University Academic Curriculum Vitae

Personal information

Name: Ilaria Palomba
Place and date of birth: Battipaglia, May 23, 1987
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Education since leaving school

- 2010/07 Bachelor Degree in Engineering and Management from the Università degli Studi di Padova.
  Thesis title (in Italian): "Motore Stirling in cogenerazione: stato dell'arte e applicazioni"
  Supervisor: Prof. Marco Noro.
  Final mark: 102/110

- 2012/10 Master Degree in Product Innovation Engineering from the Università degli Studi di Padova.
  Thesis title (in Italian): "Riduzione di modelli dinamici per l'analisi e l'ottimizzazione di sonotrodi ad ultrasuoni"
  Supervisor: Prof. Alberto Trevisani.
  Final mark: 110/110

Present appointment

- 2013/1/1-2015/12/1 PhD student in Mechatronics and Product Innovation Engineering.
  Research title: "State estimation in multibody systems with rigid or flexible links", from the Università degli Studi di Padova.
  Supervisor: Prof. Alberto Trevisani.

Professional experience

Chronological list of all previous employments (each with job title, starting and finishing dates, level, employer, responsibilities)

From / to	Job title	Name of academic Institution	Academic level	responsibilities
Nov. 12 /Dec. 12	Research contract	Università degli Studi di Padova	Post-graduate	Experimental modal analysis of an ultrasonic sonotrode.

Experience in academic teaching

From A.Y. 2012/2013 through A.Y. 2014/2015 teaching experience has been gained giving monographic lectures within the following courses of the SSD ING-IND/13:

- Fundamentals of Mechanics Applied to Machines (Fondamenti di meccanica applicata alle macchine): undergraduate level course - B.Sc. programs in Engineering and Management, and in Mechanical and Mechatronic Engineering. (Six hours per year)
- Mechanical Vibrations (Meccanica delle vibrazioni): graduate level course - M.Sc. programs in Product Innovation Engineering, and Mechatronic Engineering. (Four hour per year).

TEACHING IN PROFESSIONAL COURSES

2015

She teaches (40 hours) in the biennial program "Tecnico superiore per l'automazione ed i sistemi meccatronici" (Expert technician for automation and mechatronic systems) organized by I.T.S. Meccatronico, Fondazione Istituto Tecnico Superiore, Nuove Tecnologie per il Made in Italy - Comparto Meccatronico. The program is organized and delivered by the foundation I.T.S. involving the University of Padova.
Lecture topics:

- Trajectory Planning
- Control of Mechanical Systems
- Fundamentals of Mechanics Applied to Machines

2014

She teaches (32 hours) in the biennial program "Tecnico superiore per l'automazione ed i sistemi meccatronici" (Expert technician for automation and mechatronic systems) organized by I.T.S. Meccatronico, Fondazione Istituto Tecnico Superiore, Nuove Tecnologie per il Made in Italy - Comparto Meccatronico. The program is organized and delivered by the foundation I.T.S. involving the University of Padova.
Lecture topics:

- Trajectory Planning
- Control of Mechanical Systems
- Robotics

2013

She teaches (8 hours) in the biennial program "Tecnico superiore per l'automazione ed i sistemi meccatronici" (Expert technician for automation and mechatronic systems) organized by I.T.S. Meccatronico, Fondazione Istituto Tecnico Superiore, Nuove Tecnologie per il Made in Italy - Comparto Meccatronico. The program is organized and delivered by the foundation I.T.S. involving the University of Padova.
Lecture topics:

- Trajectory Planning

Research and scholarships

Since 2013 she has carrying out theoretical, numerical, and experimental investigations in the field of mechanics of machines and mechanical vibrations. In particular, her research interests are focused on the following topics:

1. Non-linear state estimation for multibody systems with either rigid or flexible links.
2. Model reduction of vibrating systems.
3. Inverse dynamic structural modifications of vibrating systems.

There follows a brief description of the chief activities and results achieved in the abovementioned research field. Bracket numbers refer to the publications listed in this forms.

1. NON-LINEAR STATE ESTIMATION FOR MULTIBODY (MB) SYSTEMS WITH EITHER RIGID OR FLEXIBLE LINKS

The main objective of the research activity is to synthesize state observers for rigid-link and flexible-link mechanisms and manipulators. Indeed the knowledge of the actual state of MB systems is an essential requirement for assuring proper motion through advanced control schemes, and it is also useful in the implementation of techniques for fault detection, and strategies for the identification of uncertain parameters.

Design of nonlinear state observers for rigid-link multibody systems.
A new and comprehensive theory has been developed for kinematic state estimation in MB systems with rigid-links [6].The proposed theory is capable of dealing with both open-chain and closed-chain MB systems in the whole configuration space, and explicitly addresses the problems arising from the nonlinearity of state estimation. The proposed theory models the kinematic constraints as a set of inputs, outputs and state variables related by nonlinear, first-order, ordinary differential equations, which can be used in the synthesis of state observers. Particular attention has been paid to the definition of state variables, inputs and outputs that ensure system observability. Moreover, the theory proposed addresses the problem of acceleration estimation, which is not trivial when discrete observers are employed, as it is common in practice. Finally, a novel approach to solve the problem known as "unknown inputs estimation" in MB systems with rigid-links has been developed [3].

