Francesco Costanzo

Curriculum Vitæ

Address:	Center for Neural Engineering W-315 Millennium Science Complex The Pennsylvania State University University Park, PA 16802
Phone:	+ 1 814 863-2030
FAX:	+ 1 814 865-9974
E-Mail:	fmcostanzo@psu.edu
Web:	http://www.esm.psu.edu
Rank:	Full Professor
Years of Full-Time Faculty Service:	22

Education

- Ph.D., Aerospace Engineering,
  Texas A&M University (College Station, Texas), December 1993.
  Chairman of Degree Committee: Dr. David H. Allen.

- Laurea, Aeronautical Engineering, *cum laude*,
  Politecnico di Milano (Milan, Italy), July 1989.
  Chairman of Degree Committee: Dr. Vittorio Giavotto.

Professional Positions

- **Professor of Engineering Science and Mechanics**,
  Department of Engineering Science and Mechanics,
  Professor of Mathematics,
  Department of Mathematics,
  Professor of Mechanical & Nuclear Engineering,
  Department of Mechanical & Nuclear Engineering, and
  Professor of Biomedical Engineering.
  The Pennsylvania State University: July 2016–Present.

- Professor of Engineering Science and Mechanics,
  Department of Engineering Science and Mechanics,
  Professor of Mathematics,
  Department of Mathematics, and
  Professor in the *Intercollege Graduate Degree Program in Bioengineering*
  The Pennsylvania State University: August 2015–February 2016;

- Professor of Engineering Science and Mechanics,
  Department of Engineering Science and Mechanics, and

Professor of Mathematics,
Department of Mathematics
The Pennsylvania State University: August 2009–July 2015;

- Associate Professor of Engineering Science and Mechanics,
  Department of Engineering Science and Mechanics, and
  Associate Professor of Mathematics,
  Department of Mathematics
  The Pennsylvania State University: August 2006–July 2009;

- Associate Professor of Engineering Science and Mechanics,
  Department of Engineering Science and Mechanics,
  The Pennsylvania State University: July 2001–July 2006;

- Assistant Professor of Engineering Science and Mechanics,
  Department of Engineering Science and Mechanics,
  The Pennsylvania State University: August 1995–June 2001;

- Lecturer and Senior Research Associate,
  Department of Mathematics,
  Texas A&M University: June 1994–July 1995;

- Senior Research Associate,
  Department of Aerospace Engineering,
  Texas A&M University: February 1994–June 1994;

Research Interests

- Brain Biomechanics, Mechanical Behavior of Biological Tissues and of Blood
- Computational Microacoustofluidics
- Fluid-Structure Interaction and Transport Problems in Biology and Medicine
- Computational Mechanics
- Multi-scale Mechanics and Mechanics of Materials with Complex Micro/Nano-Structure
- Time Dependent Fracture and Damage Mechanics of Composites
- Molecular Dynamics
- Continuum Thermodynamics
- Heterogeneous Systems with Evolving Interfaces
- Micromechanics and Homogenization of Inelastic Composites

Research and Publications

Recent Significant Accomplishments in Research

Professor Costanzo's research in computational mechanics has focused on the development of computational tools rooted in the physics of the problems. The following publications highlight his most recent major accomplishments in research.

(i) Costanzo F. and S. T. Miller (2017), "An Arbitrary Lagrangian–Eulerian Finite Element Formulation for a Poroelasticity Problem Stemming from Mixture Theory", *Computer Methods in Applied Mechanics and Engineering*, **323**, pp. 64–97, DOI: 10.1016/j.cma.2017.05.006.

A central problem in brain physiology is the transport of metabolites produced by cell functions in brain tissue from their production site to the main cerebrospinal fluid compartment. The modeling of these transport phenomena has traditionally focused on Fickian diffusion within the extracellular space. More recent studies point to the existence of pathways for metabolite exchange with significant convective transport. Furthermore, evidence indicates that such convective component is driven by the pulsatile motion of arterial walls along the various elements of the brain vascular tree. These hypotheses need to be tested both against basic physiological and metabolical processes that rely on transport in brain parenchyma. They must also be tested against the mechanics of both difffusion and convection. This paper is the first rigorous result in the formulation of a stable and accurate numerical framework that can sort out the relative importance of the convective and diffusive contributions to transport in brain by resolving the individual velocity fields of the interstitial fluid, vs. that of the surrounding tissue, vs. that of possible specific ionic species or neurotransmitters that one might be interested in tracking. This paper is foundational and future work will focus on testing adding diffusive transport and considering physiological relevant scenarios to be compared with experiments. The National Science Foundation recently recommended for funding a project with F. Costanzo as the PI to complete the task in question.

(ii) Nama, N., T. J. Huang, and F. Costanzo (2017), "Acoustic Streaming: A Lagrangian–Eulerian Perspective", *Journal of Fluid Mechanics*, **825**, pp. 600–630, DOI: 10.1017/jfm.2017.338.

The propagation of acoustic waves in fluids is the basis for a plethora of lab-on-a-chip applications, with the consequent prospect of revolutionizing point-of-care diagnostics in biomedical applications. While there have been many recent reports on the physics in confined resonant chamber, the physical understanding of acoustically-driven fluid and particle motion in confined leaky systems is limited. Not only is there a strong need for a mathematical and numerical framework in support of the devices in question, but there is also a need for the identification of "canonical" or benchmark experiments that can be used to validate the theoretical framework. This paper lays the foundation for the analysis of microacoustofluidics by switching the framing of the problem from its traditional Eulerian view to an arbitrary Lagrangian-Eulerian formulation. This may seem a simple reformulation without modification of the underlying physics and therefore an exercise without much practical merit. However, this is not the case. Theoretical microacoustofluidics is, at its core, a homogenization problems in time. Specifically, it consists in identifying dominant space and time scales and then using asymptotic expansions to create a cascade of boundary-value problems whose orders are defined by the separation of the identified scales. When used in practice, these expansions are truncated so as to consist of only on a finite number of problems. Therefore, the problems generated by difference kinematic frameworks yields different problems. In this paper we argue for the first time that an ALE perspective allows one to provide transparency to the boundary conditions used, the latter being only approximate in Eulerian formulations. In addition, the ALE formulation yields governing equations for the slow streaming that have less stringent regularity requirements compared to those yielded by the Eulerian framework. In very recent work, we have already provided practical results that demonstrated that the ALE formulation of the problems yields qualitative and quantitative results that are much closer to experimental results, so much so that the identification of an experimental benchmark problem seems now within reach.[*] Furthermore, we have demonstrated improved orders of convergence of the correspondent numerical implementation.[†] Continuation of this work in ongoing and corresponding publications are under review and in preparation.

(iii) Roy, S., L. Heltai, and F. Costanzo (2015), "Benchmarking the Immersed Finite Element Method for Fluid-Structure Interaction Problems", *Computers and Mathematics with Applications*, **69**(10), pp. 1167–1188. DOI: 10.1016/j.camwa.2015.03.012.

FSI problems are very challenging to solve numerically and there are not closed-form solutions that can be generated (say, with the method of manufactured solutions) for the purpose of assessing convergence and computational efficiency. In lieu of closed-formed solutions, the FSI community has *de facto* agreed to use as benchmarks a collection of numerical tests compiled by Tureck and Hron in 2006. The significance of the above work is that, until now, no immersed method was ever been shown to strictly conform to the Tureck-Hron benchmarks. Costanzo's group is the first to have produced results conforming to these benchmarks with an immersed method. This accomplishment is extraordinarily important in the FSI community.

(iv) Nama, N., R. Barnkob, Z. Mao, C. J. Kähler, F. Costanzo, and T. J. Huang (2015), "Numerical Study of Acoustophoretic Motion of Particles in a PDMS Microchannel Driven by Surface Acoustic Waves", *Lab on a Chip*, in press. DOI: 10.1039/C5LC00231A; PMID: 26001199.

This paper is focused on the prediction of the forces acting on particles suspended in a streaming flow within a microacoustofluidic device. Studies of the effects of *bulk* waves are common. However, the acoustophoretic properties of flows activated by *surface* acoustic waves are scarce. This paper represents a first rigorous computational study of such motions. This work fits in a general theme of FSI and is currently being generalized to predict the motion of soft inclusions such as cells in microacoustofluidic devices for the purpose of quantifying their mechanical properties.

(v) Nama, N., P.-H. Huang, T. J. Huang, and F. Costanzo (2014), "Investigation of Acoustic Streaming Patterns around Oscillating Sharp Edges", *Lab on a Chip*, **14**(15), pp. 2824–2836. DOI: 10.1039/c4lc00191e; PMID: 24903475; PMCID: PMC4096312.

