Alessandro Tasora

Born 6-3-1971 in Milano.

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http://www.chronoengine.info
http://www.digitaldynamicslab.unipr.it

WORK EXPERIENCE

2014-	Associate Professor, at the Department of Industrial Engineering, University of Parma, Italy.
2002-2014	Assistant Professor, at the Department of Industrial Engineering, University of Parma, Italy.
1998-2002	Research fellow at the Dipartimento di Sistemi di Trasporto e Movimentazione and Dipartimento di Elettrotecnica, at Politecnico di Milano, Italy.

EDUCATION

Mechanical Engineering at the Politecnico di Milano, M.Sc. July 1998.
Thesis: "*Simulazione multibody mediante algebra dei quaternioni*" ("Multibody simulation by means of quaternion algebra").

Italian State Certification for enabling the public profession in Engineering, 1999.

ACADEMIC APPOINTMENT

Associate Professor, Università degli Studi di Parma, area ING-IND-13 09/A2 (Applied Mechanics), since 1/10/2014.

OTHER ACADEMIC TITLES AND ORGANIZING ACTIVITIES

Vice Director of the program of Mechanical Engineering at the University of Parma, Italy, since 21/1/2020.

Deputy of the University of Parma for the international program of Electric Vehicle Engineering, since 12/12/2019, in collaboration with University of Bologna.

Honorary Associate at the University of Wisconsin Madison, USA, since 2009.

Director of the Digital Dynamics Lab at the University of Parma, since 11/7/2019.

Deputy of the University of Parma at BI-REX, Big Data Innovation & Research Excellence, since 10/12/2018.

Scientific Director of the Smart Production Lab 4.0 initiative at the University of Parma, since 2017.

Member of the board of directors DMILE-DIH Digital Innovation Hub, from 2018.

National Scientific Qualification ASN 2016, enabling to apply for a university Full Professor position.

Deputy of the Università degli Studi di Parma at the ITS Maker Foundation, since 3/11/2016

Member of the Committee for the PhD in Industrial Engineering, at the Università degli Studi di Parma, since 2002.

Member of the Committee for the assessment of PhD students in Industrial Engineering at the Università degli Studi di Parma, since 2013.

Member of the Exams Committee and Opponent for the PhD theses at Technischen Universität Kaiserslautern, Germany (24/7/2015),

Member of the Exams Committee and Opponent for the PhD theses at the Politecnico di Milano, Aerospace Engineering PhD (17/4/2009), Università degli Studi di Bergamo (14/4/2010, 26/4/2012), Università di Roma La Sapienza (9/11/2012), Politecnico di Milano, Mechanical Engineering (30/3/2015).

Mentor of more than 100 theses at the University of Parma and at the Politecnico di Milano, mostly about automation, tribology, robotics and biomechanics.

Member of the State Commission for the Italian national certification for enabling the public profession in Engineering, at the University of Parma (2007).

Referee for the MIUR Italian Department of Education, University and Research, for the evaluation of national research projects.

Referee in the database of independent experts for European research and innovation.

Member of the Wisconsin Applied Computing Center, since 2012.

OC Collaborator, ANL Argonne National Laboratory, Chicago, 18/12/2008-6/9/2013.

Member of the Patents Committee at the University of Parma, 2013-2020.

AREAS OF RESEARCH / KNOWLEDGE

Among the main research topics and consulting activities, I focus on theoretical mechanics and numerical methods for the simulation of three-dimensional mechanical systems, developing the Chrono::Engine multibody software (www.chronoengine.info). Such software targets the simulation of large multibody systems with constraints, actuators and frictional contacts, and it is currently used in many research centers in the world.

Other research topics are robotics (I developed three parallel manipulators exploiting pneumatic and electric actuators, with novel kinematic schemes, and two AGV robotic vehicles), and tribology.

Following is a more detailed list of research topics and knowledge.

- Physics of complex non-linear non-smooth mechanical systems (ODE and DAE algebraic-differential systems, DVI differential variational inequalities).
- Quaternion algebra: methods for Lie integrators and efficient dynamical simulation of constraints in multi-body mechanical simulations.
- Supercomputing and HPC with GPU and MPI parallelism.