2. MODEL REDUCTION OF VIBRATING SYSTEMS

Finite element models with fine meshes are usually employed to carefully model dynamics of vibrating systems. Unfortunately, such models can be unsuitable for example for simulation, real time control, and design optimization because of their large dimensions that often lead to numerical ill-conditioning and to considerable computational efforts. In order to get dynamic models that are at the same time accurate and small-sized, or at least of a reasonable size, model reduction techniques have to be employed. To this end, specific studies have been carried out to develop innovative criteria for performing model reduction through Craig-Bampton (CB) method.
In particular, two methods have been finalized in order to rank and select the CB interior normal modes ensuring an accurate description of:

- Method 1: the dominant vibrational modes of resonant systems [9]
- Method 2: the forced response of linear vibrating systems under harmonic excitation [10]

while guaranteeing minimum model dimensions.
METHOD 1. The first method and its improvement [8] are based on some analytically defined indices, which provide comparative evaluation of the interior modes relevance, based on the contributions of each interior mode to the dynamics of each vibrational mode, which is of interest, of a resonant system. The interior modes retained in a reduced model are those with the highest indices. Furthermore, a criterion to evaluate the minimum dimensions of the reduced models has been provided.
METHOD 2. The second method has been developed to perform model reduction of undamped, linear, and time-invariant vibrating systems under harmonic excitation. The ranking and the selection of the CB interior modes, thoroughly discussed in [7], are carried out using coefficients based on energetic considerations and taking into account the frequency and the shape of the force exciting the system, that is assumed to be known. The aforementioned coefficients provide a measure of the contribution of each interior mode to the computation of the mean mechanical energy stored by the system in a period of excitation. In [5] the method has been validated by applying it to a linear vibratory feeder, of the kind usually employed in the packaging industries for conveying small components or products. Additionally, it has been shown that the method proposed outperforms the other state-of-the-art techniques, by leading to reduced order models with significantly smaller dimensions. Finally, an extension of the method to vibrating systems under multi-harmonic excitation has been proposed in [1].

3. INVERSE DYNAMIC STRUCTURAL MODIFICATIONS OF VIBRATING SYSTEMS

The design of vibrating systems often imposes meeting requirements defined in terms of natural frequencies, modes of vibration, and, if not negligible, damping properties. The achievement of the desired dynamic behaviour requires the modification of system inertial, stiffness and damping parameters, computing through inverse eigenvalue problem. Moreover, in many cases, it is desirable assigning only the response of some critical parts rather than the response of the whole system (i.e. partial eigenvector assignment). However, the currently available methods do not provide a way to distinguish the degrees of freedom with different levels of interest. To solve this relevant open issue, a method has been developed to assign partial parts of an arbitrary number of eigenvectors [4]. In order to compute system mass and stiffness modifications (constrained by bounds), which allow getting the desired dynamic behaviour (in terms of natural frequency and mode shape) the assignment problem is cast as an optimization problem solved numerically. The proposed approach can handle general assignment tasks, with an arbitrary number of modification parameters and prescribed eigenpairs. Interrelated modifications can be also accounted for. In [2] numerical validation of the method has been proved through the dynamic optimization of a vibratory linear feeder. In particular, the partial eigenvector assignment has allowed specifying and improving just the eigenvector entries representing the upper tray translation (where the conveyed parts flow), which are those of greater concern, in practical applications.

Research grant

Date granted	Award Holder(s)	Funding Body	Title	Amount received
2013/01/01-2015/12/31 (Three years Ph.D grant)	Ilaria Palomba	Università degli Studi di Padova	State estimation in multibody systems with rigid or flexible links	55000 €

Research contract

Date granted	Award Holder(s)	Funding Body	Title	Amount received
2012/11/05-2012/12/31	Alberto Trevisani	Fondazione Studi Universitari di Vicenza	(in Italian) Sviluppo di tecnologie a ridotto consumo energetico, impiego di materiali a basso impatto ambientale e implementazione di sistemi per la sicurezza alimentare e la qualità del prodotto. Analisi delle convenienza commerciale e sostenibilità economica dei prodotti della ricerca	2600 €

Publications

- Journal Papers in refereed academic journals

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1. Ilaria Palomba, Dario Richiedei, and Alberto Trevisani
"ENERGY-BASED OPTIMAL RANKING OF THE INTERIOR MODES FOR REDUCED-ORDER MODELS UNDER PERIODIC EXCITATION".
Shock and Vibration, Article ID 348106.
IMPACT FACTOR 2014: 0.722
Open access paper, available on
http://www.hindawi.com/journals/sv/aa/348106/

