

SHORT CURRICULUM VITAE



PAOLO PENNACCHI

Full Professor of Applied Mechanics

Born in Milan, Italy, on April 5th, 1968

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EDUCATION

- Master degree in Management Engineering, Politecnico di Milano, Italy, 1993.
- Ph. D. in Applied Mechanics, Politecnico di Milano, Italy, 1997.
- Course on “Kinematics and Dynamics of Multi-Body Mechanical Systems”, CISM, Udine, Italy, 1994.
- Course on “Reliability Engineering and Software”, CISM, Udine, Italy, 1999.
- Course on “Elements of non-linear dynamics: stability, bifurcations and chaos” ENI Foundation “Enrico Mattei”, 2001.

MILITARY SERVICE

- Italian Army, 3rd Army Corp, Secretary of the Commander in Chief, 1995-1996.

ACADEMIC POSITION

- Assistant Professor on “Vibration of mechanical systems (diagnostics)”, School of Industrial Engineering, Politecnico di Milano, Italy, 1999-2002.
- Associate Professor of Applied Mechanics, School of Industrial Engineering, Politecnico di Milano, Italy, 2003-2010.
- Full Professor of Applied Mechanics, School of Industrial Engineering, Politecnico di Milano, Italy, 2010-.
- Visiting professor at Birla Science Centre, Hyderabad, India, September 1999.
- Visiting professor at UNICAMP-University of Campinas, Campinas, Brazil, February 2005.
- Visiting professor at Bharat Heavy Electrical Industries, Corporate Research and Development, Advanced Technical Education Centre, Vikasnagar, Hyderabad, India, December 2005.

- Visiting professor at NMAU, National Metallurgical Academy of Ukraine, Dnepropetrovsk, Ukraine, 2007-2009.
- Visiting professor at Tongji University, Shanghai, PRC, May-June 2011.
- Secretary of the Master and Bachelor Degrees in Mechanical Engineering and of the Master and Bachelor Degrees in Transport Engineering, 2003-2010.
- Head of the didactical and experimental laboratories of the Piacenza Campus, 2003- .
- Member of the Council of Degree in Mechanical Engineering and Energy Engineering, 2003- .
- Member of the Council of Ph.D. Degree in Mechanical Engineering 2008- .
- Co-ordinator of the Master and Bachelor Degrees for the School of Industrial Engineering, 2006-2010.
- Member of the board of directors of the Piacenza Campus, 2006- .
- Member of the board of directors of the Department of Mechanical Engineering, 2007-2010.
- Deputy Dean of School of Industrial Engineering, Politecnico di Milano, Italy, 2011-2012.
- President of the Professors and Students commission, School of Industrial and Information Technology Engineering, 2013- .
- Chairman of IFToMM (International Federation for the Promotion of Mechanism and Machine Science) Technical Committee of Rotor Dynamics, 2011-2017.
- President of AIT (Associazione Italiana di Tribologia), 2014- .
- General Conference Chairman of IFToMM - 9th International Conference on Rotor Dynamics, 22-25 September 2014, Milan, Italy.
- Member of ASME (American Society of Mechanical Engineers).
- Member of GEV 09 (Gruppo Esperti Valutatori Area 09 - expert group evaluators area 09) during VQR 2011-2014 for ANVUR (Agenzia Nazionale di Valutazione del Sistema Universitario e della Ricerca - National Evaluation Agency of the University System and Research).
- Expert for the evaluation of “Progetti relativi alle domande di finanziamento per le borse di dottorato aggiuntive emesse nell’ambito del Programma Operativo Nazionale Ricerca e Innovazione 2014-2020, ai sensi del D.D. del 5 giugno 2017, n. 1377 e successive modifiche.”, ANVUR.
- Expert for State Science and Technology Evaluation, National Center of Science and Technology Evaluation, Ministry of Education and Science, Astana, Republic of Kazakhstan, 2017.
- Expert for Evaluation of Research Proposals, KFAS Kuwait Foundation for the Advancement of Sciences, 2019.
- Expert for Evaluation of “PO FESR 2014/2020 O.S. 1.1 Avviso Pubblico per il sostegno alle imprese campane nella realizzazione di studi di fattibilita' (Fase 1) e progetti di trasferimento tecnologico (Fase2) coerenti con la RIS3, Regione Campania”, 2017- .
- Member of “Elenco aperto di accreditamento, approvato con Provvedimento Dirigenziale N. 2617 in data 13/7/2015, ai sensi della Legge Regionale 28 aprile 1998, N. 18, art. 7, comma 6, per il conferimento di incarichi professionali per la valutazione di piani di sviluppo (l.r.14/2011) e di progetti di ricerca (l.r. 84/1993), Regione Valle d’Aosta”, 2016- .

RESEARCH ACTIVITIES

Main research activities are in rotor dynamics and its related topics (especially for dynamics of machines employed for power generation and traction systems for regional and high-speed trains), in diagnostics and identification of rotating machines and mechanical systems in general. Further activities in control of vibrating systems, vehicle dynamics, kinematics and bio-mechanics.

Future research activities at Politecnico di Milano will be about rotordynamics, especially cracks in shafts and blades, seals, oil-film bearings, diagnostics and prognostics of bearing for traction systems.

Author of more than 400 scientific publications (books, journals, conferences, patents).

BIBLIOMETRIC INDEXES (16 February 2020)

ID: orcid.org/0000-0001-8174-0462

Scopus: citations: 2949, *h*-index: 28, documents: 239.

Web of Science: citations: 1907, *h*-index: 23, documents: 195.

Google Scholar: citations 3863, *h*-index: 33, *i10*-index 79.

