Stanford

Christian Linder

Professor of Civil and Environmental Engineering and, by courtesy, of Mechanical Engineering

CONTACT INFORMATION

- **Administrator**

  Kim Vonner - Administrative Associate

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Bio

BIO

Christian Linder is a Professor of Civil and Environmental Engineering and, by courtesy, of Mechanical Engineering. Through the development of novel and efficient in-house computational methods based on a sound mathematical foundation, the research goal of the Computational Mechanics of Materials (CM2) Lab at Stanford University, led by Dr. Linder, is to understand micromechanically originated multi-scale and multi-physics mechanisms in solid materials undergoing large deformations and fracture. Applications include sustainable energy storage materials, flexible electronics, and granular materials.

Dr. Linder received his Ph.D. in Civil and Environmental Engineering from UC Berkeley, an MA in Mathematics from UC Berkeley, an M.Sc. in Computational Mechanics from the University of Stuttgart, and a Dipl.-Ing. degree in Civil Engineering from TU Graz. Before joining Stanford in 2013 he was a Junior-Professor of Micromechanics of Materials at the Applied Mechanics Institute of Stuttgart University where he also obtained his Habilitation in Mechanics. Notable honors include a Fulbright scholarship, the 2013 Richard-von-Mises Prize, the 2016 ICCM International Computational Method Young Investigator Award, the 2016 NSF CAREER Award, and the 2019 Presidential Early Career Award for Scientists and Engineers (PECASE).

ACADEMIC APPOINTMENTS

- Professor, Civil and Environmental Engineering
- Professor (By courtesy), Mechanical Engineering
- Member, Bio-X
- Member, Institute for Computational and Mathematical Engineering (ICME)
- Member, Wu Tsai Neurosciences Institute

HONORS AND AWARDS

- 2019 Presidential Early Career Award for Scientists and Engineers, White House Office of Science and Technology (2019)
- 2016 NSF CAREER Award, National Science Foundation (2016)
- 2016 ICCM Young Investigator Award, International Conference on Computational Methods (2016)
- Richard-von-Mises Prize, International Association of Applied Mathematics and Mechanics (2013)

- Haythornthwaite Research Initiation Award, ASME Applied Mechanics Division. (2013)

PROFESSIONAL EDUCATION

- Habilitation, University of Stuttgart , Mechanics (2012)
- PhD, UC Berkeley , Computational Mechanics (2007)
- MA, UC Berkeley , Mathematics (2006)
- MSc, University of Stuttgart , Computational Mechanics of Materials and Structures (2003)
- Dipl.-Ing., Graz University of Technology , Civil and Environmental Engineering (2001)

LINKS

- Linder Lab: https://cm2.stanford.edu

Teaching

COURSES

2023-24

- Mechanics of Materials: CEE 101A (Win)
- Solid Mechanics: CEE 291 (Aut)

2022-23

- Mechanics of Materials: CEE 101A (Win)
- Solid Mechanics: CEE 291 (Aut)

2021-22

- Computational Solid Mechanics: CEE 310 (Spr)
- Mechanics of Materials: CEE 101A (Win)
- Solid Mechanics: CEE 291 (Aut)

2020-21

- Computational Fracture Mechanics: CEE 306 (Spr)
- Mechanics of Materials: CEE 101A (Win)
- Solid Mechanics: CEE 291 (Aut)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Wei Chen, Sabrina Ip, Enrique del Castillo

Doctoral Dissertation Advisor (AC)

Sina Abrari Vajari, Prajwal Kammardi Arunachala, Ryan McAvoy

Master's Program Advisor

Anna Cecil, Marshall Kobylski, Andrew Wang, Tingyu Wang, Yuan Xiang, Jinchen Xie, Zexi Yin, Yuecheng Yu

Publications

PUBLICATIONS

- **Investigation of driving forces in a phase field approach to mixed mode fracture of concrete** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*