Microacoustofluidics deals with the creation of controlled flow patterns for fluids in channels

[*]Barnkob, R., N. Nama, L. Ren, T. J. Huang, F. Costanzo and C. J. KÃďhler (2016), "Acoustophoresis in Soft-Walled Microchannels Driven by Surface Acoustic Waves," Flow17 for Microfluidics, Annual Conference on the Fundamentals and Applications of micro- and nanofluidics, July 3–5, 2017, Paris-Sorbonne and Pierre-and-Marie Curie (UPMC) Universités, Paris, France.

[†]Costanzo, F., N. Nama, and T. J. Huang (2017), "An Arbitrary Lagrangian-Eulerian Approach to Acoustic Streaming," 14th U.S. National Congress on Computational Mechanics (USNCCM), United States Association for Computational Mechanics (USACM), July 17–20, 2017, Montreal, Canada.

with micron-sized lumen diameter. The flow is activated by high-frequency piezoelectric actuators that "shake" the channel and, along with the primary harmonic response, activate fluid flows that are not harmonic and result from the interplay between the dissipative nature of the fluids and the compressible part of their constitutive response. Slow drifts activated by harmonic excitation of fluid have been studied for a long time, but not at the micro-level. More importantly, this field has not received a careful analytical and numerical treatment leaving a large number of technical difficult problems unsolved. This paper predicts streaming flows in a micro-mixer whose channels have walls with has sharp edges. The key innovation here is a singularity analysis for fluid flows analogous to that of stress fields around crack tips in linear elasticity.

(vi) Costanzo, F. and J. G. Brasseur (2013), "The Invalidity of the Laplace Law for Biological Vessels and of Estimating Elastic Modulus from Total Stress vs. Strain: a New Practical Method", *Mathematical Medicine & Biology*, first published online: September 25, 2013, DOI: 10.1093/imammb/dqt020.

Various mechanical tests are performed *in vivo* in a clinical setting on tubular organs, like the esophagus. Because of the intrinsic limitations of tests done on live human subjects, these tests provided only limited information. More importantly, for various reasons, the information collected in a clinical setting is routinely interpreted via formulas that are appealing to non-mechanicians, but that are compromised by the quasi-incompressibility of the tissue and the presence of residual stress. In this context, the above paper has provided a re-analysis of the inflation and extension tests of circular cylinders and a re-interpretation of the data collected by common tests so to provide new formulas for the mechanistically correct estimation of the effective shear modulus of the tissue. The formulas in question require exactly the same input as current clinical practices. However, they present clinicians with a paradigm shift in which the estimate of the tangent moduli (information that is polluted in a quasi-incompressible context) is now replaced by the correct estimation of the tissue's shear modulus. The work in this paper has the potential to have an strong impact in clinical practice in that it provides clinicians with a methodology to correctly assess the elastic response of tissues of tubular organs in live patients. Drs. Brasseur and Costanzo are now collaborating on an outreach effort to publicize the new methodology to clinicians.

(vii) Heltai, L. and F. Costanzo (2012), "Variational Implementation of Immersed Finite Element Methods", *Computer Methods in Applied Mechanics and Engineering*, **229–232**, pp. 110–127, DOI: 10.1016/j.cma.2012.04.001.

Fluid structure interaction problems in biomedical applications are challenging because one must often model objects that are fully immersed in a fluid and that undergo large displacements and rotations in addition to large strains. For example, such is the motion of red blood cells in going from arteries, to arterioles, to capillaries. Immersed methods, originally developed by C. Peskin in the late 1970s for the modeling of blood flow in the heart, have proven to be far more flexible for biomedical applications than more traditional ALE approaches. Peskin's approach and later generalizations have suffered from strong limitations, such as the requirement that the immersed body be incompressible with the same density as the surrounding fluid, the latter also incompressible. The significance of the above paper is the generation of an FEM scheme that is not limited by constitutive assumptions on either the fluid or the solid. Also, it is the first paper that presents a formal proof of the numerical stability of the method. For this reasons the above is a major contribution in the FSI literature.

Publications

Refereed Papers

1. Costanzo, F. and D. H. Allen (1993) "A Continuum Mechanics Approach to Some Problems in Subcritical Crack Propagation", *International Journal of Fracture*, **63**(1), pp. 27–57, DOI: 10.1007/BF00053315.

2. Boyd, J. G., F. Costanzo, and D. H. Allen (1993) "A Micromechanics Approach for Constructing Locally Averaged Damage Dependent Constitutive Equations in Inelastic Composites", *International Journal of Damage Mechanics*, **2**(3), pp. 209–228, DOI: 10.1177/105678959300200303.

3. Lo, D. C., F. Costanzo, M. A. Zocher, and D. H. Allen (1993) "Modeling of Damage Evolution in Thick Laminates Subjected to Low Velocity Impact", in *Mechanics of Thick Composites* (Y. D. S. Rajapakse, ed.), **162**, The American Society of Mechanical Engineers (ASME), pp. 137–150.

4. Costanzo, F. and D. H. Allen (1995) "A Continuum Thermodynamic Analysis of Cohesive Zone Models", *International Journal of Engineering Science*, **33**(15), pp. 2197–2219, DOI: 10.1016/0020-7225(95)00066-7.

5. Costanzo, F., J. G. Boyd, and D. H. Allen (1996) "Micromechanics and Homogenization of Inelastic Composites Materials with Growing Cracks", *Journal of the Mechanics and Physics of Solids*, **44**(3), pp. 333–370, DOI: 10.1016/0022-5096(95)00082-8.

6. Costanzo, F. and J. R. Walton (1997) "A Study of Dynamic Crack Growth in Elastic Materials Using a Cohesive Zone Model", *International Journal of Engineering Science*, **35**(12–13), pp. 1085–1114, DOI: 10.1016/S0020-7225(97)00030-X.

7. Costanzo, F. and J. R. Walton (1998) "Numerical Simulations of a Dynamically Propagating Crack with a Nonlinear Cohesive Zone", *International Journal of Fracture*, **91**(4), pp. 373–389, DOI: 10.1023/A:1007494031596.

8. Costanzo, F. (1998) "A Continuum Theory of Cohesive Zone Models: Deformation and Constitutive Equations", *International Journal of Engineering Science*, **36**(15), pp. 1763–1792, DOI: 10.1016/S0020-7225(98)00025-1.

9. Costanzo, F. and J. R. Walton (1998) "A Numerical Solution Technique for a Class of Integro-Differential Equations in Elastodynamic Crack Propagation Problems", *Computer Methods in Applied Mechanics and Engineering*, **162**(1–4), pp. 19–48, DOI: 10.1016/S0045-7825(97)00328-9.

10. Gray, G. L. and F. Costanzo (1999) "The Interactive Classroom and its Integration into the Mechanics Curriculum", *International Journal of Engineering Education*, **15**(1), pp. 41–50.

11. Caiazzo, A. A. and F. Costanzo (2000) "On the Constitutive Relations of Materials with Evolving Microstructure due to Microcracking", *International Journal of Solids and Structures*, **37**(24), pp. 3375–3398, DOI: 10.1016/S0020-7683(99)00150-X.

12. Costanzo, F. and G. L. Gray (2000) "On the Implementation of Interactive Dynamics", *International Journal of Engineering Education*, **16**(5), pp. 385–393.

13. Caiazzo, A. A. and F. Costanzo (2000) "On the Effective Elastic Properties of Composites with Evolving Microcracking", *Journal of Reinforced Plastics and Composites*, **19**, pp. 152–163, DOI: 10.1106/DAM0-VTAY-8PVA-G0B1.

14. Caiazzo, A. A. and F. Costanzo (2001) "Effective 3D Constitutive Relations of Composites with Evolving Damage", *Journal of Engineering Mechanics*, **127**(7), pp. 661–666, DOI: 10.1061/(ASCE)0733-9399(2001)127:7(661).

15. Caiazzo, A. A. and F. Costanzo (2001) "Modeling the Constitutive Behavior of Layered Composites with Evolving Cracks", *International Journal of Solids and Structures*, **38**(20), pp. 3469–3485, DOI: 10.1016/S0020-7683(00)00229-8.

16. Costanzo, F. (2001) "An Analysis of 3D Crack Propagation Using Cohesive Zone Models and the Theory of Configurational Forces", *Mathematics and Mechanics of Solids*, **6**(2), pp. 149–173, DOI: 10.1177/108128650100600203.

17. Costanzo, F. and J. R. Walton (2002) "Steady Growth of a Crack with a Temperature Sensitive Cohesive Zone", *Journal of the Mechanics and Physics of Solids*, **50**, pp. 1649–1679, DOI: 10.1016/S0022-5096(01)00139-9.

18. Huang, H. and F. Costanzo (2002) "On the Use of Space–Time Finite Elements in the Solution of Elasto-Dynamic Problems with Strain Discontinuities", *Computer Methods in Applied Mechanics and Engineering*, **191**(46), pp. 5315–5343, DOI: 10.1016/S0045-7825(02)00460-7.