AWARDS AND HONORS

- **Best Paper Award:** Bachschmid N., Pennacchi P. and Vania A., “Rotor-to-stator rub causing spiral vibrations: modelling and validation on experimental data of real rotating machine”, IMechE paper C623/060/2004, Proc. of *8th International Conference on Vibrations in Rotating Machinery*, 7-9 September 2004, Swansea, Wales, ISSN 1356-1448, ISBN 1-86058-447-0, pp. 671-680.
- **Best Paper Award:** Bachschmid N., Diana G., Pennacchi P. and Vania A., “Diagnostica ed Identificazione dei Malfunzionamenti delle Macchine Rotanti”, Atti della *Conferenza Nazionale sulle Prove non Distruttive Monitoraggio Diagnostica*, Milano, 13-15 ottobre 2005, pp. 1-10.
- **Best Paper Award:** Pennacchi P., Vania A. and Bachschmid N., “Robust model based identification of faults in rotor dynamics using M-estimators”, Paper-ID 96, Proc. of *IFTToMM 7th International Conference on Rotor Dynamics*, Vienna, Austria, September 25-28, 2006, ISBN 3-200-00689-7, pp. 1-11
- **Best Paper Award:** Bachschmid N., Tanzi E. and Pennacchi P., “Turbo-generator Groups Affected by Transverse Cracks: a Sensitivity Analysis of Vibrations versus Crack Position and Depth”, *Proceedings of the IMechE – 9th International Conference on Vibrations in Rotating Machinery*, paper C663/028/08, September 8-10, 2008, Exeter, UK, ISBN 978-1-84334-458-2, pp. 631-643.
- **Best Paper Award:** Chatterton S., Pennacchi P., Vania A., “Performances Degradation of Tilting-pad Thrust Bearings due to Electrical Pitting”, Proc. of *9th IFTToMM International Conference on Rotor Dynamics*, Milan, Italy, September 22-25, 2014, pp. 1-12.
- **Best Paper Award:** Pennacchi, P., Cazzulani, G., Chieppi, M., Colombo, A., “Blade Modal Analysis by Means of Continuous Optical Fiber Sensors”, *Proceedings of the 10th*

International Conference on Rotor Dynamics – IFToMM 2018, 23-27 September; Rio de Janeiro, Brazil, in *Mechanisms and Machine Science*, ISBN 978-3-319-99269-3, Vol. 62, 2019, pp. 205-218.

- **Best Application Paper Award:** Xu, L., Chatterton, S., Pennacchi, P., “Condition Monitoring of Rolling Element Bearing Based on Moving Average Cross-Correlation of Power Spectral Density”, 15th IFToMM Word Congress, June 30 – July 4, 2019, ISBN 978-3-030-20130-2, pp. 3411-3418.
- **Best Application Paper Award:** Vinh, D.P., Chatterton, S., Pennacchi, P., “Static and dynamic behaviors of a cylindrical hydrodynamic journal bearing operating at very low Sommerfeld numbers”, 15th IFToMM Word Congress, June 30 – July 4, 2019, ISBN 978-3-030-20130-2, pp. 3835-3844.
- **Award certificate of appreciation:** ASME 21st Biennial Conference on Mechanical Vibrations and Noise, Las Vegas NV, USA, September 4-7, 2007.
- **Award certificate of appreciation:** ASME 22nd Biennial Conference on Mechanical Vibrations and Noise, August 30 - September 2, 2009, San Diego, California, USA.
- **Award certificate of appreciation:** ASME 23rd Biennial Conference on Mechanical Vibrations and Noise, August 28-31, 2011, Washington, DC, USA.
- **Award certificate of appreciation:** ASME 24th Conference on Mechanical Vibrations and Noise, August 12-15, 2012, Chicago, IL, USA.
- **Sciadirect Top 25, List of Most Downloaded Articles:** *Mechanical Systems and Signal Processing* - January to March 2006, “Use of modal representation for the supporting structure in model-based fault identification of large rotating machinery: part 1-theoretical remarks”, *Mechanical Systems and Signal Processing* - Volume 20, Issue 3.
- **Sciadirect Top 25, List of Most Downloaded Articles:** *Journal of Sound and Vibration* - October to December 2006, “Thermally induced vibrations due to rub in real rotors”, *Journal of Sound and Vibration* - Volume 299, Issue 4-5.
- **Sciadirect Top 25, List of Most Downloaded Articles:** *Mechanical Systems and Signal Processing* - April to June 2008, “Diagnostics of a crack in a load coupling of a gas turbine using the machine model and the analysis of the shaft vibrations”, *Mechanical Systems and Signal Processing* - Volume 22, Issue 5.
- **Sciadirect Top 25, List of Most Downloaded Articles:** *Mechanical Systems and Signal Processing* - January to March 2011: “Diagnostics of gear faults based on EMD and automatic selection of intrinsic mode functions”, *Mechanical Systems and Signal Processing* - Volume 25, Issue 3.
- **Sciadirect Top 25, List of Most Downloaded Articles:** *Mechanical Systems and Signal Processing* - January to March 2013: “A new procedure for using envelope analysis for rolling element bearing diagnostics in variable operating conditions”, *Mechanical Systems and Signal Processing* - Volume 38, Issue 1.
- **Sciadirect Top 25, List of Most Downloaded Articles:** *Mechanical Systems and Signal Processing* - April to June 2013: “A new procedure for using envelope analysis for rolling element bearing diagnostics in variable operating conditions”, *Mechanical Systems and Signal Processing* - Volume 38, Issue 1.
- **Certificate of Excellence in Reviewing:** *Mechanical Systems and Signal Processing*, award in recognition of an outstanding contribution to the quality of the journal.

- **Associate Editor:** Mechanical Systems and Signal Processing, 2013-.
- **Associate Editor:** ASME Journal of Engineering for Gas Turbine and Power, 2019-2022.
- **Guest editor:** Mechanical Systems and Signal Processing, Special Issue: Crack Effects in Rotordynamics, Vol. 22, No. 5, 2008.
- **Editor:** International Journal of Rotating Machinery.
- **Editor:** Shock and Vibration.
- **Keynote speech:** “Diagnostic and Identification of Faults in Rotating Machines”, 4° *Congreso Internacional de Ingeniería Electromecánica y de Sistemas*, 14 - 18 noviembre 2005, México, D.F.
- **Keynote address:** “Modelling, dynamic behaviour and diagnostics of cracked rotors”, Proc. of *IMEchE 10th International Conference on Vibrations in Rotating Machinery (VIRM10)*, London, UK, September 10-13, 2012.
- **Keynote address:** “Dynamic coefficients of fluid-film bearings and seals in rotating machines: models and experimental tests”, *First Vibration Institute Middle East Conference*, 12-14 March 2018, Sharm El-Sheikh.
- **Keynote address:** “Condition monitoring and prognostics of traction systems of very high speed and regional trains”, *CMMNO18 International Conference on Condition Monitoring of Machinery in Non-stationary operations*. Santander, 20th-22nd June 2018.

