

CURRICULUM VITAE

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EDUCATION:

- 08/2016 – 08/2017 **California Institute of Technology (Caltech)**, California, USA.
Postdoctoral scholar in Aerospace. Adviser: Sergio Pellegrino.
- 09/2011 – 07/2016 **Northwestern University**, Illinois, USA
Ph.D degree in Mechanical Engineering.
Dissertation: *Data-driven Multi-scale Analyses of Materials and Structures*. Advisers:
Wing Kam Liu and Ted Belytschko.
GPA: 4.0 out of 4.0.
- 09/2005 – 07/2010 **University of Porto**, Portugal
Integrated B.S./M.S. degree in Mechanical Engineering.
Dissertation: *Meso-Mechanical Model of the Structural Integrity of Advanced Composite Laminates*. Adviser: Pedro Camanho
Graduation with highest honors (1st ranked). Dissertation grade: 20 out of 20.

PROFESSIONAL EXPERIENCE:

- 07/2022 – present **Brown University**, Rhode Island, USA.
Associate Professor in the Solid Mechanics Group of the School of Engineering.
- 04/2021 – 06/2022 **Delft University of Technology (TU Delft)**, The Netherlands.
Associate Professor in the Faculty of Mechanical, Maritime and Materials Engineering.
Director of the Delft Artificial Intelligence lab MACHINA.
- 09/2017 – 03/2021 **Delft University of Technology (TU Delft)**, The Netherlands.
Assistant Professor in the Faculty of Mechanical, Maritime and Materials Engineering.
- 08/2010 – 07/2011 **University of Porto**, Portugal.
Research assistant sponsored by the Portuguese Foundation for Science and Technology.

AWARDS & HONORS:

Research awards:

- 2019 **NWO Veni**. Personal grant from the Netherlands Organization for Scientific Research.
- 2011 – 2016 **FULBRIGHT Ph.D scholarship**.
- 2013 – 2015 **FCT Ph.D scholarship**. Portuguese Foundation for Science and Technology fellowship towards the completion of the Ph.D degree.
- 2012 – 2013 **Ted Belytschko's Walter P. Murphy fellowship**.
- 2012 **PS&ED fellowship**. Predictive Science & Engineering Design fellowship.
- 2010 – 2011 **FCT Research scholarship**. Portuguese Foundation for Science and Technology fellowship for researchers with a M.S. degree.
- 2010 **FCT M.S. scholarship**. Portuguese Foundation for Science and Technology fellowship towards the completion of the M.S. degree.

Teaching awards:

- 2019 **Best instructor** in MSc of Marine Technology (due to MT44010 course).
2014 **Graduate Teaching Fellow**. Highest teaching award attributed to graduate students by Northwestern University. Eight awards attributed in the entire University for this academic year.
2013 **NTAC Workshop Leader** for outstanding Northwestern teaching assistants (TAs).

Outreach awards:

- 2019 **US Embassy in Lisbon Small Alumni grant** for the Bridging Insularity Through STEM (BITS) project. Funding used in Science outreach activities and a Seminar for elementary school students and researchers based in Madeira island.

University of Porto awards:

- 2010 **ColepCCL award**. Award attributed to the student with highest GPA in Mechanical Engineering at the University of Porto.
2006 – 2009 **“FEUP Merit award”** (4 consecutive times in 4 possible). This highly competitive award is the most prestigious prize awarded by the School of Engineering of the University of Porto. No other Mechanical Engineering student, either working towards the B.S. or M.S. degree, has received this award except in year 2009 (which was also attributed to another student).
2006 **“Incentive Prize”**. This award is attributed by the University of Porto to the best students of each school who completed the first year of studies towards a B.S. degree. For the Engineering school 4 students were distinguished.

Travel awards:

- 2015 **USNCCM13 travel award**.

TEACHING EXPERIENCE:

As **Instructor**:

- Q1 2018-2021 **Mechanical Behavior of Materials** (MS43025). Instructor of graduate course in the first quarter of every year of the MSc program in Materials Science at TU Delft. Average of available students' evaluations of role as instructor (since main instructor): **9.29 out of 10**.
Q4 2017-2022 **Non-metallic Materials in Marine Structures** (MT44010). Co-instructor of graduate course in the fourth quarter of every year of the MSc program in Marine Technology at TU Delft. Average of available students' evaluations of role as instructor: **9.3 out of 10**.
Q4 2019-2020 **Project Materials Sciences** (WB2332). Co-instructor of undergraduate course in the fourth quarter of the BSc program in Mechanical Engineering at TU Delft.
Winter 2013 **Advanced Finite Elements I** (ME/CEE-426-1). Co-instructor of graduate course in Mechanical and Civil Engineering at Northwestern University. Students' feedback report: **5.775 out of 6.0**.
S1 2010-2011 **Technical Drawing**. Undergraduate course in Mechanical Engineering at University of Porto. Students' feedback report: **A** – grade given to top 10% of instructors of entire school of engineering during that academic year.