19. Costanzo, F. and G. L. Gray (2003) "Creating Labeled Stand-Alone Figures in LaTeX using `WARMreader` and Adobe Illustrator under Mac OS X", *TUGboat*, **24**(1), pp. 39–49, issue of the TUGboat journal containing the proceedings of the *Twenty-fourth Annual Meeting of the TeX users group*, Waikiloa, Hawai'i, July 20–24, 2003.

20. Gray, G. L. and F. Costanzo (2003) "Experiences and Lessons Learned Teaching LaTeX to University Students", *TUGboat*, **24**(1), pp. 124–131, issue of the TUGboat journal containing the proceedings of the *Twenty-fourth Annual Meeting of the TeX users group*, Waikiloa, Hawai'i, July 20–24, 2003.

21. Song, J. H., F. Costanzo, and B. L. Lee (2004) "Fatigue of Cord-Rubber Composites: V. Cord Reinforcement Effect", *Rubber Chemistry and Technology*, **77**(4), pp. 593–610, DOI: 10.5254/1.3547839.

22. Costanzo, F., G. L. Gray, and P. C. Andia (2004) "On the Notion of Average Mechanical Properties in MD Simulation via Homogenization", *Modelling and Simulation in Materials Science and Engineering*, **12**, pp. S333–S345, DOI: 10.1088/0965-0393/12/4/S04.

23. Huang, H. and F. Costanzo (2004) "On the Use of Space-time Finite Elements in the Solution of Elasto-Dynamic Fracture Problems", *International Journal of Fracture*, **127**(2), pp. 119–146, DOI: 10.1023/B:FRAC.0000035071.30893.bb.

24. Andia, P. C., F. Costanzo, and G. L. Gray (2005) "A Lagrangian-Based Continuum Homogenization Approach Applicable to Molecular Dynamics Simulations", *International Journal of Solids and Structures*, **42**(24–25), pp. 6409–6432, DOI: 10.1016/j.ijsolstr.2005.05.027.

25. Costanzo, F., G. L. Gray, and P. C. Andia (2005) "On the Definitions of Effective Stress and Deformation Gradient for Use in MD: Hill's Macro-Homogeneity and the Virial

Theorem", *International Journal of Engineering Science*, **43**(7), pp. 533–555, DOI: 10.1016/j.ijengsci.2004.12.002.

26. Costanzo, F. and H. Huang (2005) "Proof of Unconditional Stability for a Single-Field Discontinuous Galerkin Finite Element Formulation for Linear Elasto-Dynamics", *Computer Methods in Applied Mechanics and Engineering*, **194**(18–20), pp. 2059–2076, DOI: 10.1016/j.cma.2004.07.011.

27. Randow, C. L., G. L. Gray, and F. Costanzo (2006) "A Directed Continuum Model of Micro- and Nano-scale Thin Films", *International Journal of Solids and Structures*, **43**(5), pp. 1253–1275, DOI: 10.1016/j.ijsolstr.2005.03.064.

28. Andia, P. C., F. Costanzo, and G. L. Gray (2006) "A Classical Mechanics Approach to the Determination of the Stress-Strain Response of Particle Systems", *Modelling and Simulation in Materials Science and Engineering*, **14**(4), pp. 741–757, DOI: 10.1088/0965-0393/14/4/015.

29. Khalmanova, D. K. and F. Costanzo (2008) "A Space-Time Discontinuous Galerkin Finite Element Method for Fully Coupled Linear Thermo-Elasto-Dynamic Problems with Strain and Heat Flux Discontinuities", *Computer Methods in Applied Mechanics and Engineering*, **197**(13–16), pp. 1323–1342, DOI: 10.1016/j.cma.2007.11.005.

30. Miller, S. T. and F. Costanzo (2009) "A Numerical Verification for an Unconditionally Stable FEM for Elastodynamics", *Computational Mechanics*, **43**(2), pp. 223–237, DOI: 10.1007/s00466-008-0298-7.

31. Pitt, J. S. and F. Costanzo (2009) "An Adaptive *h*-Refinement Algorithm for Local Damage Models", *Algorithm*, **2**(4), pp. 1281–1300, /DOI: 10.3390/a2041281—www.mdpi.com/journal/algorithms.

32. Litzinger, T., P. Van Meter, C. M. Firetto, L. J. Passmore, C. B. Masters, S. R. Turns, G. L. Gray, F. Costanzo, and S. E. Zappe (2010), "A Cognitive Study of Problem Solving in Statics", *Journal of Engineering Education*, **9**(4), pp. 337–353.

33. Heltai, L. and F. Costanzo (2012), "Variational Implementation of Immersed Finite Element Methods", *Computer Methods in Applied Mechanics and Engineering*, **229–232**, pp. 110–127, DOI: 10.1016/j.cma.2012.04.001.

34. Chindam, C., N. Nama, M. I. Lapsley, F. Costanzo, and T. J. Huang (2013), "Theory and Experiment on Resonant Frequencies of Liquid-Air Interfaces Trapped in Microfluidic Devices", *Journal of Applied Physics*, **114**, pp. 194503-1–194503-7. DOI: 10.1063/1.4827425; PMID: 24343156; PMCID: PMC3855064.

35. Ding, X., P. Li, S.-C. S. Lin, Z. S. Stratton, N. Nama, F. Guo, D. Slotcavage, X. Mao, J. Shi, F. Costanzo, and T. J. Huang (2013), "Surface Acoustic Wave Microfluidics", *Lab on a Chip*, **13**, pp. 3626–3649. DOI: 10.1039/C3LC50361E.

36. Heltai, L., S. Roy and F. Costanzo (2014), "A Fully Coupled Immersed Finite Element Method for Fluid Structure Interaction via the Deal.II Library", *Archive for Numerical Software*, **2**(1), pp. 1–17.

37. Nama, N., P.-H. Huang, T. J. Huang, and F. Costanzo (2014), "Investigation of Acoustic Streaming Patterns around Oscillating Sharp Edges", *Lab on a Chip*, **14**(15), pp. 2824–2836. DOI: 10.1039/c4lc00191e; PMID: 24903475; PMCID: PMC4096312.

38. Mao, Z., F. Guo, Y. Xie, Z. Yanhui, M. I. Lapsley, J. D. H. Mai, F. Costanzo, and T. J. Huang (2015), "Label-Free Measurements of Reaction Kinetics using a Droplet-Based Optofluidic Device", *Journal of Laboratory Automation*, **20**(1), pp. 17–24, First published online September 23, 2014. DOI: 10.1177/2211068214549625; PMID: 25249275.

39. Xie, Y., C. Chindam, N. Nama, S. Yang, M. Lu, Y. Zhao, J. D. Mai, F. Costanzo, and T. J. Huang (2015), "Exploring Bubble Oscillation and Mass Transfer Enhancement in Acoustic-Assisted Liquid-Liquid Extraction with a Microfluidic Device", *Scientific Reports*, **5**, pp. 12572-1–12572-9. DOI: 10.1038/srep12572; PMID: 26223474; PMCID: PMC4519785. `http://www.nature.com/articles/srep12572`.

40. Roy, S., L. Heltai, and F. Costanzo (2015), "Benchmarking the Immersed Finite Element Method for Fluid-Structure Interaction Problems", *Computers and Mathematics with Applications*, **69**(10), pp. 1167–1188. DOI: 10.1016/j.camwa.2015.03.012

41. Costanzo, F. and J. G. Brasseur (2015), "The Invalidity of the Laplace Law for Biological Vessels and of Estimating Elastic Modulus from Total Stress vs. Strain: a New Practical Method", *Mathematical Medicine & Biology*, **32**(1), pp. 1–37, advance access publication on September 25, 2013. DOI: 10.1093/imammb/dqt020; PMID: 24071531.

42. Nama, N., R. Barnkob, Z. Mao, C. J. Kähler, F. Costanzo, and T. J. Huang (2015), "Numerical Study of Acoustophoretic Motion of Particles in a PDMS Microchannel Driven by Surface Acoustic Waves", *Lab on a Chip*, **15**(12):2700–2709. DOI: 10.1039/C5LC00231A; PMID: 26001199.

43. Nama, N., P.-H. Huang, T. J. Huang, and F. Costanzo (2016), "Investigation of Micromixing by Acoustically Oscillated Sharp-edges", *Biomicrofluidics*, **10**(2), pp. 024124-1–024124-17. DOI: 10.1063/1.4946875; PMID: 27158292; PMCID: PMC4833753.

44. Xie, Y., N. Nama, P. Li, Z. Mao, P.-H. Huang, C. Zhao, F. Costanzo, and T. J. Huang (2016), "Probing Cell Deformability via Acoustically Actuated Bubbles", *Small*, **12**(7), pp. 902–910, DOI: 10.1002/smll.201502220; PMID: 26715211.