- Optimization: Linear Complementarity Problem, Quadratic programming, Conic Complementarity, Variational Inequalities, as applied to unilateral frictional contact problems.
- Implementation of numerical methods: Krylov methods, stationary methods, fast decompositions and factorizations of large sparse linear systems, involved in rigid body dynamics and kinematics.
- Computational geometry: contact between freeform surfaces, topological and geometrical problems, fast collision detection.
- Solid and structural finite elements for large displacements.
- Development of parallel-kinematics robots. Three models have been built and tested (TORX, SLOTH, GRANIT, currently operational 16h/24h in an industrial environment).
- Development of the control system of AGV vehicles with autonomous guide.
- Development of experimental test beds for tests on elastomeric seals.
- Real time simulation of vehicles using Modelica and real-time rendering tools.

GRANTS AND FUNDED PROJECTS, WITH PEER REVIEW

Collaborator, in: INCANTO - INdividual Customised biomedicAl devices manufactured and supplied through a Networked platform to Treat widespread sOcial diseases project. 2020, and PrINT - Program for Institutional Internationalization of the Higher Education Institutions and Research Institutions of Brazil (2019).

In charge of FFABR-MIUR grant (L. 11/12/2016 n.232, DR 157/2018, FFABR_2017 _MIUR_TASORA_A) (2017)

Co-coordinator in: “Modelling the failure of architectural masonry structures with Non-Smooth Contact Dynamics”, AGU: Research Projects with International Participation (UAP) Project Number FUA-2017-85, 18 months (2017).

Collaborator, in: Development of a scalable physics-based high performance computing (HPC) modeling, simulation, and visualization capability to support the analysis of ground vehicle mobility on deformable terrain. US Army Rapid Innovation Fund, No. W911NF-13-R-0011. - "A Physics-based High Performance Computing Capability for Ground Vehicle Mobility Analysis". U.S. Army Research Office RIF W56HZV-14-C-0254, 24 months (2014-2016).

Scientific director of the P4 unit of the CNR project “Highly Evolvable E-waste Recycling Technologies and Systems - WEEE Reflex” (2014).

Collaborator, in: "Development of a High Performance Computing Software Infrastructure for the Modeling and Simulation of Multibody Dynamics Applications”. U.S. Army TARDEC, CREATE-GV project, W56HZV-08-C-0236 (2014)

Scientific director of the P4 unit of the CNR project “Cyber-Physical System (CPS) for reconfigurable e-waste recycling processes” (2016)

Research collaborator for the High Performance Computing PAMMS project (Parallel variational method for the simulation of the seismic behavior of masonry structures), (2014).

National coordinator of PRIN 2007Z7K4ZB research project (2007).

Research collaborator for PRIN research project “Vibrazioni di pannelli e gusci sottili in presenza di interazione fluido-struttura” (2003).

Collaborator, in US National Science Foundation Project: Advanced Computational Multi-Body Dynamics for Next Generation Simulation-Based Engineering (60 months)

Collaborator, in US National Science Foundation Project: Leveraging New Numerical Methods and Multi-processor capabilities (36 months)

Collaborator, in US Army Research Office Project: A Homogenization-Driven Multiscale Approach for Characterizing the Dynamics of Granular Media and its Implementation on Massively Parallel Heterogeneous Hardware Architectures

INVITED LECTURES AND SEMINARS

Invited talk: “Robotic Simulation in Chrono: State of the Art and Perspective”, Computing in Engineering Forum, Grainger Institute for Engineering, University of Wisconsin, USA, 29 September 2020.

Plenary lecture, “Challenges and emerging applications in large scale multibody system dynamics”, VRIPHYS 2018, 15-16 April 2018, Delft.

Keynote, “Solving differential variational inequalities in non-smooth dynamics using the preconditioned spectral projected gradient method”, 9TH International Conference On Computational Methods (ICCM2018), 6-10 August 2018, Rome.

Seminar at Czech Technical University in Prague: “Large Scale Non-Smooth Multibody Problems”, 17 February 2015, Prague, Czech Republic.

Seminar at the PhD School of the University of Parma: “High performance computing for Engineering applications”, 12 February 2015.

Keynote talk: “Chrono – a Software Capability for Computational Dynamics Problems”, W-FACE 2014, May 2014, USA.