As **Teaching Assistant**:

- Fall 2013 **Multi-scale Modeling and Simulation in Solid Mechanics** (ME 417). Graduate course in Mechanical Engineering at Northwestern University. Instructor: Professor Wing Kam Liu. Students' feedback report: **5.618 out of 6.0**.
Spring 2013 **Advanced Finite Elements II** (ME/CEE-426-2). Graduate course in Mechanical and Civil Engineering at Northwestern University. Instructor: Professor Wing Kam Liu. (No student feedback provided)

As **Tutor**:

- 2008 – 2009 “Projecto FEUP”. Research tutorials to 1st year students at University of Porto.

ASSOCIATIONS:

- 2017 **Executive board member** of the Caltech Postdoctoral Association (outreach coordinator).
- 2015 – 2016 **Founder and president** of the Northwestern student chapter of the U.S. Association for Computational Mechanics.

CONFERENCE PRESENTATIONS & INVITED TALKS:

- 12/01/2022 **Invited talk** (Virtual), BeyondFingerprinting Seminar, Sandia National Laboratory, Albuquerque, NM, USA.
- 11/15/2022 **Invited talk**, Michigan Institute for Computational Discovery and Engineering, Michigan University, Ann Harbor, MI, USA.
- 10/20/2022 **Invited talk**, Aeronautics & Astronautics Department, Stanford University, Stanford, CA, USA.
- 10/17/2022 **Invited talk**, Society of Engineering Science Annual Technical Meeting, College Station, TX, USA.
- 03/28/2022 **Keynote talk & Panel member**, Applied Machine Learning Days, Lausanne, Switzerland (<https://youtu.be/4znrv2V91rI>).
- 12/14/2021 **Invited talk** (Virtual), RAMSES, SISSA, International School for Advanced Studies, Main Campus, Trieste, Italy.
- 12/03/2021 **Invited talk** (Virtual), Department of Mechanical and Civil Engineering, California Institute of Technology, Pasadena, CA, USA.
- 10/15/2021 **Invited live talk** (Virtual), one of five live talks at the Annual Conference of the Society of Engineering Science.
- 09/27/2021 **Keynote talk**, Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering & Technology, an IACM conference, San Diego, CA, USA.
- 09/24/2021 **Plenary lecture** (Virtual), ECCOMAS VIII Conference on Mechanical Response of Composites, Göteborg, Sweden.
- 08/27/2021 (Virtual) 25th International Congress of Theoretical and Applied Mechanics, Milano, Italy.
- 05/18/2021 SIAM Conference on Mathematical Aspects of Materials Science.
- 04/28/2021 **Invited talk** (Virtual), Department of Engineering, University of Cambridge, The United Kingdom.
- 04/22/2021 **Hariri Institute for Computing Distinguished Speaker** (Virtual), Boston, MA, USA (<https://www.youtube.com/watch?v=GWpeGFFXZSM>).
- 03/25/2021 **Invited talk** (Virtual), USACM Thematic Conference: New Trends and Open Challenges in Computational Mechanics: from Nano to Macroscale.
- 03/23/2021 **Invited talk** (Virtual), ConnectinGears, Faculty of Engineering, University of Porto, Portugal.
- 01/11/2021 11th World Congress on Computational Mechanics (Virtual), Paris, France.
- 10/01/2020 **Invited talk** Society of Engineering Science (SES) Virtual Conference, Minneapolis, MN, USA.
- 03/30/2020 **Invited talk** (Virtual), Brown University, Providence, RI, USA.
- 01/22/2020 **Co-organizer** (with P. Reis, M. van Hecke and M. Pauly), CECAM-Lorentz Workshop on “Computing Complex Mechanical Systems”, EPFL, Lausanne, Switzerland.
- 01/21/2020 **Invited talk**, Physics Veldhoven, Veldhoven, The Netherlands.
- 01/17/2020 **Invited talk**, University of Amsterdam, Amsterdam, The Netherlands.
- 07/31/2019 **Semi-plenary lecture (Special Young Investigator)**, 15th U.S. National Congress on Computational Mechanics, Austin, TX, USA (<https://www.youtube.com/watch?v=1deP68tAM2o>).
- 06/24/2019 Pellegrino symposium: University of Cambridge, The United Kingdom.
- 03/10/2019 **Invited talk**, The Minerals, Metals and Materials Society (TMS) conference, San Antonio, TX, USA.
- 01/14/2019 **Invited talk**, AMOLF, Amsterdam, The Netherlands.
- 01/04/2019 Science outreach talk, University of Madeira, Portugal.
- 10/23/2018 **Invited talk**, Department of Engineering, University of Cambridge, The United Kingdom.
- 10/16/2018 **Invited talk**, Department of Computer Science, Technical University of Braunschweig, Germany.