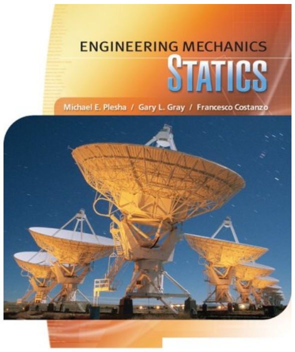
45. Mao, Z., Y. Xie, F. Guo, L. Ren, P.-H. Huang, Y. Chen, J. Rufo, F. Costanzo, and T. J. Huang (2016), "Experimental and Numerical Studies on Standing Surface Acoustic Wave Microfluidics", *Lab on a Chip*, **16**(3), pp. 515–524. DOI: 10.1039/c5lc00707k; PMID: 26698361.

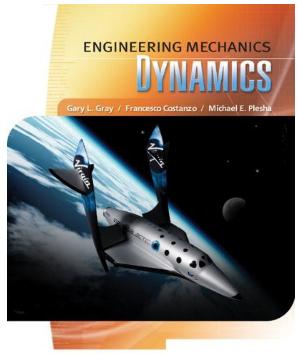
46. Mao, Z. M., P. Li, M. X. Wu, H. Bachman, N. Mesyngier, X. S. Guo, F. Liu, F. Costanzo, and T. J. Huang (2017), "Enriching Nanoparticles via Acoustofluidics", *ACS Nano*, **11**(1) , pp. 603–612. DOI: 10.1021/acsnano.6b06784; PMID: 28068078.

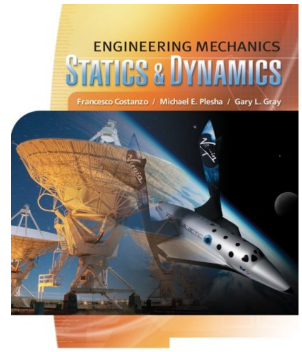
47. Costanzo F. and S. T. Miller (2017), "An Arbitrary Lagrangian?Eulerian Finite Element Formulation for a Poroelasticity Problem Stemming from Mixture Theory", *Computer Methods in Applied Mechanics and Engineering*, **323**, pp. 64–97, DOI: 10.1016/j.cma.2017.05.006.

48. Nama, N., T. J. Huang, and F. Costanzo (2017), "Acoustic Streaming: A Lagrangian–Eulerian Perspective", *Journal of Fluid Mechanics*, **825**, pp. 600–630, /DOI: 10.1017/jfm.2017.338.

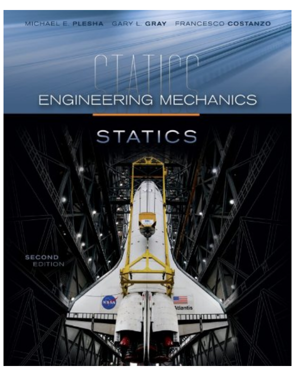
Books

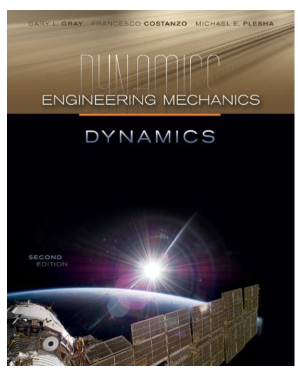


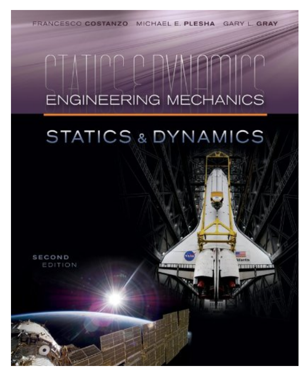




1. Plesha, M. E., G. L. Gray, and F. Costanzo (2009), *Engineering Mechanics: Statics*, McGraw-Hill Higher Education. ISBN-13 978-0077275532, No. of pages: 704.
2. Gray, G. L., F. Costanzo, and M. E. Plesha (2009), *Engineering Mechanics: Dynamics*, McGraw-Hill Higher Education. ISBN-13 978-0077275549, No. of pages: 784.
3. Costanzo, F., M. E. Plesha, and G. L. Gray (2009), *Engineering Mechanics: Statics & Dynamics*, McGraw-Hill Higher Education. ISBN-13 978-0073134123, No. of pages: 1376.







4. Plesha, M. E., G. L. Gray, and F. Costanzo (2013), *Engineering Mechanics: Statics, 2nd Edition*, McGraw-Hill Higher Education. ISBN-10: 0073380296, ISBN-13: 9780073380292, 736 pages.
5. Gray, G. L., F. Costanzo, and M. E. Plesha (2013), *Engineering Mechanics: Dynamics, 2nd Edition*, McGraw-Hill Higher Education. ISBN-10: 007338030X, ISBN-13 9780073380308, 800 pages.
6. Costanzo, F., M. E. Plesha, and G. L. Gray (2013), *Engineering Mechanics: Statics & Dynamics, 2nd Edition*, McGraw-Hill Higher Education. ISBN-10: 0073380318, ISBN-13: 9780073380315, 1504 pages.

Parts of Books

1. Gray, G. L. and F. Costanzo (2007) "Toward a New Approach to Teaching Problem Solving in Dynamics," Chapter 9 in the book entitled *Learning to Solve Complex, Scientific Problems*, edited by David H. Jonassen, Lawrence Erlbaum Associates, pp. 205–222, ISBN: 0805859187.

2. Costanzo, F. and G. L. Gray (2007) "A Micro-Mechanics-Based Notion of Stress for use in the Determination of Continuum-Level Mechanical Properties via Molecular Dynamics," Chapter 5 in the book entitled *Multiscale Modeling and Simulation of Composite Materials and Structures*, edited by Y. Kwon, D. H. Allen, and R. Talreja, Springer-Verlag, pp. 203–234. ISBN-13: 9780387363189.

3. Roy, S., L. Heltai, C. S. Drapaca, and F. Costanzo (2013), *An immersed finite element method approach for brain biomechanics, in Mechanics of Biological Systems and Materials*, Volume 5, B. C. Prorok, F. Barthelat, C. S. Korach, K. J. Grande-Allen, E. Lipke, G. Lykofatitits, and P. Zavattieri, eds., Conference Proceedings of the Society for Experimental Mechanics Series, Springer, New York, pp. 79–86. DOI: 10.1007/978-1-4614-4427-5 12.

4. Ding, X. Y., P. Li, S.-C. S. Lin, Z. S. Stratton, N. Nama, F. Guo, D. Slotcavage, X. L. Mao, J. J. Shi, F. Costanzo, T. Franke, A. Wixforth, and T. J. Huang (2015), "Lab-on-a-chip Technologies Enabled by Surface Acoustic Waves," Chapter 15 in *Microscale Acoustofluidics*, L. Thomas and L. Andreas, eds., The Royal Society of Chemistry, pp. 354–398. DOI: 10.1039/9781849737067.

5. Nguyen, D. Y., R. T. Tran, F. Costanzo, and J. Yang (2015), "Tissue Engineered Peripheral Nerve Guide Fabrication Techniques", in *Nerves and Nerve Injuries*, R. S. Tubbs, E. Rizk, M. Shoja, M. Loukas, M. Spinner, and N. Barbaro, Eds., Vol. 2, Academic Press, Ch. 60, pp. 969–990.

Conference Proceedings

1. F. Costanzo, J. G. Boyd, and D. H. Allen (1993), "Homogenization of Inelastic Composite Materials With Growing Cracks," in *Proceedings of The Fourth International Symposium on Plasticity and its Current Applications*, Baltimore MD, July 1993.

2. Lo, D. C., F. Costanzo, and D. H. Allen (1995) "Delamination Evolution in Composites using a Cohesive Zone Model," in *Proceedings of ICES-95: International Conference on Computational Engineering Science* (S. N. Atluri, G. Yagawa, and T. A. Cruise, eds.), Mauna Lani, Big Island of Hawai'i, July 30–August 3.

3. Caiazzo, A. A. and F. Costanzo (1998) "On the Effective Elastic Properties of Composites with Evolving Microcracking," in *Proceedings of the Eighth Japan-U.S. Conference on Composite Materials* (G. M. Newaz and R. F. Gibson, eds.), September 24–25, 1998, Baltimore (MD), Technomic Publishing Co., Lancaster (PA), pp. 275–284.

4. Costanzo F. and G. L. Gray (1998), "Interactive Dynamics." Proceeding of the *Workshop on Reform of Undergraduate Education*, hosted by the Engineering Mechanics Faculty of The Pennsylvania State University, August 16–18, University Park, (PA), 8 pages, no page numbers.

