

Dr. Tudor C. Ionescu

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Employment

• Assistant Professor

- November 2015 - present at **Politehnica University of Bucharest (UPB)**, Romania.
- In this job at the Dept. of Automatic Control and Systems Engineering (ACSE) I perform research and teaching duties, as well as attract independent research funding.

Teaching: i) *Linear Systems Theory* course at the Department of Computer Science for second year undergraduate students. I have elaborated the lecture notes and slides, have prepared exercise and laboratory practice, as well as mid-term and final evaluation exams. ii) Assisting the *Signals and Systems* course and *Control Systems Theory* course at ACSE, preparing laboratory and exercise practice for second year undergraduate students. iii) Teaching *Nonlinear Systems* course for fourth year ACSE undergraduate students, preparing lecture notes, exercise and lab practice as well as mid-term and final examination.

Research: I am continuing my research in the field of dynamical system approximation. The main goal is to develop model reduction techniques suitable for simulation and control, efficient, to yield accurate models. The target of these methods are complex large-scale (non)linear systems modelled as networks of finite- or infinite-dimensional systems (PDE, time-delay) which have to be approximated with finite-dimensional low order systems. One of the major tasks in my research is finding error bounds for the time-domain moment matching-based techniques, and methods to systematically compute the appropriate dimension of the approximation. Main applications are, e.g., smart power grids, electrical vehicles, platoons of vehicles, smart buildings.

Funding: See section **Grants and Awards**.

• Senior Researcher

- June 2015 - present at the "**G. Mihoc–C. Iacob**" **Institute of Mathematical Statistics and Applied Mathematics (ISMMA) of the Romanian Academy**.
- In this job I perform research duties, as well as attract research funding.

Research: I am continuing my research in the field of dynamical system approximation. The main goal is to develop model reduction techniques suitable for simulation and control, efficient, to yield accurate models. The target of these methods are complex large-scale (non)linear systems modelled as networks of finite- or infinite-dimensional systems (PDE, time-delay) which have to be approximated with finite-dimensional low order systems. The main focus here is to try to develop ODE approximations for PDE-based systems for CFD and aerodynamics. The approximations must be of low-order, simple and accurate.

Funding: See section **Other Grant Applications**.

- **Research Associate**

- September 2013 - September 2015 at the **University of Sheffield, UK**.
- In this job I have studied modelling and control of large-scale time-delay (non)linear systems and other types of industry related models, with wide application in the field of power systems, electric vehicles and multi-agent systems.

- **Research Associate**

- November 2009 - August 2013 at **Imperial College, London, UK**.
- I have solved the problem of moment matching based model reduction for nonlinear dynamical systems. I have designed theoretical algorithms yielding families of parametrized low order approximations. I have examined and computed the parameters and the subclasses of models which preserve the structure and/or the properties of the to-be-approximated system.
- Preliminary results have been published in five peer reviewed conference proceedings. The fully accomplished results are in preparation/submitted for publication in three journal papers.
- I have collaborated with the University of Groningen, the Netherlands, to achieve part of the results in the field of distributed parameters systems.
- September 2011 - I have organised an Invited Session of Papers at the 18th IFAC World Congress, Milan, Italy.

- **Research Assistant**

- January 2007 - April 2009 at the **University of Groningen, the Netherlands**.
- January 2005 - January 2007 at the **Delft University of Technology NL**.
- I have carried out research in the field of model reduction for nonlinear dynamical systems. I have tackled the problem of balanced truncation and I have obtained reduced order models that preserve dissipativity. I have obtained a new definition of symmetry for nonlinear systems and I have computed the low order nonlinear approximations that preserve this property. I have achieved the final results in collaboration with Nagoya University, Japan.
- I have collaborated with Supélec, France for application of the theoretical results on power system models.
- The accomplished results have been published in two journals and two book chapters. Preliminary results have been published in four peer reviewed conference papers.

Qualifications

• PhD in Applied Mathematics

- January 2005–September 2009. Awarded by the **University of Groningen NL**.
- Title of the thesis: **Balanced Truncation for Dissipative and Symmetric Nonlinear Systems**
- I have developed model approximation algorithms for nonlinear complex physical systems based on nonlinear balanced truncation. The reduced order models obtained through these procedures preserve crucial properties of the complex model, required for analysis, simulation and control design.
- The results have been disseminated in two peer-reviewed journal papers, four peer-reviewed conference papers and two refereed book chapters.

• BSc. and MSc. in Systems and Control

- October 1999–June 2004 at the **Politehnica University of Bucharest, Romania**.
- Title of the MSc. thesis: **Stability Analysis of Neutral Systems: a Delay-dependent Criterion**
- Grade: 10 out of 10.
- I have analysed the application of LMI techniques for establishing delay-dependent stability criteria for neutral time-delay systems. I have obtained computational algorithms which determined the largest value of the delay for which the neutral system remains asymptotically stable.
- The results have been disseminated in two peer-reviewed conference papers.