08/17/2018 **Invited talk**, Department of Mechanical Engineering, Ruhr University, Bochum, Germany.

07/23/2018 13th World Congress on Computational Mechanics, New York, NY, USA.

07/02/2018 **Keynote talk**, 10th European Solid Mechanics Conference (ESMC), Bologna, Italy.

06/05/2018 Short-course on “Mechanistic Data-driven Multiscale Analysis and Applications” at USNCTAM 2018, Chicago, IL, USA.

03/26/2018 **Invited talk**, 2nd International Conference on Simulation Technology (SimTech 2018), Stuttgart, Germany.

01/22/2018 **Invited talk**, Department of Mechanical Engineering, TU Eindhoven, The Netherlands.

12/20/2017 **Invited talk**, Advanced Computing for Earth Sciences (ACES 2017), Porto, Portugal.

11/26/2017 **Invited talk**, Department of Mechanical Engineering, University of Paris-Est, Marne-La-Vallée, France.

09/26/2017 Annual symposium of the International Association for Shell and Spatial Structures (IASS 2017), Hamburg, Germany.

07/18/2017 14th U.S. National Congress on Computational Mechanics, Montreal, QC, Canada.

05/02/2017 **Invited talk**, Faculty of Mechanical, Maritime and Materials Engineering, TU Delft, The Netherlands.

03/10/2017 **Invited talk**, Mechanical and Industrial Engineering Department, Northeastern University, Boston, MA, USA.

11/02/2016 **Invited talk**, Aerospace Engineering Department, TU Delft, The Netherlands.

03/30/2016 **Invited talk**, Structural Engineering Department, University of California, San Diego, CA, USA.

03/28/2016 **Invited talk**, Mechanical and Aerospace Engineering Department, University of California, San Diego, CA, USA.

07/27/2015 13th U.S. National Congress on Computational Mechanics, San Diego, CA, USA

07/23/2014 11th World Congress on Computational Mechanics, Barcelona, Spain

07/22/2013 12th U.S. National Congress on Computational Mechanics, Raleigh, NC, USA.

02/26/2012 **Semi-plenary lecture** with Ted Belytschko. Advances in Computational Mechanics – A Conference Celebrating the 70th Birthday of T.J.R. Hughes, San Diego, CA, USA.

PEER-REVIEW ACTIVITIES:

02/2021 – present **Associate Editor**, *Frontiers in Mechanical Engineering – Biomechanical Engineering*.

04/2018 – present **Associate Editor**, *Computer Modeling in Engineering & Sciences* journal.

Referee for *Nature*, *Nature Chemistry*, *Advanced Materials*, *Laser & Photonics Reviews*, *npj Computational Materials*, *Computer Methods in Applied Mechanics and Engineering*, *Computational Mechanics*, *International Journal for Numerical Methods in Engineering*, *Computers & Structures*, *npj 2D Materials and Applications*, *Extreme Mechanics Letters*, *International Journal of Solids and Structures*, *Theoretical and Applied Mechanics Letters*, *Composites Part A*, *Composite Structures*, *Journal of Micro and Nano-Manufacturing*, *Journal of the Mechanical Behavior of Biomedical Materials*, *International Journal of Applied Mechanics*.

JOURNAL PUBLICATIONS:

- [1] D. Shin, A. Cupertino, M. de Jong, P. Steeneken, **M.A. Bessa**, and R. Norte. **Spiderweb Nanomechanical Resonators via Bayesian Optimization: Inspired by Nature and Guided by Machine Learning**. *Advanced Materials*, 34(3):2106248, 2022.
 - Cover article. Believed to be the optomechanical sensor with the World’s highest quality factor at the time of publication.
- [2] B.P. Ferreira, F.M. Andrade Pires, and M.A. Bessa. Adaptivity for clustering-based reduced-order modeling of localized history-dependent phenomena. *Computer Methods in Applied Mechanics and Engineering*, 393:114726, 2022.
- [3] A. Chandrashekar, P. Belardinelli, **M.A. Bessa**, U. Staufer, and F. Alijani. Quantifying nanoscale forces using machine learning in dynamic atomic force microscopy. *Nanoscale Adv.*, 4:2134–2143, 2022.