GRANTS AND CONTRACTS OBTAINED

- 2002 – Research contract, Cluster S.r.l.: “Sistema di navigazione per non vedenti”, ■■■k€.
- 2003 - Grant: “Analisi degli effetti del disallineamento in sistemi di rotori sulla individuazione delle cricche negli alberi”, Primo Programma di Collaborazione Scientifica e Tecnologica tra Italia e Messico promosso dal Ministero degli Esteri (Foreign Affair Ministry), ■■■k€.
- 2003 – Research contract, CESI S.p.A.: “Aggiornamento del codice ADVANT per la diagnostica automatica nella dinamica del macchinario rotante”, ■■■k€.
- 2003 – Research contract, Varian S.p.A.: “Modellazione e analisi dinamica di pompe turbomolecolari”, ■■■k€.
- 2003 – Research contract, Italian Casinò S.r.l.: “MAGDA – Misure Applicate e Gioco D’Abilità”, ■■■k€.
- 2003 - Research contract Frascold S.r.l.: “Compressori a vite”, ■■■k€.
- 2004 – Consultancy contract, Varian S.p.A.: “Analisi di dati bivariati mediante tecniche basate sul concetto di half space location depth”, ■■■k€.
- 2004 – Research contract, Franco Tosi Meccanica S.p.A.: “Programma per la simulazione del comportamento dinamico di linee di rotori”, ■■■k€.
- 2004 - Research contract, Franco Tosi Meccanica S.p.A.: “Programma per la simulazione del comportamento dinamico di linee di rotori, parte 2”, ■■■k€.
- 2004 - Research contract, Boldrocchi S.p.A.: “Programma per la simulazione del comportamento dinamico di ventilatori industriali”, ■■■k€.
- 2004 - Research contract, Finder S.p.A.: “Sviluppo di una pompa per fluidi alimentari”, ■■■k€.
- 2005 – Experimental tests, Franco Tosi Meccanica S.p.A.: “Caratterizzazione dinamica di un cucchiaio di turbina tipo Pelton, mediante prove di tipo impulsivo”, ■■■k€.

- 2006 – Research contract, Eurobearings S.r.l.: Calcolo, ottimizzazione ed applicazione di materiali avanzati nei cuscinetti. Il contratto di ricerca si inquadra nel progetto di ricerca: “Progettazione ottimizzata di cuscinetti a lubrificazione idrodinamica”, finanziato ai sensi del bando pubblicato il 27 settembre 2004 dalla Regione Emilia Romagna relativamente alla Misura 3.1 - Azione A del PRRIITT, vista la Legge Regionale 14 maggio 2002 n.7, ■■■k€.
- 2006 – Teaching contract Franco Tosi Meccanica S.p.A. per i corsi di “Fondamenti costruttivi delle macchine rotanti”, “Tecniche di misura e misure” e “Introduzione agli elementi finiti”, ■■■k€.
- 2006 – Experimental tests, Franco Tosi Meccanica S.p.A.: “Determinazione delle frequenze proprie di un set di palette di turbina a vapore mediante caratterizzazione impulsiva”, ■■■k€.
- 2006 – Consultancy contract, Boldrocchi S.r.l.: “Rappresentazione modale di fondazioni nella dinamica dei ventilatori”, ■■■k€.
- 2006 – Consultancy contract, GARO S.p.A.: “Simulazione del comportamento dinamico di un compressore centrifugo con moltiplicatore integrale in accordo alle norme API 617 7th edition e partecipazione alle prove sperimentali presso GARO ed analisi dei risultati”, ■■■k€.
- 2007 – Consultancy contract, GARO S.p.A.: “Analisi, simulazione e misura del comportamento dinamico di compressori centrifughi tipo CC1 e CC3”, ■■■k€.
- 2007 – Consultancy and teaching contract, Danieli & C. Officine Meccaniche S.p.A.: “New Ukraine Elite Generation of Engineers for Danieli” ■■■k€+■■■k€.
- 2008 – Experimental tests, Franco Tosi Meccanica S.p.A.: “Prova sistema oleodinamico (SOD) e regolatore di velocità digitale (ABB) – Centrale di Orichella - gruppo 2”, ■■■k€.
- 2008 – Experimental tests, Bono Energia S.p.A.: “Misure di vibrazioni e deformazioni su scambiatore di calore”, ■■■k€.
- 2008 – Experimental tests, Franco Tosi Meccanica S.p.A.: “Prova sistema oleodinamico (SOD) e regolatore di velocità digitale (ABB) – Centrale di Timpagrande - gruppo 1”, ■■■k€.
- 2008 – Co-operation contract n° 5900057823 EDF Electricité de France – Politecnico di Milano: “Rotor diagnostics and best tuning of shaftline modeling”, total project ■■■k€, personal funding ■■■k€.
- 2009 – Experimental tests, Franco Tosi Meccanica S.p.A.: “Prova sistema oleodinamico (SOD) e regolatore di velocità digitale (ABB) – Centrale di Timpagrande - gruppo 2”, ■■■k€.
- 2009 – Consultancy contract, GARO S.p.A.: “Analisi rotodinamica di un compressore centrifugo bistadio tipo integrally geared”, ■■■k€.
- 2009 – Consultancy contract, Franco Tosi Meccanica S.p.A.: “Analisi del comportamento della turbina della centrale di Fos sur Mer”, ■■■k€.
- 2009 – Consultancy contract, Pieffedieci s.r.l.: “Analisi torsionale di compressori alternativi”, ■■■k€.
- 2009 – Experimental tests, Turboden s.r.l.: “Caratterizzazione dinamica mediante misure di vibrazione Turbina K5”, ■■■k€.
- 2009 – Grant Politecnico di Milano – Dipartimento di Meccanica e Fondazione Politecnico di Milano (insieme al Prof. Stefano Bruni): “Sviluppo di metodi diagnostici per il sistema di trazione di treni ad alta velocità”, ■■■k€.
- 2009 – Consultancy contract, Edipower S.p.A. (insieme al Prof. Roberto Corradi): “Comportamento dinamico della turbina Francis della centrale di Grotta dell’Angelo”, ■■■k€.
- 2009 – Research contract, Eurobearings s.r.l.: “Ingegnerizzazione di un banco prova per cuscinetti lubrificati radiali e test delle caratteristiche di un cuscinetto a 5 pattini”, ■■■k€.