Vajari, S., Neuner, M., Arunachala, P., Linder, C.
2023; 417

- **A multiscale phase field fracture approach based on the non-affine microsphere model for rubber-like materials** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*
  Arunachala, P., Vajari, S., Neuner, M., Linder, C.
  2023; 410
- **A thermodynamically consistent finite strain phase field approach to ductile fracture considering multi-axial stress states** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*
  Vajari, S., Neuner, M., Arunachala, P., Ziccarelli, A., Deierlein, G., Linder, C.
  2022; 400
- **Energy based fracture initiation criterion for strain-crystallizing rubber-like materials with pre-existing cracks** *JOURNAL OF THE MECHANICS AND PHYSICS OF SOLIDS*
  Arunachala, P., Rastak, R., Linder, C.
  2021; 157
- **A non-affine micro-macro approach to strain-crystallizing rubber-like materials** *JOURNAL OF THE MECHANICS AND PHYSICS OF SOLIDS*
  Rastak, R., Linder, C.
  2018; 111: 67–99
- **On the enhancement of low-order mixed finite element methods for the large deformation analysis of diffusion in solids** *INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN ENGINEERING*
  Krischok, A., Linder, C.
  2016; 106 (4): 278-297
- **Tri-layer wrinkling as a mechanism for anchoring center initiation in the developing cerebellum** *SOFT MATTER*
  Lejeune, E., Javili, A., Weickenmeier, J., Kuhl, E., Linder, C.
  2016; 12 (25): 5613-5620
- **Computational aspects of growth-induced instabilities through eigenvalue analysis** *COMPUTATIONAL MECHANICS*
  Javili, A., Dortdivanlioglu, B., Kuhl, E., Linder, C.
  2015; 56 (3): 405-420
- **All-electron Kohn-Sham density functional theory on hierarchic finite element spaces** *JOURNAL OF COMPUTATIONAL PHYSICS*
  Schauer, V., Linder, C.
  2013; 250: 644-664
- **Effect of electric displacement saturation on the hysteretic behavior of ferroelectric ceramics and the initiation and propagation of cracks in piezoelectric ceramics** *JOURNAL OF THE MECHANICS AND PHYSICS OF SOLIDS*
  Linder, C., Miehe, C.
  2012; 60 (5): 882-903
- **The maximal advance path constraint for the homogenization of materials with random network microstructure** *PHILOSOPHICAL MAGAZINE*
  Tkachuk, M., Linder, C.
  2012; 92 (22): 2779-2808
- **A micromechanically motivated diffusion-based transient network model and its incorporation into finite rubber viscoelasticity** *JOURNAL OF THE MECHANICS AND PHYSICS OF SOLIDS*
  Linder, C., Tkachuk, M., Miehe, C.
  2011; 59 (10): 2134-2156
- **Finite elements with embedded strong discontinuities for the modeling of failure in solids** *INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN ENGINEERING*
  Linder, C., Armero, F.
  2007; 72 (12): 1391-1433
- **Plane strain problem of flexoelectric cylindrical inhomogeneities** *INTERNATIONAL JOURNAL OF SOLIDS AND STRUCTURES*
  Xie, J., Linder, C.
  2024; 289

