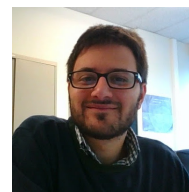# Leonardo Robol

Curriculum Vitae

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🖥 *leonardo.robol.it*
Last updated on September 17, 2024

Personal data

- Born on May, 2, 1988 in Rovereto (TN), Italy.

Academic positions

2024 – Now   **Associate professor**
Department of Mathematics, University of Pisa, Italy.
September, 1, 2024 – current position

2021 – 2024   **Senior Assistant Professor (tenure-track)**
Department of Mathematics, University of Pisa, Italy.
September, 1, 2021 – August, 30, 2024

2018 – Now   **Junior Assistant professor**
Department of Mathematics, University of Pisa, Italy.
November, 5, 2018 – August, 31, 2021.

2017 – 2018   **Researcher**
ISTI, Area della Ricerca CNR, Pisa, Italy.
April, 3, 2017 – November, 2, 2018.

2015 – 2017   **Postdoc researcher**
Department of Computer Science, KU Leuven, Belgium.
November, 1, 2015 – March, 31, 2017.

Education

2012 – 2015   **PhD in Mathematics**, *Scuola Normale Superiore, Pisa, Italy*
Thesis Exploiting rank structures for the numerical treatment of matrix polynomials.
Advisor Prof. Dario A. Bini.
Date November, 30, 2015.
Final mark 70/70 cum laude.

2010 – 2012   **Master degree in Mathematics**, *Università di Pisa, Italy*
Thesis A rootfinding algorithm for polynomials and secular equations.
Advisor Prof. Dario A. Bini.
Date September, 17, 2012.
Final mark 110/110 cum laude.

2007 – 2010   **Bachelor degree in Mathematics**, *Università di Pisa, Italy*
Thesis Compressione di immagini mediante trasformata wavelet: l'algoritmo EZW.
Advisor Prof. Dario A. Bini.
Date September, 24, 2010.
Final mark 110/110 cum laude.

Research interests

- **Low-rank approximation**: fast methods for approximating low-rank matrices tensors, and matrices with an (adaptively determined) hierarchical rank-structure.
- Solution of large scale **matrix and tensor equations**.
- **Toeplitz-like** matrices: fast solvers and matrix functions, spectra of infinite-dimensional Toeplitz operators.
- **Matrix polynomials** and **structure-preserving** linearizations. Design of fast methods for **polynomial and nonlinear eigenvalue problems**.
- **Rootfinding methods** to approximate polynomials' roots. Design of efficient methods for particular classes of polynomials.

Further info at `https://leonardo.robol.it/research/`.

Teaching experience

2018 – Now   **PhD mentoring activity**
- A. Casulli (PhD program in Computational Science, Scuola Normale Superiore),
  in progress: expected PhD defense at the end of 2024.
- A. Bucci (PhD program in mathematics, University of Pisa),
  in progress: expected PhD defense at the end of 2024.

2012 – 2024   **Courses for the Mathematics Bachelor Degree, University of Pisa**
- *Laboratorio di Comunicazione mediante calcolatore*
  - Academic year 2018 – 2019, 24 hours.
  - Academic year 2019 – 2020, 32 hours.
  - Academic year 2019 – 2020, 34 hours.
- *Laboratorio Sperimentale di Matematica Computazionale*
  - Academic year 2018 – 2019, 14 hours.
  - Academic year 2019 – 2020, 22 hours.
- *Numerical analysis*
  - Academic year 2012 – 2013, 22 hours of exercise sessions.
  - Academic year 2013 – 2014, 22 hours of exercise sessions.
  - Academic year 2017 – 2018, 20 hours of exercise sessions.
  - Academic year 2018 – 2019, 22 hours of exercise sessions.
  - Academic year 2019 – 2020, 20 hours of exercise sessions.
  - Academic year 2020 – 2021, 20 hours of exercise sessions.
  - Academic year 2021 – 2022, 20 hours of exercise sessions.
  - Academic year 2022 – 2023, 20 hours of exercise sessions.
- *Scientific Computing*
  - Academic year 2021 – 2022, 30 hours.
  - Academic year 2022 – 2023, 30 hours.
  - Academic year 2023 – 2024, 30 hours.