- 2009 – Research contract, Eurobearings s.r.l. and Consorzio MUSP: “Nuovi materiali di rivestimento per supporti a sostentamento idrodinamico di turbogeneratori e/o turbine idrauliche per produzione energia elettrica”, nell’ambito del progetto (codice 270) presentato ed approvato nel Bando Regione Emilia Romagna per il Sostegno a Progetti di Ricerca Collaborativi – Attività I.1.2 P.O.R. F.E.S.R. 2007-2013 PRRIITT Misura 3.1 Azione A (DGR n. 1043 del 07/07/2008), ■■■k€.
- 2010 – Experimental tests, Franco Tosi Meccanica S.p.A.: “Prove di attivazione della centrale di Narni”, ■■■k€.
- 2010 – Grant, Eurobearings s.r.l.: Servo-attuatori per alte risposte dinamiche (50 Hz) e Multi Channel Workstation di Comando e Controllo, ■■■k€.
- 2010 – Consultancy contract, Danieli & C. Officine Meccaniche: “Valutazione della dinamica torsionale di compressori alterativi per azoto ed ossigeno dell’impianto Emirates Steel Factory”, ■■■k€.
- 2010 – Experimental tests, Franco Tosi Meccanica S.p.A.: “Prove di funzionamento della turbina a vapore Franco Tosi Meccanica nell’impianto Cyclofos di Fos-sur-mer, Francia, dopo l’installazione dell’ultimo stadio di bassa pressione L0”, ■■■k€.
- 2010 – Consultancy contract, Techint S.p.A.: “Diagnostica delle vibrazioni di un gruppo a vapore e di altri due turbo-gruppi di azionamento dell’ impianto di produzione Metanolo di Damietta-Egitto”, ■■■k€
- 2010 – Grant Politecnico di Milano – Dipartimento di Meccanica e Fondazione Politecnico di Milano (insieme al Prof. Stefano Bruni): “Sperimentazione di sistemi di monitoraggio e di metodi diagnostici per il sistema di trazione di treni ad alta velocità”, ■■■k€.
- 2010 – Consultancy contract, Turbomach S.A. “di consulenza relativa ai problemi vibratori riscontrati sulla turbina a vapore del progetto LANXESS, ANTWERPEN, JOB no.102155”, ■■■k€.
- 2010 – Experimental tests, Danieli & C. Officine Meccaniche S.p.A: “Analisi metallografica e FEM di biella di compressore”, ■■■k€.
- 2010 – Consultancy contract, Danieli & C. Officine Meccaniche S.p.A.: “Valutazione delle cause e della dinamica secondo le quali si è sviluppata la rottura della biella di primo stadio del compressore alternativo C6100B dell’impianto Emirates Steel Industry”, ■■■k€.
- 2010 – Experimental tests, Franco Tosi Meccanica S.p.A.: “Prove di attivazione della centrale di Narni Gr.2”, ■■■k€.
- 2010 – Grant: “Progetto Sviluppo e realizzazione di un micro-cogeneratore a ciclo Stirling alimentato a gas naturale (MICROGEN)”, tra Regione Lombardia e Politecnico di Milano e Finlombarda SpA, total project ■■■k€, personal budget ■■■k€.
- 2011 – Experimental tests, Danieli & C. Officine Meccaniche S.p.A: “Misure di vibrazione presso la Emirates Steel Factory di Abu Dhabi”, ■■■k€.
- 2011 – Consultancy contract, Eurobearings S.r.l.: Definizione del profilo di pattini per cuscinetti reggispinta, ■■■k€.
- 2011 – Experimental tests, Casa Editrice Scode S.r.l.: “Misura oggettiva del comportamento dinamico di sci da discesa”, ■■■k€.
- 2011 – Research contract, Hydac S.A.: “Analisi del comportamento vibratorio di sistemi di raffreddamento per impianti idraulici ed eolici”, ■■■k€.
- 2011 – Research contract, Boldrocchi: “Analisi di vibrazioni torsionali in ventilatori”, ■■■k€.

- 2011 – Consultancy contract P D Pumps - India: “Definition of tool profile for machining screw pump rotors”, ■■■k€.
- 2012 – Grant Politecnico di Milano – Dipartimento di Meccanica and Fondazione Politecnico di Milano: “PROBEA – PROgnosis of BEARings”, ■■■k€.
- 2012 – Research contract, Maina Organi di Trasmissione SpA: “Ricerca sulla vita ed il dimensionamento di giunti a denti ad alta capacità di disallineamento”, ■■■k€.
- 2012 – Research contract, Ferrari S.p.A., “Simulazione di cuscinetti reggispinta”, ■■■k€.
- 2012 – Research contract Exergy S.p.A., “Modellazione di turbine radiali per ciclo Rankine organico (ORC)”, ■■■k€.
- 2012 – Co-operation contract between EDF- ELECTRICITE DE FRANCE and Politecnico di Milano no. 8610-5910104425, total project ■■■k€, personal budget ■■■k€.
- 2013 – Experimental tests, Sigma Technologies S.r.l.: “Characterization of the dynamical behaviour of the columns of a machine tool made of different materials”, ■■■k€.
- 2013 – Grant Politecnico di Milano – Dipartimento di Meccanica and Fondazione Politecnico di Milano: “Diagnostica del materiale rotabile e dell’infrastruttura convenzionale”, ■■■k€ plus ■■■k€ for hardware and sensors.
- 2013 – Experimental tests, Airfoil International, S.r.l.: “Vibro-acoustical characterization of axial fans”, ■■■k€.
- 2013 – Experimental tests, SIMPRO, S.p.A.: “Characterization of the dynamical behaviour of the test-rig F03 of C.D.S.O. Osmannoro”, ■■■k€.
- 2013 – Research contract, Danieli & C. Officine Meccaniche S.p.A.: “Dinamica Flessionale e Torsionale di Accoppiamenti Elastici”, ■■■k€.
- 2013 – Sponsorship contract, Danieli & C. Officine Meccaniche S.p.A.: “9th IFToMM International Conference on Rotordynamics”, ■■■k€.
- 2013 – Sponsorship contract, Eurobearings S.r.l.: “9th IFToMM International Conference on Rotordynamics”, ■■■k€.
- 2014 – Sponsorship contract, Boldrocchi S.p.A.: “9th IFToMM International Conference on Rotordynamics”, ■■■k€.
- 2014 – Experimental tests, BLUE Engineering S.r.l.: “Misura del comportamento dinamico del banco F03 del C.D.S.O. Osmannoro durante la frenatura”, ■■■k€.
- 2014 – Sponsorship contract SKF S.p.A.: “9th IFToMM International Conference on Rotordynamics”, ■■■k€.
- 2014 – Sponsorship contract, Turboden S.r.l.: “9th IFToMM International Conference on Rotordynamics”, ■■■k€.
- 2014 – Sponsorship contract, IfTA Ingenieurbuero fuer Thermoakustik GmbH: “9th IFToMM International Conference on Rotordynamics”, ■■■k€.
- 2014 – Free contribution from Fondazione Politecnico di Milano, ■■■k€.
- 2014 – Research contract, Danieli & C. Officine Meccaniche S.p.A.: “Verifica delle caratteristiche dinamiche di cuscinetti lubrificati”, ■■■k€.
- 2014 – Consultancy contract, GE Oil & Gas - Nuovo Pignone S.r.l.: “Comportamento dinamico di macchinario rotante”, ■■■k€.