5. Costanzo, F. and G. L. Gray (1999) "Collaborative Learning in Undergraduate Dynamics Courses: Some Examples," in *1999 ASEE Annual Conference and Exposition*, Charlotte, North Carolina, June 10–13, CD-ROM only, 12 pages, no page numbers. Available electronically at: `<http://www.asee.org/conferences/search/>`.

6. Yaeger, P. M., R. M. Marra, G. L. Gray, and F. Costanzo (1999) "Assessing New Ways of Learning Undergraduate Dynamics: An Ongoing Program to Improve Teaching," in *1999 ASEE Annual Conference and Exposition*, Charlotte, North Carolina, June 10–13, CD-ROM only, 10 pages, no page numbers. Available electronically at: `<http://www.asee.org/conferences/search/>`.

7. Gray, G. L. and F. Costanzo (1999) "Interactive Dynamics: A Collaborative Approach to Learning Undergraduate Dynamics," in *1999 ASEE Annual Conference and Exposition*, Charlotte, North Carolina, June 10–13, CD-ROM only, 13 pages, no page numbers. Available electronically at: `<http://www.asee.org/conferences/search/>`.

8. Yaeger, P. M., R. M. Marra, F. Costanzo, G. L. Gray, and D. Sathianathan (1999) "Interactive Mechanics: Effects of Student-Centered Activities on Learning," in *1999 Frontiers in Education Conference*, San Juan, Puerto Rico, November 10–13, pp. 11a2-12–11a2-17, paper 1290. Print Version of the proceedings: IEEE Catalog Number: 99CH37011; ISBN: 0-7803-5643-8; Library of Congress: 79-640910; ISSN: 0190-5848. CD-ROM Version of the proceedings: IEEE Catalog Number: 99CH37011C; ISBN: 0-7803-5646-2.

9. Costanzo, F. and G. L. Gray (1999) "Mechanics Reform: A Report from the Trenches," in *1999 Frontiers in Education Conference*, San Juan, Puerto Rico, November 10–13, pp. 12c5-7–12c5-12, paper 1172. Print Version of the proceedings: IEEE Catalog Number: 99CH37011; ISBN: 0-7803-5643-8; Library of Congress: 79-640910; ISSN: 0190-5848. CD-ROM Version of the proceedings: IEEE Catalog Number: 99CH37011C; ISBN: 0-7803-5646-2.

10. Andia, P. C., F. Costanzo, and G. L. Gray (2000) "On the Estimation of Intrinsic Stresses and Elastic Moduli in Thin Films," in *Complex Mediums* (A. Lakhtakia, W. S. Weiglhofer, and R. F. Messier, eds.), vol. 4097 of *Proceedings of SPIE*, SPIE—The International Society for Optical Engineering, Bellingham, WA, pp. 280–290, proceedings of SPIE's 45th Annual Meeting, 30 July–1 August, 2000, San Diego, CA.

11. Caiazzo, A. A. and F. Costanzo (2000) "Finite Element Implementation of Effective Constitutive Relations for the Macroscopic Analysis of Elastic Structural Components with Evolving Microcracking," in *EM2000, Fourteenth Engineering Mechanics Conference of the American Society of Civil Engineers* (J. L. Tassoulas, ed.), The University of Texas at Austin, May 21–24, Department of Civil Engineering at the University of Texas at Austin on CD-ROM only, Austin, TX, 6 pages, no page numbers.

12. Andia, P. C., F. Costanzo, G. L. Gray, and T. J. Yurick (2001) "Calculation of Intrinsic Stresses and Elastic Moduli in Nonhomogeneous Thin Films," in *Multiscale Modeling of Materials–2000* (L. Kubin, R. L. B. Selinger, J. L. Bassani, and K. Cho, eds.), vol. 653 of *Materials Research Society Symposium Proceedings*, Materials Research Society, Pittsburgh, PA, pp. Z10.3.1–Z10.3.6.

13. Arvin, A. C., S. T. Miller, and F. Costanzo (2003) "Delivering Lectures in Introductory Graduate-Level Continuum Mechanics Courses using Mathematica." *Proceedings of the 2003*

American Society for Engineering Education Annual Conference & Exposition, **Session 2793**, Nashville. TN, June 22–25, available on CD ROM, 17 pages, no page numbers.

14. Gray, G. L., D. L. Evans, P. Cornwell, F. Costanzo, and B. Self (2003) "Toward a Nationwide Dynamics Concept Inventory Assessment Test," in *Proceedings of the 2003 American Society for Engineering Education Annual Conference & Exposition*, **Session 1168**, Nashville, TN, June 22–25, available on CD ROM, 12 pages, no page numbers.

15. Randow, C. L., A. J. Miller, F. Costanzo, and G. L. Gray (2003) "Mathematica Notebooks for Classroom Use in Undergraduate Dynamics: Demonstration of Theory and Examples," in *Proceedings of the 2003 American Society for Engineering Education Annual Conference & Exposition*, **Session 3268**, Nashville, TN, June 22–25, available on CD ROM, 22 pages, no page numbers.

16. Andia, P. C., T. J. Yurick, F. Costanzo, and G. L. Gray (2004) "Average Stresses in Simulated Thin Films", in *Surfaces and Interfaces in Nanostructured Materials and Trends in LIGA, Miniaturization, and Nanoscale Materials: Fifth MPMD Global Innovations Symposium*, S. M. Mukhopadhyay, S. Seal, N. Dahotre, A. Agarwal, J. E. Smugeresky, and N. Moody, eds., 2004, p. 343. Proceedings of the 5th Global Innovations Symposium held at the 2004 TMS Annual Meeting, March 14–18, 2004, Charlotte, NC.

17. Randow, C. L., G. L. Gray, and F. Costanzo (2004) "A Polar Continuum Model of a Columnar Thin Film," in *ECCOMAS 2004—European Congress on Computational Methods in Applied Sciences and Engineering*, Jyväskylä, Finland, July 24–28. Paper No. 195, 12 pages, no page numbers, published on CD-ROM only, ISBN 951-39-1869-6.

18. Evans, D. L., G. L. Gray, F. Costanzo, P. Cornwell, and B. P. Self (2004) "Rigid Body Dynamics: Student Misconceptions and Their Diagnosis," in the *XXI International Congress of Theoretical and Applied Mechanics*, Warsaw, Poland, August 15–21, 2 pages, no page numbers.

19. Gray, G. L., F. Costanzo, D. L. Evans, P. Cornwell, B. Self, and J. L. Lane (2005) "The Dynamics Concept Inventory Assessment Test: A Progress Report and Some Results", *Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition*, Session N. 3268, 13 pages, no page numbers. Conference held in Portland, OR, June 12–15. Awarded "Best Paper Award" in the Mechanics Division of ASEE.

20. Gray, G. L., F. Costanzo, and M. E. Plesha (2005) "Problem Solving in Statics and Dynamics: A Review and a Proposal for a Structured Approach", *Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition*, Session N. 3268, 16 pages, no page numbers. Conference held in Portland, OR, June 12–15.

21. Gray, G. L., F. Costanzo, P. C. Andia, D. L. Evans, B. Self, and P. Cornwell (2005) "The Dynamics Concept Inventory Test as a Means of Assessing Curricular Innovations", *Proceedings of McMat2005, the Joint ASME/ASCE/SES Conference on Mechanics and Materials*, Session: 694, 6 pages, no page numbers, conference held in Baton Rouge (LA) June 1–3.

22. Khalmanova, D. K. and F. Costanzo (2006) "Discontinuous Space-Time Galerkin Finite Element Method in Linear Dynamic Fully Coupled Thermoelastic Problems with Strain and Heat Flux Discontinuities", proceedings of *ECCM-2006—III European Conference on*

Computational Mechanics, 6 pages, no page numbers, conference held in Lisbon, Portugal, June 5–9.

23. Litzinger, T., C. Firetto, L. Passmore, K. Higley, P. Van Meter, C. Masters, F. Costanzo, G. Gray, S. Turns, and J. Kulikowich (2008), "Using Parametric Analysis to Incorporate Design into Sophomore-Level Dynamics", *Proceedings of the 2008 American Society for Engineering Education Annual Conference & Exposition*, **Session N. 402**, conference held in Pittsburgh, PA, June 22–25, 2008. Available on CD ROM, 18 pages, no page numbers.

24. Gray, G. L. and F. Costanzo (2008), "A Problem-Centered Approach to Dynamics", *Proceedings of the 2008 American Society for Engineering Education Annual Conference & Exposition*, **Session N. 2295**, conference held in Pittsburgh, PA, June 22–25, 2008. Available on CD ROM, 14 pages, no page numbers.

25. Costanzo, F. and G. L. Gray (2008), "A Structured Approach to Problem Solving in Statics and Dynamics: Assessment and Evolution", *Proceedings of the 2008 American Society for Engineering Education Annual Conference & Exposition*, **Session N. 2283**, conference held in Pittsburgh, PA, June 22–25, 2008. Available on CD ROM, 10 pages, no page numbers.