2019 – 2024   **Courses for the Mathematics Master Degree, University of Pisa**
- *Advisor for 5 master theses.*
- *Numerical methods for ODEs*
  - Academic year 2020 – 2021, 48 hours.
  - Academic year 2021 – 2022, 48 hours.
  - Academic year 2022 – 2023, 48 hours.
  - Academic year 2023 – 2024, 48 hours.

2019 **PhD program on Mathematics and Computer Science, University of Cagliari**
  ○ *Low-rank Approximation*
    - Academic year 2018 – 2019, 20 hours.

2017 – 2018 **Computer Science Bachelor Degree, University of Pisa**
  ○ *Computational methods for Learning and Data Analysis*
    - Academic year 2017 – 2018, 20 hours of exercise sessions.

2015 – 2016 **Master degree in Mathematics Engineering, KU Leuven, Belgium**
  ○ *Numerical Linear Algebra*
    - Academic year 2015 – 2016, 16 hours.
    - Academic year 2016 – 2017, 16 hours.

2013 – 2020 **Scuola Normale Superiore, Pisa**
  ○ *Complementi di analisi*
    - Academic year 2013 – 2014, tutoring; 1 hour per week (equivalent to approximately 35 hours).

Prizes and awards

2023 **National habilitation, full professor**
National habilitation for the role of associate professor in Numerical Analysis. Valid until 11/12/2034.

2020 **National habilitation, associate professor**
National habilitation for the role of associate professor in Numerical Analysis. Valid until 02/07/2029.

2018–2019 **YRA (Young Researcher Award)**
The ISTI Young Researcher Award (YRA) is an annual award that honors its staff of less than 35 years old for a distinct contribute to the Institute activity with their scientific production. Obtained for two consecutive years.

2017 **Honorable mention for the Householder prize**
Awarded for the PhD thesis, Householder symposium HHXX.

Other scientific activities

Conference and workshop organization

2023 **Congress for the Italian Mathematical Association**, *Pisa, Italy*
Member of the local organizing committee.

2022 **Workshop in honor of Michele Benzi's 60th birthday**, *Pisa, Italy*
Member of the local organizing committee.

2021 **METT IX**, *Perugia, Italy*
Member of the local organizing committee.

2018 **SIAM ALA 2018**, *Hong Kong*
Organizer of the minisymposium "Recent applications of rank structures in matrix analysis".

2018 **Research in pairs**, *Luminy, France*
Co-organizer of a 'Reserarch in pairs" workshop at the CIRM in Luminy, titled "Fast solvers for fractional differential equations".

2016 **ILAS 2016**, *Leuven, Belgium*
Member of the local organizing committee.

Projects and Grants

2020 **Progetto GNCS "Metodi low-rank per problemi di algebra lineare con struttura data-sparse"**
Coordinator of the research project "Metodi low-rank per problemi di algebra lineare con struttura data-sparse", supported by INdAM/GNCS with a grant of 4400 euros.

2019 **Progetto Giovani Ricercatori GNCS**
Grant of 1200 euros for the GNCS Giovani Ricercatori project "Metodi di proiezione per equazioni di matrici e sistemi lineari con operatori definiti tramite somme di prodotti di Kronecker, e soluzioni con struttura di rango."

2018 **Grant for Young Mobility**
Grant of 4000 euros by ISTI-CNR supporting research visits to the department of Computer Science at KU Leuven, Belgium.

2017 **Research in pairs**
Granted travel and lodging support for the project "Fast solvers for fractional differential equations", requested to organize a workshop "Research in pairs" at CIRM in Luminy. Il finanziamento ha coperto le spese di soggiorno per il workshop.