Grants and awards

• ScaleFreeNet Exploratory Research National Grant

- September 2017 - present. "Scale-free modeling and optimization techniques for control of complex networks" (ScaleFreeNet) exploratory research project, funded through the Romanian Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI) grant PN-III-P4-ID-PCE-2016-0731, Contract No. 39/2017.
- Role: Co-I. In charge of efficient and reduced order modelling of the large-scale network systems for optimisation, simulation and distributed control.
- PI: Prof. Ion Necoară, ACSE, UPB, Romania.
- I have contributed with several ideas and have written the large-scale model approximation part of the grant proposal. I have studied the submission procedure at the UEFISCDI and thoroughly followed the submission and the peer review procedure.

- **Excellence in Research Grant**

- September 2017 - present Excellence in Research Grant from UPB, GEX2017, Contract no. 16/25.09.2017.
- Role: PI. I have been awarded €5,000 for research by UPB.
- I have written the grant proposal, won and awarded the contract.

- **Short Term Scientific Mission (STSM)**

- September 2017 - October 2017 STSM37646 at the University of Groningen, the Netherlands.
- Role: PI. I have been awarded €2,500 for 30 days by The EU COST Action TD1307.
- I have written the grant proposal, won and awarded the contract.

- **Travel Grant**

- March 2015 - June 2015 at the University of Groningen, the Netherlands.
- Role: Co-I. I have been awarded €6,000 for four months by The Netherlands Organisation for Scientific Research (NWO).
- PI: Dr. Orest V. Iftime, Associate Professor at the Faculty of Economics and Business, University of Groningen.
- I have contributed with several ideas and have written the grant proposal. I have mastered the submission procedure at the NWO and I have thoroughly followed and responded to the peer review procedure.

- **Travel Grant**

- April 2011 - August 2011 at the University of Groningen, the Netherlands.
- Role: Co-I. I have been awarded €6,000 for four months by The Netherlands Organisation for Scientific Research (NWO).
- PI: Dr. Orest V. Iftime, Faculty of Economics and Business, University of Groningen.
- I have contributed with several ideas and have written two sections of the grant proposal. I have studied the submission procedure at the NWO and I have thoroughly followed the submission and the peer review procedure.

• Other grant applications

- January 2017: - **Young Research Teams** grant application to the National Executive Unit for Funding Higher Education, Research and Innovation (UEFISCDI) of the National Education Department of the Romanian Government. potential duration: two years. Budget awarded if won: €100.000.
- September 2014 - **Marie Curie** European Individual Fellowship application for a 24 month research job at the University of Groningen, the Netherlands within the Horizon2020 Funding Programme. The title of the proposed research is "Model order reduction for infinite-dimensional port-Hamiltonian systems". Funding body: The European Commission.
- December 2008 - **Rubicon Grant** early career stage application for two year research visit to the Dept. of Mechanical Engineering, University of Nagoya, Japan. Funding body: The Netherlands Organisation for Scientific Research (NWO).
- February 2009 - **JSPS Fellowship** early career stage two year fellowship application. Fellowship to take place at the University of Nagoya, Japan. Funding body: Japan Society for Promotion of Science (JSPS).
- March 2014 - **Royal Society International Exchange Scheme** travel grant application - **pending review**. Research visit to take place at the Dept. of Economics, Econometrics & Finance, University of Groningen, the Netherlands. Funding body: The Royal Society, UK.

Networking

• Research Visits

- April - July 2011 research visit at Dr. Orest Iftime, in the Dept. of Economics, Econometrics & Finance, University of Groningen, the Netherlands.
- March - June 2008 research visit at Prof. Kenji Fujimoto, in the Dept. of Mechanical Engineering, Nagoya University, Japan.
- March - May 2007 research visit at Prof. Romeo Ortega, in the Laboratoire de Signaux et Systèmes, Supélec, France.

Administration

- March 2016–present: in charge of the administration of E507 Cyberphysical systems laboratory in the PRECIS Centre for Research of the Automatic control and Computer Science faculty, Politehnica Uni. of Bucharest.
- September 2010-August 2011: Organized an invited session of six contributions at the 18th IFAC World Congress, Milan, Italy. Title of the invited session: "Model order reduction".