26. Roy, S., Heltai, L., Drapaca, C., and F. Costanzo (2012), "An Immersed Finite Element Method Approach to Brain Biomechanics", to appear in the *Proceedings of SEM XII, International Congress & Exposition on Experimental and Applied Mechanics*, Costa Mesa, CA, USA, June 11–14, 2012.

Conference Presentations

1. Costanzo, F. and J. R. Walton (1995), "Thermodynamically Based Failure-Zone Constitutive Models for Dynamic Crack Propagation in Elastic and Viscoelastic Materials," *ASME Winter Annual Meeting*, San Francisco, CA, November 11–14, 1995.

2. Costanzo, F. and J. R. Walton (1996), "The Modeling of Dynamic Crack Growth using Cohesive Zone Models," invited talk, *33rd Annual Technical Meeting of the Society of Engineering Science*. October 20–23, 1996, Arizona State University, Tempe (AZ).

3. Costanzo, F. and J. R. Walton (1997), "A New Technique for the Numerical Solution of a Class of Integro-Differential Equations Arising in Elastodynamic Crack Propagation Problems," in the *Prediction for Dynamic System with Evolving Damage Symposium*, part of the *133rd Meeting of the Acoustical Society of America*, the 1997 National Conference on Noise Control Engineering (NOISE-CON 97), Pennsylvania State University, June 15–17.

4. Costanzo, F. (1997), "Effective Constitutive Equation for Inelastic Composites with Growing Damage: a Thermodynamics-Based Approach," in the*Symposium on Homogenization and Micromechanics of Composites*, part of the *McNU'97—1997 Joint ASME/ASCE/SES Summer Meeting*, June 29–July 2, 1997, Northwestern, Evanston, IL.

5. Costanzo, F. and J. R. Walton (1997), "Dynamic Crack Growth with a Nonlinear Rate Dependent Cohesive Zone," in the *Symposium on Instabilities in Fracture*, part of the *McNU'97—1997 Joint ASME/ASCE/SES Summer Meeting*. June 29–July 2, 1997. Northwestern, Evanston, IL.

6. Gray, G. L., F. Costanzo, and M. D. Toniolo (1997), "A Virtual Laboratory for Engineering Materials: Laboratory Simulation for the Study of Materials Behavior using Mathematica and MATLAB," in the *Symposium on the Computing in Undergraduate Mechanics Education*, part of the *McNU'97—1997 Joint ASME/ASCE/SES summer meeting*, June 29–July 2, 1997, Northwestern, Evanston, IL.

7. Gray, G. L. and F. Costanzo (1998), "Studio Learning Applications in Engineering Education–The Interactive Classroom," in the *Sixth Annual Teaching and Learning with Technology Symposium*, The Pennsylvania State University, University Park, Pennsylvania, April 4, 1998.

8. Costanzo, F. (1998), "On the Numerical Solution of Integro-Differential Equations in Dynamic Fracture," invited talk, in the *Analysis of Dynamic Fracture Models Symposium*, part of the *19th Annual Meeting of the Canadian Applied and Industrial Mathematics Society (Societé Canadienne de Mathematiques Appliquées et Industrielles)*, May 27–31, 1998, Simon Fraser University at Harbour Centre, Vancouver, British Columbia, Canada.

9. Gray, G. L. and F. Costanzo (1998), "On the Concept of the 'Interactive Classroom' and its Integration into the Mechanics Curriculum," *Thirteenth U.S. National Congress of Applied Mechanics*, Gainesville, Florida, June 22–26, 1998.

10. Gray, G. L., J. Mackin, and F. Costanzo (1998), "ABET 2000 Goals: Implications for Change in Engineering and Physics Courses," invited talk part of the *1998 Summer Meeting of the American Association of Physics Teachers*, Lincoln, Nebraska, August 3–8, 1998.

11. Costanzo, F. and G. L. Gray (1998), "Interactive mechanics," *Proceedings of the Workshop on Reform of Undergraduate Mechanics Education*, hosted by the Engineering Mechanics Faculty at The Pennsylvania State University, University Park, PA, August 16–18, 1998.

12. Caiazzo, A. A. and F. Costanzo (1998), "On the Effective Elastic Properties of Composites with Evolving Microcracking," invited talk, *Eighth Japan-U.S. Conference on Composite Materials*, September 24–25, 1998, Baltimore (MD).

13. Yaeger, P. M., R. M. Marra, G. L. Gray, and F. Costanzo (1999), "Active Learning in the Engineering Classroom: Students Master the Content while Gaining Teamwork and Computer Skills," *Annual Meeting of the American Educational Research Association*, Montreal, Canada, April 19–23, 1999.

14. Costanzo, F. and G. L. Gray (1999), "Collaborative Learning in Undergraduate Dynamics Courses: Some Examples," *1999 ASEE Annual Conference and Exposition*, Charlotte, North Carolina, June 20–23.

15. Gray, G. L. and F. Costanzo (1999), "Interactive Dynamics: A Collaborative Approach to Learning Undergraduate Dynamics," *1999 ASEE Annual Conference and Exposition*, Charlotte, North Carolina, June 20–23.

16. Yaeger, P. M., R. M. Marra, G. L. Gray, F. Costanzo (1999), "Assessing New Ways of Teaching Dynamics: An Ongoing Program to Improve Teaching, Learning, and Assessment," *1999 ASEE Annual Conference and Exposition*, Charlotte, North Carolina, June 20–23.

17. Costanzo, F. and J. R. Walton (1999), "Analysis of the Dynamic Steady State Propagation of a Mode III Crack with a Temperature Dependent Cohesive Zone," invited talk, *36th Annual Technical Meeting of the Society of Engineering Science*, October 25–27, 1999, The University of Texas at Austin, Austin (TX).

18. Costanzo, F. and G. L. Gray (1999), "Mechanics Reform: A Report from the Trenches," *1999 Frontiers in Education Conference*, San Juan, Puerto Rico, November 10–13, 1999.

19. Caiazzo, A. A. and F. Costanzo (2000), "Finite Element Implementation of Effective Constitutive Relations for the Macroscopic Analysis of Elastic Structural Components with Evolving Microcracking," invited talk, *EM2000, Fourteenth Engineering Mechanics Conference of the American Society of Civil Engineers*, The University of Texas at Austin, May 21–24, 2000.

20. Andia, P. C., F. Costanzo, and G. L. Gray (2000), "On the Estimation of Intrinsic Stresses and Elastic Moduli in Thin Films," in the *Symposium on Complex Mediums*, part of the *45th Meeting of SPIE*, July 30–August 1, 2000, San Diego, USA.

21. Caiazzo, A. A. and F. Costanzo (2000), "Effective Constitutive Relations for the Structural Analysis of Components with Evolving Cracks," invited talk, the *ICTAM 2000, the 20th IUTAM Congress of the International Union of Theoretical and Applied Mechanics*, August 27–September 2, 2000, Chicago, USA.

22. Costanzo, F. and J. R. Walton (2000), "Temperature Effects in Dynamic Fracture," invited talk, in the *L. B. Freund Symposium On the Dynamic Failure of Materials*, part of the *37th Annual Technical Meeting of the Society of Engineering Science*, October 23–25, 2000, The University of South Carolina, Columbia, South Carolina, USA.

23. Andia,P. C., F. Costanzo, G. L. Gray and T. J. Yurik (2000), "Calculation of Intrinsic Stresses and Elastic Moduli in Thin Films," *2000 MRS Fall Meeting*, Materials Research Society, Hynes Convention Center and Sheraton Boston Hotel, November 27–December 1, 2000, Boston, Massachusetts, USA.

24. Costanzo, F. and J. R. Walton (2002), "Mode III Steady Dynamic Propagation of a Crack with a Rate and Temperature Dependent Cohesive Zone," *USNCTAM14 Fourteenth U.S. National Congress of Theoretical and Applied Mechanics*, June 23–28, 2002 Blacksburg (VA).

25. Costanzo, F., G. L. Gray, P. C. Andia, T. J. Yurick, Jr., and C. Randow (2002) "On the Relation Between Morphology and Elastic Properties in Amorphous Columnar Thin Films," *WCCM V Fifth World Congress on Computational Mechanics*, International Association for Computational Mechanics, July 7–12, 2002, Vienna, Austria.

26. Gray, G. L., F. Costanzo, T. J. Yurick, and P. C. Andia (2002) "Deriving Continuum Properties from MD Simulations for Columnar Thin Films," *39th Annual Technical Meeting of the Society of Engineering Science*, October 13–16, 2002, University Park (PA).