- 2014 – Consultancy contract, Pozzi Electra S.p.A.: “Cause di usura precoce di cuscinetti reggispinta di macchine idrauliche verticali tipo Kaplan”, ■■■k€.
- 2015 – Consultancy contract, EUROBEARINGS S.r.l.: “Calcolo delle caratteristiche statiche e dinamiche dei cuscinetti: Combined bearing secondo specifica 102598 Rev.6, Journal bearing secondo specifica 102598 Rev.6”, ■■■k€.
- 2015 – Experimental tests, ABB S.P.A. - Process Automation Division: “Prova vibrazioni compressori centrifughi sito Haoud Berkaoui”, ■■■k€.
- 2015 – Experimental tests, Danieli & C. Officine Meccaniche S.p.A.: “Analisi vibrazioni unità Sizing Mill – Seversky Tube Works JSCo”, ■■■k€.
- 2016 – Experimental tests, ABB S.P.A. - Process Automation Division: “Nawara: Inspection notification: compressor test sales 2 + bearing inspection”, ■■■k€.
- 2016 – Research contract, Terna Rete Italia SpA: “Attività di ricerca nel settore della prevenzione ed eliminazione dei sovraccarichi di ghiaccio e neve sulle linee elettriche aeree di Terna Rete Italia S.p.A.”, ■■■k€.
- 2016 – Research contract, GE – Nuovo Pignone Srl: “Calculation of Labyrinth Seals Rotordynamic Coefficients and of Brush Seals Rotordynamic Stability”, ■■■k€.
- 2017 – Consultancy contract Exergy S.p.A: “Calcolo delle caratteristiche statiche e dinamiche di cuscinetti portanti e reggispinta a lubrificazione idrodinamica”, ■■■€ per each calculation.
- 2017 – Research contract ENI S.p.A., “Sviluppo di nuovi lubrificanti da impiegare nei processi di laminazione di sezioni intere per prodotti lunghi”, €■■■■■.
- 2017 – Research contract Danieli & C. Officine Meccaniche S.p.A.: “Modellazione e prove di lubrificanti per laminatoi”, €■■■■■.
- 2017 – Consultancy Contract, ABB S.P.A. - Process Automation Division: “Considérations relatives à la rupture des plates valves des compresseurs K-102”, ■■■k€.
- 2017 – Research Contract, ESP International S.r.l.: “Sistema innovativa di accensione per estintori a polvere e sistema di riduzione della temperatura superficiale”, ■■■k€.
- 2017 – Research Contract, Rösler Italiana S.r.l. “Sistemi di vibro-finitura innovativi dedicati alla lavorazione di superfici e canali interni in parti a geometria complessa”, ■■■k€.
- 2017 – Collaboration contract between EDF- ELECTRICITE DE FRANCE and Politecnico di Milano no. 8610-5920042662 “Experimental identification of dynamic impedance on a tilting pad journal bearing in presence of scratches”, total project ■■■k€, personal budget ■■■k€.
- 2017 – Consultancy Contract, Nuovo Pignone S.r.l.: “Technical evaluation of the rotor high speed balancing test performed in the NP shop”, ■■■k€.
- 2017 – Consultancy Contract, SCL Srl – DICA: “Supporto scientifico e verifica indipendente per la progettazione meccanica e strutturale delle opere di sostegno del telescopio E-ELT”, total budget €■■■■■, personal budget €■■■■■.
- 2017 – Consultancy Contract, SCL Servizi Sas: “Supporto scientifico per l’esecuzione di studi sul controllo di posizione per il telescopio E-ELT”, ■■■k€.
- 2017 – Experimental tests, ABB SPA - Process Automation Division: “Prova vibrazioni compressori alternativi sito Haoud Berkaoui”, ■■■k€.
- 2017 – Experimental tests, “SIAE Microelettronica S.p.A.: “Life test of cooling fans for electronic devices”, ■■■k€.

- 2018 – Consultancy Contract, Nuovo Pignone Tecnologie S.r.l.: “Thermally induced vibration caused by rotor/seal rub - LT12 Galileo OR#1, Progettazione CDR PDR”, ■■■k€.
- 2018 – Consultancy Contract, SCL Servizi Sas: “Supporto scientifico per l'esecuzione di studi su sistemi di bloccaggio verticale in presenza di dispositivi elastomerici per il telescopio E-ELT”, ■■■k€.
- 2018 – Consultancy Contract, Nuovo Pignone Tecnologie S.r.l.: “Technical evaluation and troubleshooting of Therma Visayas shaft line high vibrations”, ■■■k€.
- 2018 – Consultancy Contract, SCL Servizi Sas: “Valutazione dei sistemi di bloccaggio per dispositivi antisismici e del controllo non co-locato per il telescopio E-ELT”, ■■■k€.
- 2018 – Research Contract, Hitachi Ltd.: “The development of wireless measurement system for condition monitoring for railway”, ■■■k€.
- 2018 – Research contract, ENI S.p.A., “Simulazione del comportamento di oli ISO VG 68 ESO su una sezione di laminazione di riferimento”, ■■■k€.
- 2019 – Consultancy contract, Danieli S.p.A., “JY11 - ROLLING MILL ROLLSHOP”, ■■■k€.
- 2019 – Consultancy contract, Nuovo Pignone Tecnologie S.r.l., “Technical evaluation of steam turbines stability”, ■■■k€.
- 2019 – Consultancy contract, Nuovo Pignone Tecnologie S.r.l., “Technical evaluation of labyrinth seals on steam turbines stability”, ■■■k€.
- 2019 – Consultancy contract, Boldrocchi S.r.l., “Fan Selection and Design Software”, ■■■k€.
- 2019 – Consultancy contract, Panificio San Francesco S.p.A, “Valutazione meccanica e statica della nuova linea produttiva chiamata Koenig, con particolare focalizzazione alla sala impasti (Mixer) ed al movimento teglie”, ■■■■■k€.
- 2019 – Test contract, Schaeffler Monitoring Services GmbH, “Rolling bearings analysis”, ■■■k€.