Evidence of esteem

• Invited Talks

- July 2011: Invited talk at the 7th Congress of Romanian Mathematicians, Braşov, Romania. Title: "Moment matching for finite and infinite dimensional systems".
- May 2011: Invited talk at the Systems Theory Seminar of the Faculty of Mathematics and Natural Sciences, University of Groningen, the Netherlands. Title: "Moment matching for linear and nonlinear systems".
- July 2010: Mini-course (1 lecture) at the the European Consortium fr Mathematics in Industry Conference, Wuppertal, Germany. Title: "Model reduction for nonlinear systems - overview of nonlinear balancing and moment matching".
- April 2008: Colloquium at the Department of Mechanical Science and Engineering, Nagoya University, Japan. Title: "Balancing for Passive Systems".
- January 2008: Invited speaker at the Numerical Mathematics Working Party (NWNP), NXP Semiconductors, Eindhoven, the Netherlands. Title: "Balancing for Nonlinear Passive Systems".
- May 2007: Short course (2 lectures) at the Laboratoire de Signaux et Systèmes, Supélec, France. Title: "Model reduction based on balancing".

Membership of professional bodies

- November 2007 - present: IEEE Member.

Publications

- Disseminated in the journal and conference papers described in the attached file **Tudor C. Ionescu – List of publications**

Tudor C. Ionescu – List of Publications

Journal papers - refereed

1. I. Necoara and **T. C. Ionescu**. H_2 Model Reduction of Linear Network Systems by Moment Matching and Optimization. *IEEE Transactions on Automatic Control*, ISSN 0018-9286, to appear, December 2020.
2. **T. C. Ionescu**. Two-sided time-domain moment matching for linear systems. *IEEE Transactions on Automatic Control*, ISSN 0018-9286, 61(9):2632-2637, 2016.
3. **T. C. Ionescu** and A. Astolfi. Nonlinear moment matching based model order reduction. *IEEE Transactions on Automatic Control*, ISSN 0018-9286, 61(10):2837-2847, 2016.
4. **T. C. Ionescu**, A. Astolfi and P. Colaneri. Families of moment matching based, low order approximations for linear systems. *Systems & Control Letters*, 64: 47–56, 2014.
5. **T. C. Ionescu** and A. Astolfi. Families of moment matching based, structure preserving approximations for linear port Hamiltonian systems. *Automatica*, 49(8):2424–2434, 2013.
6. **T. C. Ionescu**, K. Fujimoto and J. M. A. Scherpen. Singular value analysis of nonlinear symmetric systems. *IEEE Transactions on Automatic Control*, 56(9):2073–2086, 2011.
7. **T. C. Ionescu**, K. Fujimoto and J. M. A. Scherpen. Dissipativity preserving balancing for nonlinear systems - a Hankel operator approach. *Systems & Control Letters*, 59:180–194, 2010.

Journal papers - submitted

- **T. C. Ionescu**, O. V. Iftime and I. Necoara. Model reduction with pole-zero placement and matching of derivatives. *Automatica*, submitted March 2020.
- I. Necoara and **T. C. Ionescu**. OPTIMAL H_2 MOMENT MATCHING-BASED MODEL REDUCTION FOR LINEAR SYSTEMS BY (NON)CONVEX OPTIMIZATION. *SIAM Journal on Control and Optimization*, submitted 2019.

Journal papers - in preparation

- X. Cheng, **T. C. Ionescu** and M. Patrascu. Time-Domain Moment Matching for Second-Order Systems. In preparation, 2020.
- **T. C. Ionescu** and C. Oara. Moment matching based closed-loop reduction to achieve stabilization and asymptotic performance. In preparation, 2020.
- **T. C. Ionescu**, G. C. Flutur and J. M. A. Scherpen. Families of time-domain momentmatching-based models for descriptor systems. In preparation, 2020.
- **T. C. Ionescu**, A. Astolfi and R. Barbulescu. Nonlinear moment matching-based model order reduction with preservation of physical properties. In preparation, 2020.
- **T. C. Ionescu** and O. V. Iftime. Moment matching for infinite-dimensional systems. In preparation, 2015.