27. Huang, H. and F. Costanzo (2002), "On the Use of Space-time Finite Element Method in the Solution of Dynamic Crack Propagation," *39th Annual Technical Meeting of the Society of Engineering Science*, October 13–16, 2002, University Park (PA).

28. Song, J., F. Costanzo, and B.-L. Lee (2003), "Fatigue of Cord-Rubber Composites: V. Cord Reinforcement Effect," *Meeting of the Rubber Division of the American Chemical Society*, April 28–30, 2003, San Francisco, CA.

29. Arvin, A. C., S. T. Miller, and F. Costanzo (2003), "Delivering Lectures in Introductory Graduate-Level Continuum Mechanics Courses using Mathematica," *2003 ASEE Annual Conference & Exposition*, Nashville, TN, June 22–25, 2003.

30. Gray, G. L., D. Evans, P. Cornwell, F. Costanzo, and B. Self (2003) “Toward a Nationwide Dynamics Concept Inventory Assessment Test,” *2003 ASEE Annual Conference & Exposition*, Nashville, TN, June 22–25, 2003.

31. Randow, C. L., A. J. Miller, F. Costanzo, and G. L. Gray (2003) “Mathematica Notebooks for Classroom Use in Undergraduate Dynamics: Demonstration of Theory and Examples,” *2003 ASEE Annual Conference & Exposition, Nashville*, TN, June 22–25, 2003.

32. Johnson, D. K., J. Lane, G. L. Gray, F. Costanzo, and T. Zhang (2003) “Assessment of a Problem-Centered Approach to Putting the Motion Back in Dynamics,” *2003 ASEE Annual Conference & Exposition*, Nashville, TN, June 22–25, 2003.

33. Costanzo, F. and G. L. Gray (2003), “Creating Labeled “Stand-Alone” Figures in LaTeX Using WARMreader and Adobe Illustrator under Mac OS X,” *The 24th Annual Meeting and Conference of the TeX Users Group*, July 20ÃŘ24, 2003, Waikoloa, Hawaii.

34. Gray, G. L. and F. Costanzo (2003), “Experiences and Lessons Learned Teaching LaTeX to a Group of University Students,” *The 24th Annual Meeting and Conference of the TeX Users Group*, July 20ÃŘ24, 2003, Waikoloa, Hawaii.

35. Gray, G. L., F. Costanzo, P.C. Andia and T. J. Yurick (2003), “Determination of the Mechanical Properties of Amorphous Columnar Thin Films from MD Simulations,” *Seventh U.S. National Congress on Computational Mechanics USNCCM7*, July 27–31, 2003, Albuquerque (NM).

36. Costanzo, F. and J. R. Walton (2003), “Mode III Dynamic Crack Growth with a Rate Dependent Cohesive Zone and a Combined Critical Stress-COD Criterion,” *Seventh U.S. National Congress on Computational Mechanics USNCCM7*, July 27–31, 2003, in Albuquerque (NM).

37. Self, B. P., G. L. Gray, D. Evans, P. Cornwell, F. Costanzo, and A. Ruina (2004) “Progress on the Dynamics Concept Inventory,” in *Rocky Mountain Section Meeting of the American Society for Engineering Education*, Laramie, Wyoming, April 16–17.

38. Gray, G. L., D. Evans, F. Costanzo, P. Cornwell, and B. Self (2004) “Progress on the Dynamics Concept Inventory,” *American Society for Engineering Education Annual Conference*, Salt Lake City, Utah, June 20–23.

39. Randow, C. L., G. L. Gray, and F. Costanzo (2004) “A Polar Continuum Model of a Columnar Thin Film,” *ECCOMAS 2004–European Congress on Computational Methods in Applied Sciences and Engineering*, Jyväskylä, Finland, July 24–28.

40. Evans, D. L., G. L. Gray, F. Costanzo, P. Cornwell, and B. P. Self (2004) “Rigid Body Dynamics: Student Misconceptions and Their Diagnosis,” *XXI International Congress of Theoretical and Applied Mechanics*, Warsaw, Poland, August 15–21.

41. Randow,C. L., G. L. Gray, and and F. Costanzo (2004), “A Micropolar Approach to Modeling Columnar Thin Films,” *41th Annual Technical Meeting of the Society of Engineering Science*, October 10–13, 2004, Lincoln (NE).

42. Costanzo, F., G. L. Gray, and P. C. Andia (2004), “On Hill’s Macrohomogeneity Condition and the Virial Theorem,” *41th Annual Technical Meeting of the Society of Engineering Science*, October 10–13, 2004, Lincoln (NE).

43. Gray, G. L., F. Costanzo, P. C. Andia, D. L. Evans, B. Self, and P. J. Cornwell (2005), "The Dynamics Concept Inventory Test as a Means of Assessing Curricular Innovations," *McMat2005, the Joint ASME/ASCE/SES Conference on Mechanics and Materials*, Baton Rouge, Louisiana, June 1–3.

44. Andia, P. C., F. Costanzo, and G. L. Gray (2005), "A Lagrangian-Based Approach Bridging Molecular to Continuum Scales," *McMat2005, the Joint ASME/ASCE/SES Conference on Mechanics and Materials*, Baton Rouge, Louisiana, June 1–3.

45. Gray, G. L., F. Costanzo, and M. E. Plesha (2005), "Problem Solving in Statics and Dynamics: A Proposal for a Structured Approach," *2005 American Society for Engineering Education Annual Conference & Exposition*, Portland, Oregon, USA, June 12–15.

46. Gray, G. L., F. Costanzo, D. L. Evans, P. J. Cornwell, B. Self, and J. L. Lane (2005), "The Dynamics Concept Inventory Assessment Test: A Progress Report and Some Results,"*2005 American Society for Engineering Education Annual Conference & Exposition*, Portland, Oregon, USA, June 12–15. Awarded "Best Paper" by the Mechanics Division of ASEE.

47. Khalmanova, D. K. and F. Costanzo (2006), "Discontinuous Space-Time Galerkin Finite Element Method in Linear Dynamic Fully Coupled Thermoelasticity Problems with Strain and Heat Flux Discontinuities," *ECCM-2006—III European Conference on Computational Mechanics*, Lisbon, Portugal, June 5–9.

48. Khalmanova, D. K. and F. Costanzo (2006), "Discontinuous Space-Time Galerkin Finite Element Method in Linear Dynamic Fully Coupled Thermoelastic Problems with Strain and Heat Flux Discontinuities," *WCCM-VII—7th World Congress on Computational Mechanics*, Los Angeles, California, July 16–22.

49. Miller, A. J., P. C. Andia, F. Costanzo, and G. L. Gray (2006), "The Stress-Strain Response of Nanoscale Systems", *SES 2006—The 43rd Annual Technical Meeting of the Society of Engineering Science*, State College, Pennsylvania, August 13–16.

50. Thatte, A. M., J. Brasseur, and F. Costanzo (2006), "On the Misuse of the Laplace Law for Estimating Stress and Stiffness for Biological Vessels", *SES 2006—The 43rd Annual Technical Meeting of the Society of Engineering Science*, State College, Pennsylvania, August 13–16.

51. Costanzo F. and G. L. Gray (2007), "On the Continuum-Level Stress Response of Particle Systems", in the *Symposium on Mathematical Modeling, Mechanics & Materials*, part of the Mid-term meeting co-organized by the Italian Research Projects "Mathematical Models for Materials Science" and "Modeling and Approximation in Advanced Mechanical Problems", held in Brixen/Bressanone, Italy, March 17–21, 2007.

52. Pitt, J. S. and F. Costanzo (2007), "A Dynamic Parallel Finite-Element Implementation of a Linear Thermo-Elastic Material with Damage," in the *Multiscale Damage and Failure Mechanics Symposium*, part of the *9th US National Congress in Computational Mechanics*, July 23–26, 2007, San Francisco, CA.

53. Heltai, L. and F. Costanzo (2007), "The Use of Distributional Body Forces to Enforce Cracks in Elastic Materials," in the *Numerical Techniques for the Modeling of Failure in Solids Symposium*, part of the *9th US National Congress in Computational Mechanics*, July 23–26, 2007, San Francisco, CA.

54. Costanzo, F. and G. L. Gray (2007), "Homogenization-Based Lagragian MD Scheme for the Stress-Deformation Behavior of Nanoscale Systems," in the *Computational Methods for Micro and Nano Systems Symposium*, part of the *9th US National Congress in Computational Mechanics*, July 23–26, 2007, San Francisco, CA.

55. Pitt, J. S. and F. Costanzo (2007), "Dynamic Modeling of Damage in Linear Thermoelastic Materials," *SES 2007ÃŚThe 44th Meeting of the Society of Engineering Science*, October 21–24, College Station, TX.

