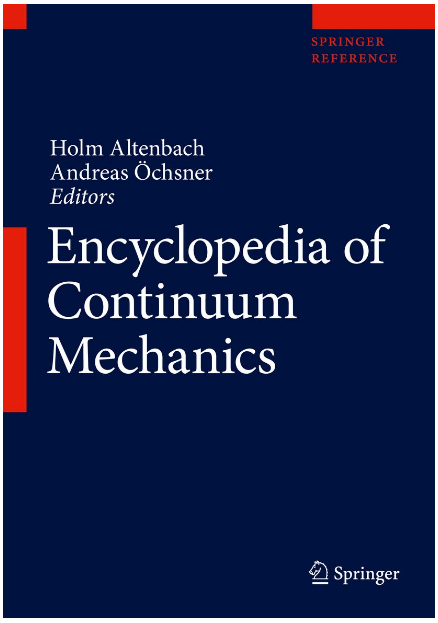

1st ed. 2019, 2400 p.

Printed book

Hardcover

Ca. 999,00 € | Ca. £899.50 | Ca. $1,350.00
[1]Ca. 1.068,93 € (D) | Ca. 1.098,90 € (A) | Ca. CHF 1'331,30

E-reference work

Ca. 1.188,81 € | Ca. £1,079.40 | Ca. $1,350.00
Ca. 1.188,81 € (D) | Ca. 1.188,81 € (A) | Ca. CHF 1'331,26

Book with Online Access

Ca. 1.860,00 € | Ca. £1,630.00 | Ca. $2,239.00
Ca. 2.063,85 € (D) | Ca. 2.083,20 € (A) | Ca. CHF 2'044,50

Springer Reference

Holm Altenbach, Andreas Öchsner (Eds.)

Encyclopedia of Continuum Mechanics

- Assembles for the first time the concepts and tools for the entire science of continuum mechanics
- Offers a clear and well-structured reference with over than 600 entries
- Includes topics from a wide range in solid mechanics and fluid mechanics
- Serves as an interdisciplinary nexus for engineers, e.g. mechanical, civil and aerospace), materials scientists and applied mathematicians

This Encyclopedia covers the entire science of continuum mechanics including the mechanics of materials and fluids. The encyclopedia comprises mathematical definitions for continuum mechanical modeling, fundamental physical concepts, mechanical modeling methodology, numerical approaches and many fundamental applications. The modelling and analytical techniques are powerful tools in mechanical civil and areospsace engineering, plus in related fields of plasticity, viscoelasticity and rheology. Tensor-based and reference-frame-independent, continuum mechanics has recently found applications in geophysics and materials. This three-volume encyclopedia comprises approximately uniform 600 entries.

Encyclopedia of Continuum Mechanics
Living Edition
| Editors: Holm Altenbach, Andreas Öchsner

Variational Principles in Numerical Practice

- Authors
- Authors and affiliations

- Ugo Andreaus
- Ivan Giorgio

- Ugo Andreaus
  - 1

Email author

- Ivan Giorgio
  - 2

1 1.DISGUniversity of Rome La SapienzaRomeItaly
2 2.International Research Center M&MoCSL'AquilaItaly

Living reference work entry

First Online: 06 December 2017
DOI: https://doi.org/10.1007/978-3-662-53605-6_175-1

Synonyms

Bone-resorbable graft interaction; Dissipation in concrete; PEM vibration damping

Definitions

Variational principles represent a general framework for determining the mechanical state of a system, by identifying its motion as a minimum of a pertinent functional. Moreover, finite element methods are naturally based on variational principles and provide a very powerful tool for numerically solving many mechanical as well as other multi-physics problems. The purpose of the present note is to illustrate some recent applications with special reference to biomechanics and dissipation in quasi-brittle materials and piezo-electromechanical structures, in order to confirm the validation and to highlight the bright prospects of this method.

Introduction

Theoretical elegance of the variational approach applied to mechanical problems has long been extensively and thoroughly formalized in fundamental scientific works (Landau and Lifshitz, 1976; Marsden et al., 2001; Berdichevsky, 2009;...

References

1. Alessandroni S, dell'Isola F, Frezza F (2001) Optimal piezo-electro-mechanical coupling to control plate vibrations. Int J Appl Electromagn Mech 13(1–4):113–120Google Scholar

2. Alessandroni S, dell'Isola F, Porfiri M (2002) A revival of electric analogs for vibrating mechanical systems aimed to their efficient control by PZT actuators. Int J Solids Struct 39(20):5295–5324Google Scholar

3. Alessandroni S, Andreaus U, dell'Isola F, Porfiri M (2004) Piezo-electromechanical (PEM) Kirchhoff–Love plates. Eur J Mech A Solids 23(4):689–702Google Scholar

4. Alessandroni S, Andreaus U, dell'Isola F, Porfiri M (2005) A passive electric controller for multimodal vibrations of thin plates. Comput Struct 83(15):1236–1250Google Scholar

5. Andreaus U, Giorgio I, Madeo A (2015) Modeling of the interaction between bone tissue and resorbable biomaterial as linear elastic materials with voids. Z Angew Math Phys 66(1):209–237. https://doi.org/10.1007/s00033-014-0403-z MathSciNetCrossRefMATHGoogle Scholar

6. Batra RC, dell'Isola F, Vidoli S, Vigilante D (2005) Multimode vibration suppression with passive two-terminal distributed network incorporating piezoceramic transducers. Int J Solids Struct 42(11):3115–3132Google Scholar

7. Berdichevsky V (2009) Variational principles of continuum mechanics: I. Fundamentals. Springer Science & Business Media, Berlin/HeidelbergMATHGoogle Scholar