Conference papers - refereed

1. R. Barbulescu, G. Ciuprina, **T. C. Ionescu**, D. Ioan, and L. M. Silveira. Efficient model reduction of myelinated compartments as port-Hamiltonian systems. Proc. Scientific Computing in Electrical Engineering, to appear 2020.
2. **T. C. Ionescu**, O. V. Iftime and I. Necoara. Optimal time-domain moment matching with partial placement of poles and zeros. Proc. European Control Conference, to appear 2020.
3. **T. C. Ionescu**, O. V. Iftime and Q.-C. Zhong. Model reduction by moment matching: case study of a FIR system. Proc. European Control Conference, pp. 2319–2324, 2019.
4. I. Necoara and **T. C. Ionescu**. Parameter selection for best H_2 moment matching-based model approximation through gradient optimization. Proc. European Control Conference, pp. 2301–2306, 2019.
5. **T. C. Ionescu** and O. V. Iftime. A moment matching approach for systems of delayed differential equations. Proc. European Control Conference, pp. 2605–2610, 2018.
6. **T. C. Ionescu** and I. Necoară. A scalable moment matching-based model reduction technique of linear networks. Proc. of the 20th IFAC World Congress, 2017.
7. P. Schulze, **T. C. Ionescu** and J. M. A. Scherpen. Families of moment matching-based reduced order models for linear descriptor systems. Proc. of European Control Conf., pages 1964-1969, 2016.
8. **T. C. Ionescu** and O. V. Iftime. On moment matching of transfer functions and their derivatives. Proc. of European Control Conf., pages 2104-2109, 2015.
9. **T. C. Ionescu** and A. Astolfi. Moment matching based controller reduction for linear systems. Proc. of 52nd IEEE Conf. on Decision and Control, 2013.
10. **T. C. Ionescu** and A. Astolfi. Moment matching for nonlinear port Hamiltonian and gradient systems. Proc. of 9th IFAC Symposium on Nonlinear Control Systems, 2013.
11. O. V. Iftime and **T. C. Ionescu**. On an approximation with prescribed zeros of SISO abstract boundary control systems. Proc. of European Control Conference, 2013.
12. **T. C. Ionescu** and A. Astolfi. Families of reduced order models that achieve nonlinear moment matching. Proc. of the American Control Conference, 2013.
13. **T. C. Ionescu**, J. M. A. Scherpen, O. V. Iftime and A. Astolfi. Balancing as a moment matching problem. Proc. 20th International Symposium on Mathematical Theory of Networks and Systems.
14. **T. C. Ionescu** and O. V. Iftime. Moment matching with prescribed poles and zeros for infinite-dimensional systems. Proc. American Control Conference, Montreal, Canada, 2012.
15. **T. C. Ionescu** and A. Astolfi. Moment matching for linear systems - overview and new results. Proc. 11th IFAC World Congress, 2010.
16. **T. C. Ionescu** and A. Astolfi. On moment matching with preservation of passivity and stability. In Proc. 49th IEEE Conference on Decision and Control, 2010.
17. **T. C. Ionescu**, K. Fujimoto and J. M. A. Scherpen. Positive and bounded real balancing for nonlinear systems - a controllability and observability function approach. In Proc. 48th IEEE Conf. on Decision and Control, pages 4310–4315, 2009.

18. **T. C. Ionescu**, K. Fujimoto and J. M. A. Scherpen. The cross operator and the singular value analysis for nonlinear symmetric systems. In *Proc. European Control Conference ECC09*, pages 1565–1570, 2009.
19. **T. C. Ionescu** and J. M. A. Scherpen. Passivity preserving model order reduction for the SMIB. In *Proc. 47th IEEE Conf. on Decision and Control*, pages 4879 – 4884, 2008.
20. **T. C. Ionescu** and J. M. A. Scherpen. Nonlinear cross Gramians and gradient systems. In *Proc. 46th IEEE Conf. on Decision and Control*, pages 3745 – 3750, 2007.

Other papers - Book chapters, refereed

1. A. Dumitrache, F. Frunzuliță and **T. C. Ionescu**. Mathematical Modelling and Numerical Investigations on the Coanda Effect. In J. Awrejcewicz and P. Hagedorn, editors, *Nonlinearity, Bifurcation and Chaos - Theory and Applications*, ISBN 978-953-51-0816-0, DOI: 10.5772/50403, 2012.
2. **T. C. Ionescu** and J. M. A. Scherpen. Nonlinear cross Gramians. In A. Korytowski, K. Malanowski, W. Mitkowski, and M. Szymkat, editors, *System Modeling and Optimization*, volume 312 of *IFIP Advances in Information and Communication Technology*, pages 293–306. Springer, 2009.
3. **T. C. Ionescu** and R. Ștefan. Stability analysis of neutral systems: a delay-dependent criterion. to appear in *Topics in Time-Delay Systems: Analysis, Algorithms and Control*, Springer series Lecture Notes in Control and Information Sciences, 2008.
4. **T. C. Ionescu** and J. M. A. Scherpen. Positive real balancing for nonlinear systems. In G. Ciuprina and D. Ioan, editors, *Scientific Computing in Electrical Engineering*, volume 11 of *ECMI*, pages 153–160. Springer, 2007.
5. **T. C. Ionescu** and R. Ștefan. A comparison method for the stability analysis of neutral systems. In J.-J. Loiseau, S.-I. Niculescu, V. Răsvan, and D. Selișteanu, editors, *Réunion ECO-NET Dynamique - Interconnexions - Environnement*, pages 68–73. Editura Universitaria Craiova, Romania, 2007.