2017 **ProgettISTI**
1 year project funded by ISTI-CNR: "Tensor algorithms for performability analysis of large systems". Grant of 2500 euros.

2016 – 2017 **C1 project / KU Leuven**
Participation to the project "Inverse-free Rational Krylov Methods: Theory and Applications"

2015 – 2017 **Participation in INdAM/GNCS projects**
- GNCS 2022 "Tecniche avanzate per problemi differenziali evolutivi: discretizzazione, algebra lineare numerica e ottimizzazione";
- GNCS 2020 "Metodi low-rank per problemi di algebra lineare con struttura data-sparse";
- GNCS 2018 "Tecniche innovative per problemi di algebra lineare";
- GNCS 2017 "Metodi numerici avanzati per equazioni e funzioni di matrici con struttura";
- GNCS 2016 "Equazioni e funzioni di matrici con struttura: analisi e algoritmi";
- GNCS 2015 "Metodi numerici per autovalori e funzioni di matrici con strutture";

Foreign languages

Italian	Mother tongue	
English	C1 Level	*Fluent speaking and writing skills*

Publications

To see an up-to-date list of my publications, check my Google Scholar profile or my personal web page.

Google Scholar [632 citations, h-index 16]
                    https://scholar.google.com/citations?user=j9WP_U4AAAAJ
Scopus [343 citations, h-index 11]
          https://www.scopus.com/authid/detail.uri?authorId=55748770500

Books

1. **Core-Chasing Algorithms for the Eigenvalue Problem**, J. L. Aurentz, T. Mach, L. Robol, R. Vandebril, D. S. Watkins , SIAM, 2018.

Journal papers

2. **Low-rank tensor structure preservation in fractional operators by means of exponential sums**, A. Casulli, L. Robol, BIT Numerical Mathematics — DOI: 10.1007/s10543-023-00974-y.

3. **A nested divide-and-conquer method for tensor Sylvester equations with positive definite hierarchically semiseparable coefficients**, S. Massi, L. Robol, IMA Journal of Numerical Analysis — DOI: 10.1093/imanum/drad089.

4. **Computing eigenvalues of semi-infinite quasi-Toeplitz matrices**, D.A. Bini, B. Iannazzo, B.Meini, J. Meng, L. Robol, Numerical Algorithms, 2023 — DOI: 10.1007/s11075-022-01381-0.

5. **Hierarchical adaptive low-rank format with applications to discretized PDEs**, S. Massei, L. Robol, D. Kressner, Numerical Linear Algebra with Applications, 2022. — DOI: 10.1002/nla.2448.

6. **Mixed precision recursive block diagonalization for bivariate functions of matrices**, S. Massei, L. Robol, SIAM Journal on Matrix Analysis and Applications, 2022 — DOI: 10.1137/21M1407872.

7. **Rank-structured QR for Chebyshev rootfinding**, A. Casulli, L. Robol, SIAM Journal on Matrix Analysis and Applications, 2021 — DOI: 10.1137/20M1375115.

8. **Sampling the eigenvalues of random orthogonal matrices**, M. Fasi, L. Robol, Linear Algebra and Its Applications, 2021 — DOI: 10.1016/j.laa.2021.02.031.

9. **Structured backward errors in linearizations**, V. Noferini, L. Robol, R. Vandebril, ETNA, 2021 — DOI: 10.1553/etna_vol54s420.

10. **A finite element model updating method based on global optimization**, M. Girardi, C. Padovani, D. Pellegrini, L. Robol, Mechanical Systems and Signal Processing, 152, 2021 — DOI: 10.1016/j.ymssp.2020.107372.

11. **Rational Krylov for Stieltjes matrix functions: convergence and pole selection**, S. Massei, L. Robol, BIT Numerical Math., 2020 — DOI: 10.1007/s10543-020-00826-z.

12. **A computational framework for two-dimensional random walks with restarts**, D. A. Bini, S. Massei, B. Meini, L. Robol, SIAM Journal on Scientific Computing, Volume 42, 2020 — DOI: 10.1137/19M1304362.