8. Biot MA (1962) Mechanics of deformation and acoustic propagation in porous media. J Appl Phys 33(4):1482–1498. https://doi.org/10.1063/1.1728759 MathSciNetCrossRefMATHGoogle Scholar

9. Bowland AG, Weyers RE, Charney FA, Dowling NE, Murray TM, Ramniceanu A (2012) Effect of vibration amplitude on concrete with damping additives. ACI Mater J 109(3):371–378Google Scholar

10. Cazzani A, Malagù M, Turco E (2016a) Isogeometric analysis of plane-curved beams. Math Mech Solids 21(5):562–577. https://doi.org/10.1177/1081286514531265 MathSciNetCrossRefMATHGoogle Scholar

11. Cazzani A, Malagù M, Turco E, Stochino F (2016b) Constitutive models for strongly curved beams in the frame of isogeometric analysis. Math Mech Solids 21:183–209. https://doi.org/10.1177/1081286515577043 MathSciNetMATHGoogle Scholar

12. Cowin SC (1999) Bone poroelasticity. J Biomech 32(3):217–238. https://doi.org/10.1016/S0021-9290(98)00161-4

13. dell'Isola F, Porfiri M, Vidoli S (2003a) Piezo-electromechanical (PEM) structures: passive vibration control using distributed piezoelectric transducers. Comptes Rendus Mecanique 331(1):69–76Google Scholar

14. dell'Isola F, Santini E, Vigilante D (2003b) Purely electrical damping of vibrations in arbitrary PEM plates: a mixed non-conforming FEM-Runge-Kutta time evolution analysis. Arch Appl Mech 73(1–2):26–48Google Scholar

15. dell'Isola F, Andreaus U, Placidi L (2015) At the origins and in the vanguard of peridynamics, non-local and higher-gradient continuum mechanics: an underestimated and still topical contribution of Gabrio Piola. Math Mech Solids 20(8):887–928. https://doi.org/10.1177/1081286513509811

16. Den Hartog JP (1947) Mechanical vibrations. McGraw-Hall Book Company, New YorkMATHGoogle Scholar

17. Eugster SR, dell'Isola F (2017) Exegesis of the introduction and sect. I from "Fundamentals of the Mechanics of Continua"** by E. Hellinger. ZAMM-Zeitschrift für Angewandte Mathematik und Mechanik 97(4):477–506Google Scholar

18. Giorgio I, Scerrato D (2017) Multi-scale concrete model with rate-dependent internal friction. Eur J Environ Civil Eng 21(7–8):821–839CrossRefGoogle Scholar

19. Giorgio I, Culla A, Del Vescovo D (2009) Multimode vibration control using several piezoelectric transducers shunted with a multiterminal network. Arch Appl Mech 79(9):859–879CrossRefMATHGoogle Scholar

20. Giorgio I, Galantucci L, Della Corte A, Del Vescovo D (2015) Piezo-electromechanical smart materials with distributed arrays of piezoelectric transducers: current and upcoming applications. Int J Appl Electromagn Mech 47(4):1051–1084CrossRefGoogle Scholar

21. Giorgio I, Andreaus U, Scerrato D, dell'Isola F (2016) A visco-poroelastic model of functional adaptation in bones reconstructed with bio-resorbable materials. Biomech Model Mechanobiol 15(5):1325–1343. https://doi.org/10.1007/s10237-016-0765-6

22. Greco L, Cuomo M (2014) An implicit G1 multi patch B-spline interpolation for Kirchhoff–Love space rod. Comput Methods Appl Mech Eng 269:173–197. https://doi.org/10.1016/j.cma.2013.09.018 CrossRefMATHGoogle Scholar

23. Greco L, Cuomo M (2016) An isogeometric implicit G1 mixed finite element for Kirchhoff space rods. Comput Methods Appl Mech Eng 298:325–349. https://doi.org/10.1016/j.cma.2015.06.014 CrossRefGoogle Scholar

24. Landau L, Lifshitz E (1976) Mechanics: volume 1 (course of theoretical physics), 3rd edn. Pergamon Press, OxfordGoogle Scholar

25. Lekszycki T, dell'Isola F (2012) A mixture model with evolving mass densities for describing synthesis and resorption phenomena in bones reconstructed with bio-resorbable materials. Z Angew Math Mech 92(6):426–444. https://doi.org/10.1002/zamm.201100082

26. Marsden JE, Pekarsky S, Shkoller S, West M (2001) Variational methods, multisymplectic geometry and continuum mechanics. J Geom Phys 38(3):253–284MathSciNetCrossRefMATHGoogle Scholar

27. Misra A (1998) Stabilization characteristics of clays using class C fly ash. Transp Res Rec: J Transp Res Board 1611:46–54CrossRefGoogle Scholar

28. Oliveto G, Cuomo M (1988) Incremental analysis of plane frames with geometric and material nonlinearities. Eng Struct 10(1):2–12CrossRefGoogle Scholar

29. Scerrato D, Giorgio I, Madeo A, Limam A, Darve F (2014) A simple non-linear model for internal friction in modified concrete. Int J Eng Sci 80:136–152MathSciNetCrossRefGoogle Scholar

Copyright information

Section editors and affiliations

- Francesco dell'Isola
  - 1

1 1.Dipartimento di Ingegneria, Strutturale e GeotecnicaUniversità di Roma "La Sapienza"RomaItalia

How to cite

Cite this entry as:

Andreaus U., Giorgio I. (2018) Variational Principles in Numerical Practice. In: Altenbach H., Öchsner A. (eds) Encyclopedia of Continuum Mechanics. Springer, Berlin, Heidelberg

About this entry

CrossMark

- **DOI** https://doi.org/10.1007/978-3-662-53605-6
- **Publisher Name** Springer, Berlin, Heidelberg
- **Online ISBN** 978-3-662-53605-6
- **eBook Packages** Engineering