- **Analysis of Flexoelectric Solids With a Cylindrical Cavity** *JOURNAL OF APPLIED MECHANICS-TRANSACTIONS OF THE ASME*
  Xie, J., Linder, C.
  2024; 91 (1)
- **Highly stretchable polymer semiconductor thin films with multi-modal energy dissipation and high relative stretchability.** *Nature communications*
  Wu, H. C., Nikzad, S., Zhu, C., Yan, H., Li, Y., Niu, W., Matthews, J. R., Xu, J., Matsuhisa, N., Arunachala, P. K., Rastak, R., Linder, C., Zheng, et al
  2023; 14 (1): 8382
- **An analytical model for nanoscale flexoelectric doubly curved shells** *MATHEMATICS AND MECHANICS OF SOLIDS*
  Xie, J., McAvoy, R., Linder, C.
  2023
- **SenseNet: A Physics-Informed Deep Learning Model for Shape Sensing** *JOURNAL OF ENGINEERING MECHANICS*
  Qiu, Y., Arunachala, P., Linder, C.
  2023; 149 (3)
- **A better understanding of the mechanics of borehole breakout utilizing a finite strain gradient-enhanced micropolar continuum model** *COMPUTERS AND GEOTECHNICS*
  Neuner, M., Vajari, S., Arunachala, P. K., Linder, C.
  2023; 153
- **A unified finite strain gradient-enhanced micropolar continuum approach for modeling quasi-brittle failure of cohesive-frictional materials** *INTERNATIONAL JOURNAL OF SOLIDS AND STRUCTURES*
  Neuner, M., Regueiro, R. A., Linder, C.
  2022; 254
- **Understanding thermal and mechanical effects on lithium plating in lithium-ion batteries** *JOURNAL OF POWER SOURCES*
  Qiu, Y., Zhang, X., Usubelli, C., Mayer, D., Linder, C., Christensen, J.
  2022; 541
- **A Modified Electrochemical Model to Account for Mechanical Effects Due to Lithium Intercalation and External Pressure** *JOURNAL OF THE ELECTROCHEMICAL SOCIETY*
  Zhang, X., Klinsmann, M., Chumakov, S., Li, X., Kim, S., Metzger, M., Besli, M. M., Klein, R., Linder, C., Christensen, J.
  2021; 168 (2)
- **Strain-insensitive intrinsically stretchable transistors and circuits** *NATURE ELECTRONICS*
  Wang, W., Wang, S., Rastak, R., Ochiai, Y., Niu, S., Jiang, Y., Arunachala, P., Zheng, Y., Xu, J., Matsuhisa, N., Yan, X., Kwon, S., Miyakawa, et al
  2021
- **Swelling-Induced Interface Crease Instabilities at Hydrogel Bilayers** *JOURNAL OF ELASTICITY*
  Dortdivanlioglu, B., Yilmaz, N., Goh, K. B., Zheng, X., Linder, C.
  2021
- **An Electro-chemo-thermo-mechanical Coupled Three-dimensional Computational Framework for Lithium-ion Batteries** *JOURNAL OF THE ELECTROCHEMICAL SOCIETY*
  Zhang, X., Chumakov, S., Li, X., Klinsmann, M., Kim, S., Linder, C., Christensen, J.
  2020; 167 (16)
- **Interpreting stochastic agent-based models of cell death** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*
  Lejeune, E., Linder, C.
  2020; 360
- **Three-dimensional explicit finite element formulation for shear localization with global tracking of embedded weak discontinuities** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*
  Jin, T., Mourad, H. M., Bronkhorst, C. A., Livescu, V., Zhang, X., Linder, C., Regueiro, R. A.
  2019; 353: 416–47
- **Strain- and Strain-Rate-Invariant Conductance in a Stretchable and Compressible 3D Conducting Polymer Foam** *MATTER*
  Chen, G., Rastak, R., Wang, Y., Yan, H., Feig, V., Liu, Y., Jiang, Y., Chen, S., Lian, F., Molina-Lopez, F., Jin, L., Cui, K., Chung, et al
  2019; 1 (1): 205–18

- **Diffusion-driven swelling-induced instabilities of hydrogels** *JOURNAL OF THE MECHANICS AND PHYSICS OF SOLIDS*
  Dortdivanlioglu, B., Linder, C.
  2019; 125: 38–52

- **Understanding the mechanical link between oriented cell division and cerebellar morphogenesis.** *Soft matter*
  Lejeune, E., Dortdivanlioglu, B., Kuhl, E., Linder, C.
  2019

- **Evaluation of convective heat transfer coefficient and specific heat capacity of a lithium-ion battery using infrared camera and lumped capacitance method** *JOURNAL OF POWER SOURCES*
  Zhang, X., Klein, R., Subbaraman, A., Chumakov, S., Li, X., Christensen, J., Linder, C., Kim, S.
  2019; 412: 552–58

- **Modeling mechanical inhomogeneities in small populations of proliferating monolayers and spheroids.** *Biomechanics and modeling in mechanobiology*
  Lejeune, E., Linder, C.
  2018; 17 (3): 727–43

- **Area of lineal-path function for describing the pore microstructures of cement paste and their relations to the mechanical properties simulated from mu-CT microstructures** *CEMENT & CONCRETE COMPOSITES*
  Han, T., Zhang, X., Kim, J., Chung, S., Lim, J., Linder, C.
  2018; 89: 1–17