- Other publications

- Papers in International Conference Proceeding

2. R. Belotti, I. Palomba, D. Richiedei, A. Trevisani
"PARTIAL EIGENSTRUCTURE ASSIGNMENT IN VIBRATING SYSTEMS THROUGH HOMOTOPY OPTIMIZATION".
Proceeding of the ICoEV 2015, International Conference on Engineering Vibration, September 7-10, Ljubljana (Slovenia).
ISBN: 978-961-6536-97-4

3. I. Palomba, D. Richiedei, A. Trevisani
"SIMULTANEOUS ESTIMATION OF KINEMATIC STATE AND UNKNOWN INPUT FORCES IN RIGID-LINK MULTIBODY SYSTEMS".
Proceedings of the ECCOMAS 2015, Thematic Conference on Multibody Dynamics, pp. 229-240, June 29 –July 2, 2015, Barcelona (Spain).
ISBN: 978-84-944244-0-3

4. R. Belotti, I. Palomba, D. Richiedei, A. Trevisani
"A NEW METHOD FOR PASSIVE PARTIAL EIGENSTRUCTURE ASSIGNMENT IN VIBRATING SYSTEMS".
Proceedings of the IOMAC 2015, 6th International Operational Modal Analysis Conference, May 12-14, 2015, Gijón (Spain).
ISBN: 978-846173880-9

5. R. Belotti, I. Palomba, D. Richiedei, A. Trevisani.
"INTERIOR MODE SELECTION IN THE CRAIG BAMPTON REDUCTION TECHNIQUE BASED ON AN ENERGY APPROACH".
Proceedings of the IOMAC 2015, 6th International Operational Modal Analysis Conference, May 12-14, 2015, Gijón (Spain).
ISBN: 978-846173880-9

6. I. Palomba, D. Richiedei, A. Trevisani.
"NONLINEAR KINEMATIC STATE ESTIMATION IN RIGID-LINK MULTIBODY SYSTEMS BY SIMPLEX SIGMA POINT UNSCENTED KALMAN FILTERS".
Proceedings of the ISMA 2014, International Conference on Noise and Vibration Engineering and USD 2014, International Conference on Uncertainty in Structural Dynamics, pp. 2899-2914, September 15-17, 2014, Leuven, (Belgium).
ISBN: 978-907380291-9

7. I. Palomba, D. Richiedei, A. Trevisani
"ENERGY-BASED INTERIOR MODE SELECTION FOR REDUCED-ORDER MODELS UNDER HARMONIC EXCITATION".
Proceedings of the ISMA 2014, International Conference on Noise and Vibration Engineering and USD 2014, International Conference on Uncertainty in Structural Dynamics, pp. 2899-2914, September 15-17, 2014, Leuven, (Belgium).
ISBN: 978-907380291-9

8. I. Palomba, D. Richiedei, A. Trevisani
"A RANKING METHOD FOR THE SELECTION OF THE INTERIOR MODES OF REDUCED ORDER RESONANT SYSTEM MODELS".
Proceedings of the ASME 2014 12th Biennial Conference on Engineering Systems Design and Analysis, ESDA 2014, Vol. 2, July 25-27, 2104, Copenhagen (Denmark).
DOI: 10.1115/ESDA2014-20607

9. R. Ashfar, I. Palomba, D. Richiedei, A. Trevisani
"MODE SELECTION IN REDUCED-ORDER MODELS FOR ULTRASONIC HORNS UNDER LONGITUDINAL VIBRATION".
Proceedings of the IOMAC 2013, 5th International Operational Modal Analysis Conference, May 13-15, 2013, Guimarães (Portugal).

- Extended Abstract in International Conference

10. I. Palomba, D. Richiedei, A. Trevisani
"INTERIOR MODE SELECTION FOR HARMONICALLY FORCED SYSTEMS: AN ENERGY-BASED APPROACH".
Proceedings of the XIX Symposium VISHNO, VIbrations SHocks and Noise, June 16-19, 2014, Aix en Provence, (France).

Further data

Presentations at scientific conferences:

- ASME 2014 12th Biennial Conference on Engineering Systems Design and Analysis, ESDA 2014, July 25-27, 2104, Copenhagen (Denmark).
- Thematic Conference on Multibody Dynamics, ECCOMAS 2015, June 29 – July 2, Barcelona (Spain).

Statement of interest

It is with great interest that the candidate applies this position of research assistant. The candidate considers her profile extremely coherent with the one described in the call. In particular, she has already taught lessons covering some of the topics listed in the call, and she has gained relevant scientific expertise in such topics.
The research experience gained so far has allowed learning how utilize analytical and quantitative reasoning and developing excellent problem solving skills. She has become a diligent and meticulous researcher with an eye for details. Specific and thorough skills have been gained in the fields of multibody systems, robotics and trajectory planning not only by research investigations but also through teaching activities. Additionally, optimization and inverse eigenvalue problem have been addressed since the master thesis. Finally, the doctoral experience and the involvement in a research project have contributed to the development of practical and laboratory expertise which could be fruitfully exploited in the proposed activity.

Language competence

Italian – mother tongue

English:

Understanding	Writing	Speaking
B2	B1	B1

Vicenza, 03/10/2015