- [4] G.I. Kuś, S. van der Zwaag, and **M.A. Bessa**. Sparse quantum gaussian processes to counter the curse of dimensionality. *Quantum Machine Intelligence*, 3(1):6–, 2021.
 • Research video: <https://slideslive.com/38944567>.
- [5] P.R. Kuppens, **M.A. Bessa**, J.L. Herder, and J.B. Hopkins. Monolithic binary stiffness building blocks for mechanical digital machines. *Extreme Mechanics Letters*, 42:101120–, 2021.
 • Research video: https://www.youtube.com/watch?v=T5wnomW_CJE
 • STL files for 3D printing: <https://www.thingiverse.com/thing:4759853> .
- [6] P.R. Kuppens, **M.A. Bessa**, J.L. Herder, and J.B. Hopkins. Compliant mechanisms that use static balancing to achieve dramatically different states of stiffness. *J. Mechanisms Robotics*, 13(2):–, January 2021.
- [7] C. Furtado, L. Pereira, R. Tavares, M. Salgado, F. Otero, G. Catalanotti, A. Arteiro, **M.A. Bessa**, and P. Camanho. A methodology to generate design allowables of composite laminates using machine learning. *International Journal of Solids and Structures*, 233:111095, December 2021.
- [8] A. Dekhovich, D. Tax, M. Sluiter, and **M.A. Bessa**. Neural network relief: a pruning algorithm based on neural activity. *arXiv preprint arXiv:2109.10795*, 2021.
- [9] W. Zhang, R. Bostanabad, B. Liang, X. Su, D. Zeng, **M.A. Bessa**, Y. Wang, W. Chen, and J. Cao. A numerical bayesian-calibrated characterization method for multiscale prepreg preforming simulations with tension-shear coupling. *Composites Science and Technology*, 170:15 – 24, 2019.
- [10] **M.A. Bessa**, P. Glowacki, and M. Houlder. **Bayesian Machine Learning in Metamaterial Design: Fragile Becomes Supercompressible**. *Advanced Materials*, 31(48):1904845, 2019.
 • Top 10% most read articles in Adv. Mater. in Jan. 2018 – Dec. 2019, despite being published in Oct. 14, 2019.
 • Featured in the media, e.g. Popular Mechanics, phys.org, deeplearning.ai
 • Research video: <https://www.youtube.com/watch?v=cWTWHhMAu7I>.
- [11] M. Mozaffar, R. Bostanabad, W. Chen, K. Ehmann, J. Cao, and **M.A. Bessa**. **Deep learning predicts path-dependent plasticity**. *Proceedings of the National Academy of Sciences*, 116(52):26414–26420, 2019.
 • Classified as “highly cited paper” by Web of Science: top 1% of the academic field of Engineering based on a highly cited threshold for the field and publication year.
- [12] A. Arteiro, L.F. Pereira, **M.A. Bessa**, C. Furtado, and P.P. Camanho. A micro-mechanics perspective to the invariant-based approach to stiffness. *Composites Science and Technology*, 176:72 – 80, 2019.
- [13] **M.A. Bessa** and S. Pellegrino. **Design of ultra-thin shell structures in the stochastic post-buckling range using Bayesian machine learning and optimization**. *International Journal of Solids and Structures*, 139-140:174 – 188, 2018.
- [14] L.F. Varandas, A. Arteiro, **M.A. Bessa**, A.R. Melro, and G. Catalanotti. The effect of through-thickness compressive stress on mode ii interlaminar crack propagation: A computational micromechanics approach. *Composite Structures*, 182(Supplement C):326–334, 2017.
- [15] **M.A. Bessa**, R. Bostanabad, Z. Liu, A. Hu, Daniel W. Apley, C. Brinson, W. Chen, and Wing Kam Liu. **A framework for data-driven analysis of materials under uncertainty: Countering the curse of dimensionality**. *Computer Methods in Applied Mechanics and Engineering*, 320:633 – 667, 2017.
 • Classified as “highly cited paper” by Web of Science: top 1% of the academic field of Computer Science based on a highly cited threshold for the field and publication year.
- [16] C. Leclerc, L.L. Wilson, **M.A. Bessa**, and S. Pellegrino. Characterization of ultra-thin composite triangular rollable and collapsible booms. In *4th AIAA Spacecraft Structures Conference*, page 0172, 2017.
- [17] C. Furtado, A. Arteiro, **M.A. Bessa**, B.L. Wardle, and P.P. Camanho. Prediction of size effects in open-hole laminates using only the young’s modulus, the strength, and the r-curve of the 0° ply. *Composites Part A: Applied Science and Manufacturing*, 101:306 – 317, 2017.
- [18] J. Zhao, **M.A. Bessa**, J. Oswald, Z. Liu, and T. Belytschko. A method for modeling the transition of weak discontinuities to strong discontinuities: from interfaces to cracks. *International Journal for Numerical Methods in Engineering*, 105(11):834–854, 2016.