Other research projects:

- 1995 – FP5 - Brite EuRam Project BE95-2015 “MODIAROT - Model based diagnosis of rotor systems”. (in charge of prof. Nicolò Bachschmid).
- 1996 – Settima Meccanica S.r.l. “Controllo dell’emissione sonora di una pompa a tre viti” (in charge of Prof. Giovanni Mimmi).
- 1998 – ASI-ARS-98-207 “Controllo ottimo delle manovre di un manipolatore a bracci flessibili” (in charge of Prof. Giovanni Mimmi).
- 1999 – ASI-ARS-99-58 (in charge of Prof. Giovanni Mimmi).
- 2000 – Morse TEC Europe S.r.l. “Dinamica di Catene di trasmissione” (in charge of prof. Nicolò Bachschmid).
- 2001 – EDF Electricité de France: P54L08/C28009/EP959 “Cricche in alberi rotanti” (in charge of prof. Nicolò Bachschmid).
- 2001 - CESI S.p.A.: “Metodi di diagnostica automatica nella dinamica del macchinario rotante” (in charge of prof. Nicolò Bachschmid).
- 2001 – MURST: “Tecniche di identificazione di malfunzionamenti di sistemi meccanici basate sull’analisi del comportamento dinamico” (in charge of prof. Nicolò Bachschmid).

- 2003 – EDF Electricité de France: “Modelization of the dynamical behaviour of cracked primary pump and turbo-generator rotors” - N. G26776, N. O.T. T65L39 (in charge of prof. Nicolò Bachschmid).
- 2003 – FP6 - EU ALFA II Project: “VICONDIA” (in charge of prof. Nicolò Bachschmid). Ha svolto le funzioni di segretario del progetto.
- 2003 – BHEL Bharat Heavy Electrical Ltd.: Studio del comportamento dinamico di un compressore centrifugo trialbero (in charge of prof. Nicolò Bachschmid).
- 2004 – FP6 - EU MODLINK – MODCOUPLER (in charge of prof. Giorgio Diana).
- 2004 – MIUR: “Modellazione dei sistemi meccanici per la diagnostica” (in charge of prof. Nicolò Bachschmid).
- 2004 – SNAM S.p.A. “Simulazione della caduta di un corpo e relativa animazione” (in charge of prof. Nicolò Bachschmid).
- 2005 – Franco Tosi S.p.A. “Analisi del comportamento dinamico di componenti innovativi per turbine a vapore”. (in charge of prof. Bruno Pizzigoni).
- 2005 – Franco Tosi S.p.A. “Tecniche innovative di diagnostica e monitoraggio per le macchine rotanti”. (in charge of prof. Nicolò Bachschmid).
- 2006 – EDF Electricité de France: Co-Operation Contract No. 4300064312 AMA - 055 “Fault Diagnostics in Large Turbogenerator: A Case Study”. (in charge of prof. Nicolò Bachschmid).
- 2015 – Horizon 2020 EU.3.4. Roll2Rail Project “New dependable rolling stock for a more sustainable, intelligent and comfortable rail transport in Europe” (in charge of prof. Stefano Bruni).

STUDENT SUPERVISION

More than 50 master students, 11 Ph.D. students (Roberto Ricci, Pietro Borghesani, Filippo Cangioli, Phouc Vinh Dang, Lang Xu, Manfredi Mazzola, Syed Muhammad Tayyab, Shuai Gao, Fabio Massacesi, Davide Massocchi, Behrouz Rahimi).

REFeree OF INTERNATIONAL JOURNALS

- AIAA Journal
- Applied Mathematical Modelling
- ASME – JMD Journal of Mechanical Design
- ASME – JVA Journal of Vibration and Acoustics
- Communications in Nonlinear Science and Numerical Simulations
- Communications in Statistics - Theory and Methods
- Computers & Industrial Engineering
- Entropy
- European Journal of Mechanics A-Solids

- FE – Journal of Fluid Engineering
- IEEE Transactions on Instrumentation and Measurement
- IJMS – International Journal of Mechanical Sciences
- IJRM – International Journal of Rotating Machines
- IJSSD – International Journal of Structural Stability and Dynamics
- Información Tecnológica
- JETR – Journal of Engineering and Technology Research
- JMES – Proceedings of the Institution of Mechanical Engineers, Part C, Journal of Mechanical Engineering Science
- JoMMS – Journal of Mechanics of Materials and Structures
- JPEM – International Journal of Precision Engineering and Manufacturing
- JSA – Journal of Strain Analysis for Engineering Design
- JSV – Journal of Sound and Vibrations
- JVC – Journal of Vibration and Control
- MCM – Mathematical and Computer Modelling
- MEAS – Measurement
- Meccanica
- MMT – Mecahanisms and Machine Theory
- MSSP – Mechanical Systems and Signal Processing
- NLM – International Journal of Non-Linear Mechanics
- NODY – Nonlinear Dynamics
- PRRI – Physical Review & Research International
- RESS – Reliability Engineering & System Safety
- Sensors
- Shock and Vibration
- SRE – Scientific Research and Essays
- Strain – An International Journal for Experimental Mechanics
- Structural Health Monitoring
- TRIBINT – Tribology International
- UTRB – Tribology Transactions
- ZUSA – Journal of Zhejiang University-Science A

Milan, February 16th, 2020



LIST OF SCIENTIFIC PUBLICATIONS

Books

- 1) Mimmi G. and Pennacchi P., “**Appunti di Meccanica Applicata alle Macchine**”, Collana Scientifica, Edizioni CUSL, Milano, 1998, pp. 1-312 (in Italian).
- 2) Pennacchi P. and Frosini L., “**Temi d’esame svolti di Meccanica Applicata alle Macchine**”, Collana Scientifica, Edizioni CUSL, Milano, 2002, ISBN 88-8132-179-3, pp. 1-164 (in Italian).
- 3) Bachschmid N., Pennacchi P. and Tanzi E., “**Cracked Rotors, A Survey on Static and Dynamic Behaviour Including Modelling and Diagnosis**”, Springer, Berlin – Heidelberg, 2010, DOI 10.1007/978-3-642-01485-7, ISBN 978-3-642-01484-0 (Print), 978-3-642-01485-7 (Online), pp. 1-401.