- **Microstructural origin of resistance-strain hysteresis in carbon nanotube thin film conductors** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Jin, L., Chortos, A., Lian, F., Pop, E., Linder, C., Bao, Z., Cai, W.
  2018; 115 (9): 1986–91

- **PREFACE: MULTISCALE COMPUTATIONAL ANALYSIS OF COMPLEX MATERIALS** *INTERNATIONAL JOURNAL FOR MULTISCALE COMPUTATIONAL ENGINEERING*
  Mishnaevsky, L., Linder, C., Sun, W.
  2018; 16 (4): V-VI

- **Computational aspects of morphological instabilities using isogeometric analysis** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*
  Dortdivanlioglu, B., Javili, A., Linder, C.
  2017; 316: 261-279

- **A highly stretchable, transparent, and conductive polymer.** *Science advances*
  Wang, Y., Zhu, C., Pfattner, R., Yan, H., Jin, L., Chen, S., Molina-Lopez, F., Lissel, F., Liu, J., Rabiah, N. I., Chen, Z., Chung, J. W., Linder, et al
  2017; 3 (3)

- **Modeling tumor growth with peridynamics.** *Biomechanics and modeling in mechanobiology*
  Lejeune, E., Linder, C.
  2017

- **Quantifying the relationship between cell division angle and morphogenesis through computational modeling.** *Journal of theoretical biology*
  Lejeune, E., Linder, C.
  2017; 418: 1-7

- **Highly stretchable polymer semiconductor films through the nanoconfinement effect** *SCIENCE*
  Xu, J., Wang, S., Wang, G. N., Zhu, C., Luo, S., Jin, L., Gu, X., Chen, S., Feig, V. R., To, J. W., Rondeau-Gagne, S., Park, J., Schroeder, et al
  2017; 355 (6320): 59-?

- **A variational framework to model diffusion induced large plastic deformation and phase field fracture during initial two-phase lithiation of silicon electrodes** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*
  Zhang, X., Krischok, A., Linder, C.
  2016; 312: 51-77

- **A highly stretchable autonomous self-healing elastomer** *NATURE CHEMISTRY*
  Li, C., Wang, C., Keplinger, C., Zuo, J., Jin, L., Sun, Y., Zheng, P., Cao, Y., Lissel, F., Linder, C., You, X., Bao, Z.
  2016; 8 (6): 619-625

- **A highly stretchable autonomous self-healing elastomer.** *Nature chemistry*
  Li, C., Wang, C., Keplinger, C., Zuo, J., Jin, L., Sun, Y., Zheng, P., Cao, Y., Lissel, F., Linder, C., You, X., Bao, Z.
  2016; 8 (6): 618-624
- **Understanding geometric instabilities in thin films via a multi-layer model.** *Soft matter*
  Lejeune, E., Javili, A., Linder, C.
  2016; 12 (3): 806-816
- **A micromechanical model with strong discontinuities for failure in nonwovens at finite deformations** *INTERNATIONAL JOURNAL OF SOLIDS AND STRUCTURES*
  Raina, A., Linder, C.
  2015; 75-76: 247-259
- **The reduced basis method in all-electron calculations with finite elements** *ADVANCES IN COMPUTATIONAL MATHEMATICS*
  Schauer, V., Linder, C.
  2015; 41 (5): 1035-1047
- **A Complex Variable Solution Based Analysis of Electric Displacement Saturation for a Cracked Piezoelectric Material** *JOURNAL OF APPLIED MECHANICS-TRANSACTIONS OF THE ASME*
  Linder, C.
  2014; 81 (9)
- **Three-dimensional finite elements with embedded strong discontinuities to model failure in electromechanical coupled materials** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*
  Linder, C., Zhang, X.
  2014; 273: 143-160
- **A homogenization approach for nonwoven materials based on fiber undulations and reorientation** *JOURNAL OF THE MECHANICS AND PHYSICS OF SOLIDS*
  Raina, A., Linder, C.
  2014; 65: 12-34
- **A homogenization approach for nonwoven materials based on fiber undulations and reorientation** *Journal of the Mechanics and Physics of Solids. Accepted for publication*
  Raina, A., Linder, C.
  2014
- **A marching cubes based failure surface propagation concept for three-dimensional finite elements with non-planar embedded strong discontinuities of higher-order kinematics** *INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN ENGINEERING*
  Linder, C., Zhang, X.
  2013; 96 (6): 339-372
- **A strong discontinuity approach on multiple levels to model solids at failure** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*
  Linder, C., Raina, A.
  2013; 253: 558-583
- **Modeling reorientation phenomena in nonwoven materials with random fiber network microstructure.**
  Raina, A., Linder, C.
  2013
- **3D finite elements to model electromechanical coupled solids at failure.**
  Linder, C.
  2013
- **An analysis of the exponential electric displacement saturation model in fracturing piezoelectric ceramics.** *Technische Mechanik.*
  Linder, C.
  2012; 32: 53-69
- **Homogenization of random elastic networks with non-affine kinematics.**
  Tkachuk, M., Linder, C.