Seminar at Statoil/Multiconsult, Tromsø, Norway: “Numerical methods for nonsmooth dynamics” (October 2013)

Seminar at Fraunhofer Institute for Industrial Mathematics, Kaiserlautern, DE: “Off-road vehicle dynamics: methods for deformable and granular soil” (November 2010)

Seminar at University of Chicago (ANL): “A CPU/GPU Heterogeneous Computing Framework for Computational Dynamics Applications” (September 2010).

Seminars at Ferrari S.p.A: “Computational mechanics: software and methods” (May-June 2010).

Seminar at the Politecnico di Milano: “From multi-body to many-body: software and methods” (November 2010)

Seminar at NASA, Jet Propulsion Laboratories, USA, “Large scale granular dynamics on the GPU” (September 2009).

Seminar at Nvidia Corporation headquarters, Santa Clara, USA, “Multibody solver on GPU parallel architecture” (September 2009).

Seminar at the Politecnico di Milano on: "Development of high performance software for multibody mechanical simulations" for the Ph.D students in Aerospace Engineering and Mechanical Engineering (November 2008).

Seminar at the Argonne National Laboratories, USA, “A new solver for large multibody systems and granular flows: computational and theoretical issues” (February 2008).

Seminar at the Politecnico di Milano on: "Computational Issues in MultiBody Simulation" for the Ph.D students in Aerospace Engineering and Mechanical Engineering (November 2007).

Seminar at the Politecnico di Milano on "Development of high-performance Multi-Body methods", for the Ph.D students in Aerospace Engineering and Mechanical Engineering (February 2007).

EDITORIAL ACTIVITIES

Member of the Editorial board of Multibody System Dynamics (Springer) since 2021.

Guest editor for the International Journal of Vehicle Performance (IJVP), special issue "Vehicle simulation with the open-source Project Chrono software", 2016.

Member of the Editorial board of Mathematical Problems in Engineering, since 2016.

Member of the Editorial board of the International Journal of Vehicle Performance (IJVP) since 2015.

Guest editor of Mechanical Sciences, special issue: "Recent advances and current trends in numerical multibody dynamics", 2012.

Reviewer for peer-review activity in international journals (Springer, Elsevier, Wiley, etc.) in the field of mechanical engineering and applied mathematics: Mechanism and Machine Theory, Meccanica, Multibody System Dynamics, International Journal for Computational Methods in Engineering Science and Mechanics, Nonlinear Dynamics, SIAM Journal on Optimization, International Journal of Vehicle Systems Modelling and Testing, Mathematics and Computers in Simulation, ASME Journal of Computational and Nonlinear Dynamics, Wear, Algorithms, SIAM Journal on Scientific Computing, et al.

CONFERENCES ORGANIZATION

Director of the Multibody Dynamics Workshop 2021 – 3rd International Summer School on Multibody Dynamics, 13-17 September 2021.

Chair of Multibody and Vehicle Dynamics session at ICTAM 2020, Milano, 23-28 August 2020, rescheduled 2021.

Director of the Multibody Dynamics Workshop 2019 – 2nd International Summer School on Multibody Dynamics, Parma, 20-24 May 2019.

Director of the CHRONO-MBDYN User Meeting and Conference 2017 – Parma, 19-21 April 2017.

Director of the Multibody Dynamics Workshop 2016 – 1st Italian Summer School on Multibody Dynamics, Parma, 11-15 April 2016.

ASME symposium coordination: "Software Tools for Computational Dynamics in Industry and Academia", International Conference on Multibody Systems, Nonlinear Dynamics, and Control, Charlotte, USA, 21-24 August 2016.

Chair of Efficient Methods and Real-Time Applications in ECCOMAS Multibody Dynamics 2015, Barcelona, June 29-July 2, 2015.

ASME symposium coordination: "Contact and Interface Dynamics", ASME 9th International Conference on Multibody Systems, Nonlinear Dynamics, and Control, Portland, Oregon, USA, 4-7 August 2013.

ASME symposium coordination: "Contact and Interface Dynamics", ASME 8th International Conference on Multibody Systems, Nonlinear Dynamics, and Control, Washington DC, USA, 28-31 August 2011.

Organizer and chairman of the conference "The Lamborghini Computer-Aided Styling Process", Parma, 11 November 2009.