Books (editor)

- 1) Bachschmid N. and Pennacchi P., “**Modelling of rotating machinery in power plants. Monitoring and diagnostics.**”, Proceedings of the *Workshop Modelling of rotating machinery in power plants. Monitoring and diagnostics*, May 27, 2005, Milan, ISBN 88-901916-0-0, pp. 1-74.
- 2) Bachschmid N. and Pennacchi P., “**Advances in vibration control and diagnostics**”, 2006, Polimetrica International Publisher, Monza, Italy, ISBN 88-7699-036-4, pp. 1-258.
- 3) Pennacchi P. “**Proceedings of the 9th IFToMM International Conference on Rotor Dynamics**”, Mechanisms and Machine Science, Vol. 21, 2015, Springer, ISBN 978-3-319-06590-8, pp. 1-2214.
- 4) Trivella, A., Raparelli, T., Pennacchi P., “**Atti del 6° workshop AIT Tribologia e Industria**”, ISBN 9788890191602, pp. 1-100.

Books (chapters)

- 1) Braghin F., Pennacchi P., Pennastrì E. and Sabbioni E., “**Biomeccanica**”, Proceedings of the *Workshop Modelling of rotating machinery in power plants. Monitoring and diagnostics*, May 27, 2005, Milan, ISBN 88-901916-0-0, pp. 1-74.
- 2) Pennacchi P., Vania A. and Bachschmid N., “**Fault Identification in Industrial Rotating Machinery: Theory and Applications**”, *IUTAM Symposium on Emerging trends in Rotor Dynamics*, K. Gupta ed., 2011, Springer, Dordrecht, ISBN 978-94-007-0019-2, DOI: 10.1007/978-94-007-0020-8, pp. 455-467.
- 3) Bachschmid N., Pennacchi P. and Tanzi E., “**Cracked rotating shafts: typical behaviors, modeling and diagnosis**”, *IUTAM Symposium on Emerging trends in Rotor Dynamics*, K. Gupta ed., 2011, Springer, Dordrecht, ISBN 978-94-007-0019-2, DOI: 10.1007/978-94-007-0020-8, pp. 441-454.
- 4) Pennacchi P., Ricci R., Chatterton S. and Borghesani P., “**Effectiveness of MED for Fault Diagnosis in Roller Bearings**”, *Vibration Problems ICOVP 2011*, J. Náprstek et al. ed., 2011, Springer, Dordrecht, ISBN 978-94-007-2068-8, DOI: 10.1007/978-94-007-2069-5, pp. 637-642.
- 5) Pennacchi P., Borghesani P., Ricci R. and Chatterton S. “**Bearing Fault Diagnostics Using the Spetral Pattern Recognition**”, *Vibration Problems ICOVP 2011*, J. Náprstek et al. ed., 2011, Springer, Dordrecht, ISBN 978-94-007-2068-8, DOI: 10.1007/978-94-007-2069-5, pp. 643-648.
- 6) Pennacchi P., “**Introduction of advanced technologies for steam turbine bearings**”, in *Advances in steam turbines for modern power plants*, T. Tanuma ed., 2017, Woodhead Publishing – Elsevier, ISBN 978-0-08-100314-5.00015-4, pp. 321-360.
- 7) Chatterton S., Dang P.V., Pennacchi P., Vania A., “**Behaviour of tilting-pad journal bearings in case of large manufacturing errors**”, *Mechanisms and Machine Science*, ISBN 9783319483740, Vol. 47, 2017, pp. 221-227, doi: 10.1007/978-3-319-48375-7_24.
- 8) Chatterton, S., Pennacchi, P., Vania, A., “**Investigation of cooled pads for tilting-pad bearings**”, *Mechanisms and Machine Science*, ISBN 978-3-319-99261-7, Vol. 60, 2019, pp. 505-519.
- 9) Pennacchi, P., Chatterton, S., Vania, A., “**Effects of severe operating conditions (high loads/low rotational speeds) on sleeve journal bearings**”, *Mechanisms and Machine Science*, ISBN 978-3-319-99261-7, Vol. 60, 2019, pp. 491-504.
- 10) Pennacchi, P., Chatterton, S., Vania, A., Xu, L., “**Diagnostics of Bearings in Rolling Stocks: Results of Long Lasting Tests for a Regional Train Locomotive**”, *Mechanisms and Machine Science*, ISBN 978-3-319-99267-9, Vol. 61, 2019, pp. 321-335.

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- 12) Vania, A., Pennacchi, P., Chatterton, S., Cangioli, F., “**Intermittent Rub Caused by Carbonized Oil in a Steam Turbine**”, *Mechanisms and Machine Science*, ISBN 978-3-319-99267-9, Vol. 61, 2019, pp. 290-304.
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- 14) Vania, A., Pennacchi, P., Chatterton, S., Cangioli, F., “**Special Signal Processing Tools for the Experimental Data of Spiral Vibrations**”, *Mechanisms and Machine Science*, ISBN 978-3-319-99267-9, Vol. 61, 2019, pp. 305-320.
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- 18) Vinh, D.P., Chatterton, S., Pennacchi, P., “**Static and dynamic behaviors of a cylindrical hydrodynamic journal bearing operating at very low Sommerfeld numbers**”, *Mechanisms and Machine Science*, ISBN 978-3-030-20130-2, Vol. 73, 2019, pp. 3835-3844.
- 19) Chatterton, S., Vania, A., Pennacchi, P., “**Simulation of Tilting-pad Journal Bearing Equipped with Cooled Pads**”, *Mechanisms and Machine Science*, ISBN 978-3-030-20130-2, Vol. 73, 2019, pp. 3805-3844.
- 20) Chatterton, S., Pennacchi, P., “**Condition monitoring and diagnostics of wind turbine power train**”, *Structural Control and Fault Detection of Wind Turbine Systems*, 978-1-78561-394-4, 2018, pp. 237-251.