2012

- **New three-dimensional finite elements with embedded strong discontinuities to model solids at failure.**
  Zhang, X., Linder, C.
  2012
- **Modeling quasi-static crack growth with the embedded finite element method on multiple levels.**
  Raina, A., Linder, C.
  2012
- **All-electron calculations with finite elements.**
  Schauer, V., Linder, C.
  2012
- **New finite elements with embedded strong discontinuities for the modeling of failure in electromechanical coupled solids** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*
  Linder, C., Rosato, D., Miehe, C.
  2011; 200 (1-4): 141-161
- **Microstructural driven computational modeling of polymers.**
  Tkachuk, M., Linder, C.
  2011
- **Finite element solution of the Kohn-Sham equations.**
  Schauer, V., Linder, C.
  2011
- **A strong discontinuity based adaptive refinement approach for the modeling of crack branching.**
  Raina, A., Linder, C.
  2011
- **Modeling crack micro-branching using finite elements with embedded strong discontinuities.**
  Raina, A., Linder, C.
  2010
- **Numerical simulation of dynamic fracture using finite elements with embedded discontinuities** *INTERNATIONAL JOURNAL OF FRACTURE*
  Armero, F., Linder, C.
  2009; 160 (2): 119-141
- **Finite elements with embedded branching** *20th Annual Robert J Melosh Conference*
  Linder, C., Armero, F.
  ELSEVIER SCIENCE BV.2009: 280–93
- **Numerical modeling of dynamic fracture.**
  Armero, F., Linder, C.
  2009
- **New finite elements with embedded strong discontinuities in the finite deformation range** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*
  Armero, F., Linder, C.
  2008; 197 (33-40): 3138-3170
- **Numerical simulation of dynamic fracture using finite elements with embedded discontinuities.** *Report No. UCB/SEMM-2008/01, Department of Civil and Environmental Engineering*
  Armero, F., Linder, C.
  2008
- **On configurational compatibility and multiscale energy momentum tensors** *JOURNAL OF THE MECHANICS AND PHYSICS OF SOLIDS*
  Li, S., Linder, C., Foulk, J. W.
  2007; 55 (5): 980-1000

- **Recent developments in the formulation of finite elements with embedded strong discontinuities** *IUTAM Symposium on Discretization Methods for Evolving Discontinuities*
  Armero, F., Linder, C.
  SPRINGER.2007: 105–122
- **New finite elements with embedded strong discontinuities for the modeling of failure in solids.** *Ph.D. Thesis, Department of Civil and Environmental Engineering*
  Linder, C.
  2007
- **Application of differential topology for the derivation of compatibility conservation laws in mechanics.** *M.A. Thesis, Department of Mathematics, University of California*
  Linder, C.
  2006
- **Finite elements with strong discontinuities.** *Qualifying Report, Department of Civil and Environmental Engineering*
  Linder, C.
  2005
- **Analogy model for the axisymmetric elastic edge bending problem in shells of revolution based on Geckeler's approximation.**
  Guggenberger, W., Linder, C.
  2004
- **An arbitrary Lagrangian-Eulerian finite element formulation for dynamics and finite strain plasticity models.** *M.Sc. Thesis, Computational Mechanics of Materials and Structures, University of Stuttgart.*
  Linder, C.
  2003
- **Elastic stress analysis of axisymmetric discontinuities in shells of revolution by an effective ring analogy model.**
  Guggenberger, W., Linder, C.
  2003