Organizer and chairman of the conference "Metodologie di Computer Aided Styling presso il Centro Stile Lamborghini", Parma, 19 Novembre 2008.

Member of the organizing committee at the "ISCSB VII International Symposium on Computer Simulation in Biomechanics", Milano, 2001

Member of the organizing committee at the “AITC-AIT 2006 International Conference on Tribology”, Parma, 2006.

Member of the ECCOMAS scientific committee at the “III International Conference on Advances in Computational Multibody Dynamics”, Milano, 2007.

Chairman of various sessions at international conferences about mechanical simulation, robotics and tribology, since 2002.

Organized and chaired seminars for visiting / invited researchers:

- “A first order Nesterov method for multi body dynamics with frictional contact”, H. Mazhar, University of Wisconsin (Parma, 19/1/2015)
- “Interior point methods”, Prof. F. A. Potra, University of Maryland (Parma, 27/6/2013);
- “Introduction to Vehicle Dynamics”, Ing. A. Toso, Dallara Auto (Parma, 7/6/ 2011)
- “A parallel method for large scale collision detection problems”, H. Mazhar, University of Wisconsin (Parma, 4/6/2010)
- “High performance computing for mechanical simulation”, Prof. D. Negrut, University of Wisconsin (Parma, 25/11/2009)

MEMBERSHIPS AND COMMITTEES

Member of the IACM, International Association for Computational Mechanics.

Member of the AIMETA Association for Theoretical and Applied Mechanics.

Member of the EUROMECH.

Member of the IADAT international scientific committee.

Member of the AIT tribology association.

Member of the AIMETA group 'Kinematics and Dynamics of Multibody Systems'.

Member of AssoMotoRacing.

Member of ATA, Associazione Tecnica dell’Automobile.

Member of the NVIDIA Professor Partnership Program.

Member of BioPharmaNET.

Member of NAFEMS MBD-WG

Member of ASME Technical Committee on Multibody Systems and Nonlinear Dynamics (TC-MSND), from 1 July 2017

Member of the board of directors of eDriveLab S.r.L., from 25/5/2017.

Member of the “Bi-Rex Big Data Innovation & Research Excellence” consortium, DRD n.3024/2018

Member of the board of SMILE-DIH Digital Innovation Hub, from 17/1/2018.

Member of the ASME from 25/9/2019

VISITING PROFESSORSHIP AND STUDENT EXCHANGE PROGRAMS

Collaboration with M.Anitescu, US Argonne National Laboratories, Mathematics and Computer Science Division, and University of Chicago, for developing novel numerical methods to simulate dense granular flow in PBR nuclear reactors. Since 2005.

Collaboration with D.Negrut (University of Wisconsin, Madison, USA), for implementing parallel methods for large-scale multibody problems with application to vehicle mobility. Since 2007.

Honorary Associate at the University of Wisconsin, Madison, USA, since 2009.

Collaboration with Fraunhofer ITWM (Kaiserlautern, DE) about solvers for variational formulations, with application to the interaction between earth-moving machines and soil. PhD student exchange in 2010-2015.

Seminars and professors/students international exchange programs about multibody dynamics and robotics, at the Department of Robotic Systems of the University of Brno, VUT, CZ. 2006-2010.

Student mobility (PhD) for research activities on formulations for non-smooth contact dynamics, at INRIA (Grenoble, FR). 2017.

Student mobility (PhD) for the international projects INCANTO PrINT (Universitade Federal de Santa Caterina, Brasil: CAPES-PRINT 88887.310575/2018-00). 2020

TEACHING ACTIVITIES

At the University of Parma and University of Bologna (joint program)

Appointed as teacher of 'Dynamics and Compliant Control Of Electric Vehicles', (M.Sc. program: Electric Vehicle Engineering). Since the academic year 2020-2021.

At the Università degli studi di Parma:

Appointed as teacher of the following courses for the program of Mechanical Engineering: 'Robotics', 'Mechanical Design', 'Mechanics of Automatic Machines', 'Principles of Structural Mechanics', 'Robotics and Mechanical Actuators', 'Functional mechanics'. Since the academic year 2002/2003 to nowadays.

Appointed teacher of the "Computational mechanics" course for the PhD program at the University of Parma, since 2020.