13. **Rational Krylov and ADI iteration for infinite size quasi-Toeplitz matrix equations**, L. Robol, Linear Algebra and Its Applications, 604, 2020 — DOI: 10.1016/j.laa.2020.06.013.

14. **hm-toolbox: Matlab software for HODLR and HSS matrices**, S. Massei, L. Robol, D. Kressner, SIAM Journal on Scientific Computing, Volume 42, 2020 — DOI: 10.1137/19M1288048.

15. **Finite element model updating for structural applications**, M. Girardi, C. Padovani, D. Pellegrini, L. Robol, Journal of Computational and Applied Mathematics, 370, 2020 — DOI: 10.1016/j.cam.2019.112675.

16. **Computing performability measures by means of matrix functions**, G. Masetti, L. Robol, Journal of Computational and Applied Mathematics, 368, 2020 — DOI: 10.1016/j.cam.2019.112534.

17. **When is a matrix unitary or Hermitian plus low rank?**, G. M. Del Corso, F. Poloni, L. Robol, R. Vandebril, Numerical Linear Algebra with Applications, 26(6), 2019 — DOI: 10.1002/nla.2266.

18. **Nonsingular systems of generalized Sylvester equations: an algorithmic approach**, F. De Terán, B. Iannazzo, F. Poloni, L. Robol, Numerical Linear Algebra with Applications, 2019 — DOI: 10.1002/nla.2261.

19. **Model Updating Procedure to Enhance Structural Analysis in FE Code NOSA-ITACA**, M. Girardi, C. Padovani, D. Pellegrini, L. Robol, Journal of Performance of Constructed Facilities, 2019, 33(4) — DOI: 10.1061/(ASCE)CF.1943-5509.0001303.

20. **Fast solvers for Two-dimensional fractional diffusion equations using rank structured matrices**, S. Massei, M. Mazza, L. Robol, SIAM Journal on Scientific Computing,

Volume 41, 2019 — DOI: 10.1137/18M1180803.

21. **Low-rank updates and a divide-and-conquer method for linear matrix equations**, D. Kressner, S. Massei, L. Robol, SIAM Journal on Scientific Computing, Volume 41, 2019 — DOI: 10.1137/17M1161038.

22. **Factoring block Fiedler Companion Matrices**, G. M. Del Corso, F. Poloni, L. Robol, R. Vandebril, Springer INdAM series, 2019 — DOI: 10.1007/978-3-030-04088-8_7.

23. **Quasi-Toeplitz matrix arithmetic: a MATLAB toolbox**, D. A. Bini, S. Massei, and L. Robol, Numerical Algorithms, 81.2, 2019 — DOI: 10.1007/s11075-018-0571-6.

24. **Fast and backward stable computation of the eigenvalues and eigenvectors of matrix polynomials**, J. L. Aurentz, T. Mach, L. Robol, R. Vandebril, D. S. Watkins, Mathematics of Computation, Volume 88, Issue 315, 2018 — DOI: 10.1090/mcom/3338.

25. **Solving rank structured Sylvester and Lyapunov equations**, S. Massei, D. Palitta, and L. Robol, SIAM Journal on Matrix Analysis and Applications, Volume 39 (4), 2018 — DOI: 10.1137/17M1157155.

26. **Fast and backward stable computation of roots of polynomials, Part II: general backward error analysis**, J. L. Aurentz, T. Mach, L. Robol, R. Vandebril, and D. S. Watkins, SIAM Journal on Matrix Analysis and Applications, Volume 39 (3), 2018 — DOI: 10.1137/17M1152802.

27. **On quadratic matrix equations with infinite size coefficients encountered in QBD stochastic processes**, D. A. Bini, S. Massei, B. Meini, L. Robol, Numerical Linear Algebra with Applications, Volume 25, Issue 6, 2018 — DOI: 10.1002/nla.2128.