- [19] R.P. Tavares, A.R. Melro, **M.A. Bessa**, A. Turon, W.K. Liu, and P.P. Camanho. Mechanics of hybrid polymer composites: analytical and computational study. *Computational Mechanics*, 57(3):405–421, 2016.
- [20] Z. Meng, **M.A. Bessa**, W. Xia, W.K. Liu, and S. Keten. Predicting the macroscopic fracture energy of epoxy resins from atomistic molecular simulations. *Macromolecules*, 49(24):9474–9483, 2016.
- [21] Z. Liu, **M.A. Bessa**, and Wing Kam Liu. **Self-consistent clustering analysis: An efficient multi-scale scheme for inelastic heterogeneous materials.** *Computer Methods in Applied Mechanics and Engineering*, 306:319 – 341, 2016.
 - Classified as “highly cited paper” by Web of Science: top 1% of the academic field of Computer Science based on a highly cited threshold for the field and publication year.
- [22] Z.P. Bazant, W. Luo, V.T. Chau, and **M.A. Bessa**. Wave dispersion and basic concepts of peridynamics compared to classical nonlocal damage models. *Journal of Applied Mechanics*, 83(11):111004–111004, August 2016.
- [23] N. Vu-Bac, **M.A. Bessa**, T. Rabczuk, and W.K. Liu. **A Multiscale Model for the Quasi-Static Thermo-Plastic Behavior of Highly Cross-Linked Glassy Polymers.** *Macromolecules*, 48(18):6713–6723, 2015.
- [24] X. Bai, **M.A. Bessa**, A.R. Melro, P.P. Camanho, L. Guo, and W. K. Liu. High-fidelity micro-scale modeling of the thermo-visco-plastic behavior of carbon fiber polymer matrix composites. *Composite Structures*, 134:132 – 141, 2015.
- [25] **M.A. Bessa**, J.T. Foster, T. Belytschko, and Wing Kam Liu. **A meshfree unification: reproducing kernel peridynamics.** *Computational Mechanics*, 53(6):1251–1264, 2014.
- [26] P.P. Camanho, **M.A. Bessa**, G. Catalanotti, M. Vogler, and R. Rolfes. Modeling the inelastic deformation and fracture of polymer composites – part ii: Smearred crack model. *Mechanics of Materials*, 59(0):36 – 49, 2013.

BOOK CHAPTERS:

- G. Catalanotti, L.F. Varandas, António R. Melro, T.A. Sebaey, **M.A. Bessa**, and B.G. Falzon. Modelling the longitudinal failure of fibre-reinforced composites at microscale. In Wim Van Paepegem, editor, *Woodhead Publishing Series in Composites Science and Engineering*, Chapter 12, pages 349–378. Woodhead Publishing, 2021.
- J.S. Chen, W.K. Liu, M.C. Hillman, S.W. Chi, Y. Lian, and **M.A. Bessa**. Reproducing Kernel Approximation and Discretization. *Encyclopedia of Computational Mechanics, Second Edition* [Erwin Stein, René de Borst, and Thomas J. R. Hughes Eds.], John Wiley & Sons, Ltd., Chapter 20, pp. 1–41, 2017.
- Z. Dai, **M.A. Bessa**, Shaofan Li, and Wing Kam Liu. Particle method modeling of nonlocal multiresolution continua. In Michael Griebel and Marc Alexander Schweitzer, editors, *Meshfree Methods for Partial Differential Equations VII*, volume 100 of *Lecture Notes in Computational Science and Engineering*, pages 43–60. Springer International Publishing, 2015.

BOOKS:

- **M.A. Bessa**, K.I. Elkhodary, W.K. Liu, T. Belytschko, and B. Moran. *Nonlinear Finite Elements for Continua and Structures: Solution Manual*. Wiley, 2013.

December 20, 2022