Teaching assistant for the courses of 'Applied Mechanics' and 'Principles of Theoretical and Applied Mechanics'. Since the academic year 2002/2003 to nowadays.

Supervisor of the laboratories of 'Numerical Applications' and 'Applied Mechanics and Machine Building'. Since the academic year 2002/2003 to nowadays.

At the University of Parma and Politecnico di Torino (joint program)

Appointed teacher of the "Modeling studio - Modelling, Drawing and Rendering for Design" course for the program of Sustainable Design for Food System. Since the academic year 2021-2022.

At the Politecnico di Milano:

Invited seminars for the PhD in Aerospace Engineering and Mechanical Engineering, since 2007.

Teaching assistant for the following courses: 'Applied Mechanics' (for the nuclear engineering course, years 1999, 2000, 2001) and 'Functional Mechanical Design' (for the mechanical engineering course, years 2000,2001,2002).

Other teaching activities:

Invited lecturer at the University of Wisconsin Madison, for the Lindbergh Lecture Series (February 2008). Topic: parallel supercomputing for mechanical engineering problems.

Teacher of the courses "Theory of the Monte Carlo method, with Matlab applications" and "Technical and Industrial Design" within a MIUR financed project (DM 28621) hold at Procomac Spa, Parma (February, March 2008).

Teacher of “Principles of Software Engineering” for the post-graduate course “Validation of automated systems for pharmaceutical and other regulated healthcare industries”. ENAIP - Parma (2006).

Teacher of 'Mechanical Design' for the Nettuno consortium (2002-2007).

Teacher of 3D computer graphics at the international BIT Movie expo, (1994, 1995).

Teacher of Robotics in a course about automation organized in Milano by Fondazione L.Clerici, Brugherio, Milano, sponsored by CEE, European Community (theory and practice with a Mitsubishi robot). (1999).

OTHER ACTIVITIES

Consulting for GOLDWIND L.t.d., China, from 2020, on aeroelasticity of turbine blades.

Consulting for FONDAZIONE POLITECNICO / WAM subcontract, from 2020, on SPH.

Consulting for SIDEL SpA, from 2018, on Industry 4.0 and robotics.

Consulting for ALTAIR Srl, from 2017. Real time simulation of vehicles.

Consulting for MOTESQUE, from 2018. Biomechanical simulation.

Consultant for the development of an AGV robot, at Hands Company, from 2013.

Software developer of Chrono::Engine middleware for physical simulation. Since 2006.

Software developer of HyperOCTANT (high performance solver for massive NLCP problems arising in physical simulations). Since 2006.

Software developer of the Chrono::R3D plugin (multi-body interactive simulation plugin for the Realsoft3D rendering and animation software). Founder of DeltaKnowledge (licenses distributed worldwide through Realsoft OY, Finland). From 1998 to present.

Software developer of Revolution4D (solid modeling software plugin. Embeds OpenCASCADE, supports STEP, IGES, etc.). Distributed worldwide. From 2003.

Consultant for Ferrari S.p.A (modal analysis, NVH, EHD-TEHD lubrication), engine department, since 2010.

Research contract for developing a novel AGV robot at Pyxis Srl and implementation of the wireless control system. From 2006 to 2008.

Project leader for a robotics research at EMMETI SpA, from 2006 to 2007.

Designer of the GRANIT high-performance ultra-stiff parallel robot (2004-2006).

Consultant of the student team PR43100 about suspensions and frame of a Formula ATA car (which won the 2nd place in 2007).

Designer of mechatronic subsystems with digital motor control within the GHIBLI automatic assembly plant, at Gamma S.p.A., from 2004 to 2006.

Artwork for the book ‘Cinematica e Dinamica dei Sistemi Multibody’, ed.CEA, 2005 (also author of four chapters).

Forensic engineering (accident reconstruction), Piacenza, 2004.

Multibody analysis of a plant for fast cutting of large tubes (Marcegaglia – Oto Mills S.p.A.) 2004.

Developer of a novel articulator device for prosthetic teeth reconstruction, (Patent P.Simeone, PCT/IB2005/002685, September 2004)

Developer of the Gear-ON software for designing gears to be cut via EDM, for the PersonalMachine3D company (2003).

