since 2018
- Member of the review board of the of the Master Course in Mechatronics Engineering since 2013
- Responsible for the administrative practices (admission, credits, study plans etc.) of the Master Course in Mechatronics Engineering since 2010
- Member of the faculty-students joint commission for the didactic (commissione paritetica) of the Department of Industrial Engineering, 2016-2018
- Member of the commission for the procurement of didactic instruments and tools, Faculty of Engineering, University of Trento, 2009
- Member of the board for the admission of the foreign students to the Master Course in Mechatronics Engineering (MasterMech), 2012, 2013, 2014
- Member of the Executive board of the Materials, Mechatronics and System Engineering doctoral school, Department of Industrial Engineering, University of Trento, 2012-2017
- Member of the board for the admission to the Materials, Mechatronics and System Engineering doctoral school, Department of Industrial Engineering, University of Trento, 29th cycle
- Responsible of the Laboratory of Space Applications of the Department of Industrial Engineering, University of Trento, since 2012
- Member of the commission for the State Examination for the Engineering professional qualification, 2004, 2013 (adjoint), 2016 (adjoint), 2017 (adjoint), 2021 (adjoint)

Participation to project review panels

- ASI (Agenzia Spaziale Italiana) designated panel member for the Baseline Design Review of the Gravitational Reference Sensor Flight Model developed by Carlo Gavazzi Space for the LISA Pathfinder mission, 2005
- EADS Astrium GmbH designated panel member for the Preliminary Design Review e Critical Design Review of the Caging Mechanism Assembly Flight Model developed by Alcatel Alenia Space Italia for the LISA Pathfinder mission, 2005, 2006, 2008
- Thales Alenia Space designated panel member for the Critical Design Review of the Grabbing Positioning and Release Mechanism Flight Model for the LISA Pathfinder mission, 2007
- ESA designated panel member for the Critical Design Review of the Drag-Free Attitude and Control System of the LISA Pathfinder spacecraft developed by EADS Astrium GmbH, 2008
- Carlo Gavazzi Space designated panel member for the Critical Design Review of the Caging and Vent Mechanism for the LISA Pathfinder mission, 2012

Teaching

Undergraduate courses

- Mechanical Automation (6CFU), Bachelor degree in Food Industry Engineering, School of Engineering, University of Trento, Italy. Academic Years 2004/2005 to 2009/2010
- Applied Mechanics, Bachelor degree in Viticolture and Oenology, School of Engineering, University of Trento, Italy. Academic years 2005/2006 to 2008/2009
- Plants and machinery for oenology/food engineering, Bachelor degree in Viticolture and Oenology, School of Engineering, University of Trento, Italy. Academic years 2009/2010 to 2011/2012
- Dynamic, control and automation (9CFU), Bachelor degree in Food Industry Engineering, School of Engineering, University of Trento, Italy. Academic years 2010/2011 to 2012/2013
- Mechanical systems and models (12CFU), Bachelor degree in Industrial Engineering, academic year 2016/2017

Graduate courses

- Mechanical vibrations (6CFU), Master degree in Mechatronics Engineering, Department of Industrial Engineering, University of Trento, academic years 2011/2012 to date
- Industrial robotics (6CFU), Master degree in Mechatronics Engineering, Department of Industrial Engineering, University of Trento, academic years 2013/2014 to date

PhD courses

- Non-linear vibrations, Doctoral School in Civil and mechanical structural systems, Department of Mechanical and Structural Engineering, Univesity of Trento, academic year 2008/2009
- Non-linear vibrations, Doctoral School in Material, Mechatronics and System Engineering, Department of Industrial Engineering, University of Trento, academic year 2013/2014, 2015/2016, 2019/2020, 2020/2021

Thesis project and internship supervision

I have supervised more than 80 theses. Here a selection of the most recent is reported.

Bachelor's degree in industrial engineering

- Analisi delle vibrazioni libere di un corpo per la caratterizzazione di un impulso, G. Agostini, academic year 2020/2021
- Modellazione e risposta dinamica della sospensione a quadrilatero nel piano, L. Rinaldi, academic year 2019/2020
- Studio e modellazione della dinamica longitudinale di un veicolo in frenata e dell'usura dei freni a disco, Y. El Ourrak, academic year 2019/2020
- Modellazione della dinamica longitudinale di un veicolo mediante reti neurali, D. Cattoi, academic year 2018/2019
- Modello differenziale di un freno a disco, F. Nicolini, academic year 2018/2019

Master's degree in Mechatronics Engineering

- A vibration mode-based adhesion impulse characterization technique, A. Masutti, academic year 2019/2020
- Estimation of impacts of the LISA Pathfinder test mass in the release phase, Jacopo Antonini, academic year 2019/2020
- Kinodynamic Motion Planning for Manipulators, R. Dellolio, academic year 2019/2020
- Ideazione, implementazione e simulazione di un robot manipolatore didattico per movimentazione pick and place, M. Tomasi, academic year 2019/2020

- Design, Fabrication and Commissioning of a Teaching Rotating Machine for Flexural Speeds Analysis, R. De Biasi, academic year 2019/2020

Ph.D.

- Carlo Zanoni, Drag-free spacecraft technologies: criticalities in the initialization of geodesic motion, University of Trento, Doctoral School in Engineering of Civil and Mechanical Structural Systems, Cycle XXVII, academic year 2013/2014
- Andrea Zambotti, Ground Testing and In-Flight Performance of a Space Mechanism, Doctoral School in Materials, Mechatronics and System Engineering, Cycle XXX, academic year 2018/2019

Internships

In the academic years from 2011 to 2014 I have supervised several internships, mainly for graduate students. Among them, I would like to mention those performed at Astrium GmbH Friedrichshafen on subjects related to the LISA Pathfinder mission or mechanical/mechatronics subjects applied to space technology.