International Journals

- 1) Mimmi G. and Pennacchi P., “**Determination of Tool Profile for the Milling of Three Screw Pump Rotor**”, *Meccanica, International Journal of the Italian Association of Theoretical and Applied Mechanics*, Vol. 32, n. 4, 1997, CODEN MECCB9 ISSN 0025-6455, pp. 363-376.
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- 3) Mimmi G. and Pennacchi P., “**Rotor Design and Optimization in Internal Lobe Pumps**”, *Applied Mechanics Reviews*, Vol.50, n.11, part 2, November 1997, ISSN 0003-6900, pp. S133-S141.
- 4) Mimmi G. and Pennacchi P., “**Internal Lobe Pump Design**”, *Transactions of the Canadian Society of Mechanical Engineering (CSME)*, Vol. 21, n. 2, 1997, ISSN 0315-8977, pp. 109-122.
- 5) Mimmi G. and Pennacchi P., “**Involute Gear Pumps versus Lobe Pumps: a Comparison**”, *Transactions of ASME - Journal of Mechanical Design*, Vol. 119, No. 4, December 1997, ISSN 1050-0472, pp. 458-465.
- 6) Mimmi G. and Pennacchi P., “**Computation of Pressure Loads in Three Screw Pump Rotors**”, *Transactions of ASME - Journal of Mechanical Design*, Vol. 120, No. 4, December 1998, ISSN 1050-0472, pp. 581-588.
- 7) Mimmi G. and Pennacchi P., “**Dynamic Effects of Pressure Loads in Three Screw Pump Rotors**”, *Transactions of ASME - Journal of Mechanical Design*, Vol. 120, No. 4, December 1998, ISSN 1050-0472, pp. 589-592.
- 8) Mimmi G. and Pennacchi P., “**Analytical Model of a Particular Type of Positive Displacement Blower**”, *IMEchE Proc. Instn. Mech. Engrs.-Journal of Mechanical Engineering Science - part C*, Vol. 213, No C5, 1999, ISSN 0954-4062, pp. 517-526.
- 9) Mimmi G. and Pennacchi P., “**Dynamic Loads in the Three-Lobe Supercharger**”, *Transactions of ASME - Journal of Mechanical Design* Vol. 121, No. 4., December 1999, ISSN 1050-0472, pp. 602-605.
- 10) Mimmi G. and Pennacchi P., “**Non Undercutting Conditions in Internal Gears**”, *Mechanism and Machine Theory*, Vol. 35, No 4, Apr-2000, ISSN 0094-114X, pp. 477-490.

- 11) Mimmi G. and Pennacchi P., “**Preshaping Motion Input for a Rotating Flexible Link**”, *International Journal of Solids and Structures*, Vol. **38**, Issue 10-13, Jan-2001, ISSN 0020-7683, pp. 2009-2023.
- 12) Bachschmid N., Pennacchi P., Tanzi E. and Vania A., “**Accuracy of Modelling and Identification of Malfunctions in Rotor Systems: Experimental Results**”, *Journal of the Brazilian Society of Mechanical Sciences*, Vol. **XXII**, No. 3, 2000, ISSN 0100-7386, pp. 423-442.
- 13) Mimmi G. and Pennacchi P., “**Diaphragm Design Improvement for a Metering Pump**”, *Engineering Failure Analysis* Vol. **8**, No 1, Feb-2001, ISSN 1350-6307, pp 1-13.
- 14) Mimmi G. and Pennacchi P., “**Compression Load Dynamics in a Special Helical Blower: a Modeling Improvement**”, *Transactions of ASME - Journal of Mechanical Design* Vol. **123**, No. 3, September 2001, ISSN 1050-0472, pp 402-407.
- 15) Mimmi G. and Pennacchi P., “**A Special Type of Crank Mechanism with Variable Stroke**”, *Transactions of ASME - Journal of Mechanical Design* Vol. **123**, No. 3, September 2001, ISSN 1050-0472, pp 468-472.
- 16) Bachschmid N., Pennacchi P., Tanzi E. and Vania A., “**Identification of Transverse Crack Position and Depth in Rotor Systems**”, *Meccanica, International Journal of the Italian Association of Theoretical and Applied Mechanics*, Vol. **35**, n. 6, 2000, CODEN MECCB9 ISSN 0025-6455, pp. 563-582.
- 17) Bachschmid N., Pennacchi P. and Audebert S., “**Algunos Resultados en la Identificación Basada en Modelos de Fisuras Transversales en Sistemas de Rotores**”, *Información Tecnológica*, Vol. **12**, n.5, 2001, ISSN 0716-8756, pp. 25-32.
- 18) Pennacchi P., Mimmi G. and Frosini L., “**Reduction of Quasi-impulsive Forces and Noise Emission in Three-screw Pump Rotors**”, *International Journal of Fluid Power*, **2** (2001), No. 3, ISSN 1439-9776, pp.23-31.
- 19) Bachschmid N., Pennacchi P. and Vania A., “**Identification of Multiple Faults in Rotor Systems**”, *Journal of Sound and Vibration*, Vol. **254**, No. 2, 2002, ISSN 0022-460X, pp. 327-366.
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- 21) Bachschmid N., Tanzi E., Pennacchi P. and Audebert S., “**Transverse crack modeling and validation in rotor systems including thermal effects**”, *International Journal of Rotating Machinery*, Vol. **9**, No. 2, 2003, ISSN 1023-621X, pp.113-126.
- 22) Bachschmid N., Pennacchi P., Vania A., Zanetta G.A. and Gregori L., “**Identification of Rub and Unbalance in a 320MW Turbogenerator**”, *International Journal of Rotating Machinery*, Vol. **9**, No. 2, 2003, ISSN 1023-621X, pp.97-112.
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- 25) Pennacchi P. and Vania A., “**Accuracy in the Identification of a Generator Thermal Bow**”, *Journal of Sound and Vibration*, Vol. **274**, No. 1-2, 2004, ISSN 0022-460X, pp.273-295.
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 Inventor(s): MIMMI GIOVANNI [IT]; PENNACCHI PAOLO [IT]
 Applicant(s): UNIV PAVIA [IT]; MIMMI GIOVANNI [IT]; PENNACCHI PAOLO [IT]
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 - international: F04C18/56; F04C18/48; (IPC1-7): F04C18/56
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- 2) Titolo: CUSCINETTO LUBRIFICATO PER MACCHINE ROTANTI
 Autori: Chatterton, S.; Pennacchi, P.
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- 3) Titolo: SUPPORTO, MACCHINA E PROCESSO PER FINITURE SUPERFICIALI
 Autori: Chatterton, Steven; Lecis, Nora Francesca Maria; Pennacchi, Paolo Emilio Lino Maria; Vedani, Maurizio; Giussani, Alessandro; Falzetti, Angelo
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