Consultant for the Hall of Milano about the assessment of the safety of two-wheeled vehicles running on uneven road pavements. (2002)

Designer of a prototype of a SOS system to be installed on highways, Ducati Sistemi Bologna, 2002.

Software developer of PHENOMENA, particle animation plugin for the animation software Real 3D, from 1995 to 1998.

Author of more than 100 monthly articles about 3d computergraphics on the italian EAR magazine (GR Edizioni), from 1992 to 1998, and reviews of 3d software for other italian computer science magazines.

Designer for the the Cyberfood™ device, Cyberfood Gmbh Zurich, 1997.

Alpha and beta tester of the 3D modeling/animation/rendering software "Realsoft3d" from Realsoft OY, Finland, from 1996.

Illustrations for magazine covers, GR Edizioni, Italy, (1992-1998)

Pictures for advertising, computergraphics for Cd ROMs, animations for TV commercials (Zeneca), from 1992.

Designer of dynamic web sites with PHP and SQL technology.

OTHER TECHNICAL AND SCIENTIFIC SKILLS

Superior knowledge of object-oriented programming (more than 450'000 lines of C++ code).

Implementation of real-time multibody simulations, with man-in-the-loop feedback and real-time visualization for car simulation.

Advanced 3D computergraphics (procedural textures and shaders, automatic modeling functions, particle dynamics behavioral and procedural approaches, interface design, etc.)

Design of automatic assembly machines, with real-time full digital authority.

Knowledge of the 3d parametric CAD package SolidEdge

Knowledge of the 3d parametric CAD package SolidWords and of its API.

Knowledge of the 3d parametric CAD package Inventor and of its API.

Design of dynamic web sites with PHP and SQL.

Development of embedded systems using PIC and ATMEL microcontrollers, knowledge of CAD tools for designing electronic circuits and PCBs.

Development of custom MCU controllers with fieldbus for motor control.

Deep knowledge of software, APIs and SDKs for engineering, ex.: CUDA, MPI, FTP, SSH, VPN, Doxygen, SVN, CVS, GIT, Apache, LaTeX, CMake, Markdown, GNU tools, Android, NET and COM interop, Matlab, Simulink, SciPy, NumPy, VTK, Unreal (both Blueprint and C++ API), MPICH2, FMI.

KNOWN PROGRAMMING LANGUAGES:

C, C++, RPL, FORTH, Pascal, Basic, ROOPS, Install Shield™ scripting, InnoSetup scripting, Java, Javascript, ECMA scripting, SQL, PHP, Matlab, Makefile, C++/CLI, Assembler, Python, C#, Modelica.

PUBLICATIONS

[see the list at http://projectchrono.org/tasora/publications.html]

PATENTS

“Manipulating Device For A Robot, Robot Having A Manipulating Device For A Receptacle Treatment Machine, Receptacle Treatment Machine Having A Robot And Quality Control Method”, European Patent EP20205372.4 - 03 November 2020

"Robotic arm for manipulating a capping head, robot comprising the robotic arm, and packaging apparatus comprising the robot", pending, European Patent EP21210944.1 - 29 November 2021.

AWARDS

Best Paper Award, 2021, ASME IDETC-CIE 2021, International Conference on Multibody Systems, Nonlinear Dynamics, and Control (MSNDC).

Top-SNIP paper (doi: 10.1145/2735627 SNIP '15 3.744) at the Department of Engineering and Architecture, 15/10/2017.

Competition winner in International CAE Conference Poster Award, Italy, October 2015

Best Paper Award, 2010, 5th Asian Conference on Multibody Dynamics (ACMD2010).

TOP 4 paper, 2011, 20th International Workshop on Robotics (RAAD 2011).

MEDIA COVERAGE

Relevant coverage about my researches appeared on international media, such as HPCwire, MyScience USA, TMCNews, SciDAC Review (DOE), WTN News, NewsWise, WISbusiness, eScienceNews, ScienceDaily, Science Centric, ChemEurope, Innovations Report, ACM Communications, Sole24Ore.

KNOWN LANGUAGES

Italian, English, French (basic)

OTHER

Hobbies: guitar, painting.

My Erdös number is 4.

Software developer OpenHub ranking: 8th level Kudos, ranking in the highest 1% of 9 millions of developers in the world (20/10/2018).

1st developer in Italy in the C++ CodersRank ranking (15/4/2020).