28. **Solvability and uniqueness criteria for generalized Sylvester-type equations**, F. De Terán, B. Iannazzo, F. Poloni, L. Robol, Linear Algebra and its Applications, Volume 542, April 2018, Pages 501–521 — DOI: 10.1016/j.laa.2017.07.010.

29. **Efficient Ehrlich–Aberth iteration for finding intersections of interpolating polynomials and rational functions**, L. Robol and R. Vandebril, Linear Algebra and its Applications, Volume 542, April 2018, Pages 282–309 — DOI: 10.1016/j.laa.2017.05.010.

Proceedings

30. **FE model updating of masonry towers: Modeling and numerical issues**, R.M. Azzara, M. Girardi, C. Padovani, D. Pellegrini, L. Robol, Proceedings of the International Conference on Structural Dynamic , EURODYN, 2020 — ISBN: 978-618850720-3.

31. **Nonlinear FE model updating for masonry constructions via linear perturbation and modal analysis**, M. Girardi, C. Padovani, D. Pellegrini, L. Robol, COMPDYN Proceedings, 2019 — ISBN: 978-618828446-3.

32. **Stochastic Evaluation of Large Interdependent Composed Models Through Kronecker Algebra and Exponential Sums**, G. Masetti, L. Robol, S. Chiaradonna, F. Di Giandomenico, Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 2019 — ISBN: 978-303021570-5.

33. **Model parameter estimation using Bayesian and deterministic approaches: The case study of the Maddalena Bridge**, A. De Falco, M. Girardi, D. Pellegrini, L. Robol, G. Sevieri, Procedia Structural Integrity, 2018 — DOI: 10.1016/j.prostr.2018.11.028.

34. **FEA for masonry structures and vibration-based model updating using NOSA-ITACA**, M. Girardi, C. Padovani, D. Pellegrini, L. Robol, 10th International Masonry Conference, Milano, 9-11 July 2018.

35. **NOSA-ITACA: a free FE program for historic masonry buildings**, M. Girardi, C. Padovani, D. Pellegrini, L. Robol, CoRASS 2017 - ECCOMAS Conference on Recent Advances in Nonlinear Models - Design and Rehabilitation of Structures (Coimbra, Portugal, 16-17 November 2017) — ISBN: 978-989-96461-8-6.

36. **A multiprecision algorithm for the solution of polynomials and polynomial eigenvalue problems**, D. A. Bini, L. Robol, Proceedings of the 2014 Symposium on Symbolic-

Numeric Computation, 2014 — ISBN: 978-1-4503-2963-7.

Theses

37. **Exploiting rank structures for the numerical treatment of matrix polynomials**, L. Robol, PhD thesis, Scuola Normale Superiore di Pisa, 2015.
38. **A rootfinding algorithm for polynomials and secular equations**, L. Robol, Master thesis, Università di Pisa, 2012.

Software

I develop and contribute to a broad range of software. Most of my contributions are available on my Github page at `https://github.com/robol`.

2011 – Now **MPSolve**, *multiprecision polynomial solver that computes the roots of univariate polynomial at arbirtrary precision*, The project is written in C/C++, and it amounts to more than 50k LOC. The code is open source and available at `http://numpi.dm.unipi.it/software/mpsolve/`. Bindings for several languages (Python, MATLAB, Octave, Fortran, . . .), a desktop user interface, and an Android app are available. The implementation relies on pthreads for parallelism

2017 – Now **cqt-toolbox**, *a MATLAB toolbox to compute with infinite Toeplitz matrices with finite corrections*, `https://github.com/numpi/cqt-toolbox/`

2017 – Now **hm-toolbox**, *a MATLAB toolbox to compute with Hierarchical matrices and HSS, and to solve some kinds of matrix equations*, `https://github.com/numpi/hm-toolbox/`

2017 – Now **NOSA**, *a finite element code for masonry-like structures, with modules for static, dynamic, and modal analysis, as well as support for advanced model updating features*, `http://www.nosaitaca.it/`