56. Pitt, J. S. and F. Costanzo (2008), "Theory and Simulation of a Brittle Damage Model in Thermoelastodynamics," in the *Multiscale Damage and Failure Mechanics of Engineering Materials Symposium*, part of the *8th World Congress On Computational Mechanics (WCCM8) and 5th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)*, June 30–July 4, 2008, Venice, Italy.

57. Heltai, L. and F. Costanzo (2008), "Residual Based Formulations of Space-Time Discontinuous Galerkin Methods for Elasto-Dynamic Problems," in the *Theory and Applications of Discontinuous Galerkin Methods Symposium*, part of the *8th World Congress On Computational Mechanics (WCCM8) and 5th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)*, June 30–July 4, 2008, Venice, Italy.

58. Costanzo, F. (2008), "An Unconditionally Stable Space-Time Discontinuous Galerkin Method for Linear Thermo-Elasto-Dynamics with Propagating Weak Discontinuities," in the *Theory and Applications of Discontinuous Galerkin Methods Symposium*, part of the *8th World Congress On Computational Mechanics (WCCM8) and 5th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)*, June 30–July 4, 2008, Venice, Italy.

59. Costanzo, F. (2008), "On the relationship between the continuum notion of stress and the notion of virial stress in molecular dynamics," *9th Congress of the Italian Society for Applied and Industrial Mathematics (SIMAI)*, in Cooperation with the Society for Industrial and Applied Mathematics (SIAM), September 15–19, 2008, Rome, Italy.

60. Acharya, R., B. Evans, J. S.Pitt, F. Costanzo, and K. K. Kuo (2009), "Coupling of Transient Heating and Induced Stresses Computations in Graphite Nozzle Materials," presented at the *8th International Symposium on Special Topics in Chemical Propulsion*, 2–6 November, 2009, Cape Town, S. Africa.

61. Pitt, J. S. and F. Costanzo (2009), "A Computational Framework for the Numerical Modeling of Damage in Thermoelastodynamics," *National Defense Education Program Conference*, Crystal City, VA, June 1, 2009.

62. Costanzo, F. and J. G. Brasseur (2010), "The Inapplicability of the Laplace Law for the Measurement of Wall Stiffness of Biological Tissue, and a Replacement," *Nonlinear Modeling of Muscle and Soft Tissue Symposium, 16th US National Congress on Theoretical and Applied Mechanics (USNCTAM)*, The Pennsylvania State University in University Park, PA, June 27–July 2, 2010.

63. Pitt, J. S. and F. Costanzo (2010), "Damage Induced Dynamic Heating in Brittle Materials," *Damage Mechanics of Solids and Structure-II Symposium, 16th US National Congress on Theoretical and Applied Mechanics (USNCTAM)*, The Pennsylvania State University in University Park, PA, June 27–July 2, 2010.

64. Costanzo, F. (2010), "A Micromechanical Approach to Understanding The Notion of Virial Stress in Molecular Dynamics," *Workshop on the Modeling of the Mechanics of Heterogenous Media in Honor of David H. Allen's 60th Birthday*, Varese, Italy, May 29–June 1, 2010.

65. Pitt, J. S. and F. Costanzo (2011), "Influence of Thermal Coupling on Failure Statistics for a Damage Model in Thermoelastodynamics," *Multiscale Damage and Failure Mechanics of Engineering Materials, Symposium, 11th US National Congress on Computational Mechanics (USNCTAM)*, University of Minnesota, Minneapolis, MN, July 25–July 28, 2011.

66. Costanzo, F. and L. Heltai (2011), "An Immersed Finite Element Method for Compressible and Incompressible Elastic Bodies Immersed in an Incompressible Linear Viscous Fluid," *Fluid-Structure Interaction Algorithms and Applications Symposium, 11th US National Congress on Computational Mechanics (USNCTAM)*, University of Minnesota, Minneapolis, MN, July 25–July 28, 2011.

67. Heltai, L., Roy, S., and F. Costanzo (2011), "Bypassing the Explicit Approximation of the Dirac Delta Distribution in Immersed Finite Element Methods," *48th Annual Technical Conference of the Society of Engineering Science (SES48)*, Northwestern University, Evanston IL, October 12–14, 2011.

68. Costanzo, F. and J. G. Brasseur (2011), "Reinterpreting the Inflation and Extension Test for the In Vivo Assessments of the Elastic Properties of the Esophagus," *48th Annual Technical Conference of the Society of Engineering Science (SES48)*, Northwestern University, Evanston IL, October 12–14, 2011.

69. Costanzo, F. (2012), "Current Topics in Brain Biomechanics," invited presentation in the workshop*Mechanics of Soft Materials and Tissues: Modeling, Simulation and Experiments*, SISSA–International School for Advanced Studies, May 7–9, 2012, Trieste, Italy.

70. Heltai, L., S. Roy, and F. Costanzo (2013),"An Immersed Finite Element Method for Fluid-Structure Interaction Problems and Applications to Hydrocephalus," *SIAM Conference on Computational Science and Engineering*, February 25–March 1, 2013, Boston, Massachusetts, USA.

71. Roy, S., L. Heltai, and F. Costanzo (2013), "Validation of an Immersed Finite Element Method for Fluid-Structure Interaction Problems," *Seventh M.I.T. Conference on Computational Fluid and Solid Mechanics*, June 12–14, 2013, Cambridge, MA.

72. Nama, N., R. Barnkob, C. J. Kahler, F. Costanzo, and T. J. Huang (2014), "Numerical Analysis of Particles undergoing Acoustophoresis in a PDMS Channel Driven by Surface Acoustic Waves," *Acoustofluidics 2014*, Prato, Italy, September 11–12, 2014.

73. Nama, N., P.-H. Huang, T. J. Huang, and F. Costanzo (2014), "Numerical and Experimental Investigation of Sharp-edge-based Acoustofluidic Mixers," *Biomedical Engineering Society (BMES) 2014*, San Antonio, Texas, USA, October 22–25, 2014.

74. Nama, N., P.-H. Huang, T. J. Huang, and F. Costanzo (2014), "Numerical and Experimental Investigation of Acoustic Streaming Around Oscillating Sharp-edges in Microfluidics," *The 18th International Conference on Miniaturized Systems for Chemistry and Life Sciences*, San Antonio, Texas, USA, October 26–30, 2014.

75. Chisena, R., J. G. Brasseur, F. Costanzo, H. Gregersen, J. Zhao (2014), “Tubular Muscle Segments *In Vitro* and *In Vivo*,” *7th World Congress of Biomechanics*, July 6–11, 2014, Boston, Massachusetts.

76. Chisena, R., J. G. Brasseur, F. Costanzo, H. Gregersen, J. Zhao (2014), “Approximating the Elastic Response of Tubular Organs with an Effective Shear Modulus,” *American Physical Society 67th Annual DFD Meeting*, November 23–25, 2014, San Francisco, California.

77. Lanaro, E., C. S. Drapaca, B. Gluckman, E. Toro and F. Costanzo (2015), “Poroelastic Model of Glymphatic Flow Driven by Vasculature Pulsation,” *5th Annual Scientific Meeting of the International Society for Neuromuscular Disease*, March 27–28, 2015, Naples, Italy.

78. Miller, S. T. and F. Costanzo (2015), “A Poroelastic Mixture Model for Simulating Interstitial Fluid Flow in Brain: Formulation and Numerical Solutions,” *13th US National Congress on Computational Mechanics*, July 26–30, 2015, San Diego, California.

79. Nama, N., P.-H. Huang, F. Costanzo, and T. J. Huang (2015), “"Acoustic Streaming Driven Mixing,” *COMSOL Conference 2015*, October 7–9, 2015, Boston, Massachusetts.

80. Nama, N., R. Barnkob, C. J. Kähler, F. Costanzo, and T. J. Huang (2015), “Simulation of SAW-Driven Microparticle Acoustophoresis Using COMSOL Multiphysics®,” *COMSOL Conference 2015*, October 7–9, 2015, Boston, Massachusetts.

81. Nama, N., P.-H. Huang, F. Costanzo, and T. J. Huang (2015), “Numerical and Experimental Investigation of Sharp Edge Based Acoustofluidic Mixing,” *µTAS 2015 — The 19th International Conference on Miniaturized Systems for Chemistry and Life Sciences*, October 25–29, 2015, Gyeongju, Korea.

82. Nama, N., R. Barnkob, C. J. Kähler, F. Costanzo, and T. J. Huang (2015), “Numerical Investigation of Surface Acoustic Wave Driven Microparticle Acoustophoresis,” *µTAS 2015 — The 19th International Conference on Miniaturized Systems for Chemistry and Life Sciences*, October 25–29, 2015, Gyeongju, Korea.

83. Miller, S. T. and F. Costanzo (2015), “A Poroelastic Mixture Model for Simulating Interstitial Fluid Flow in Brain: Formulation and Numerical Solutions,” *52nd Annual Technical Meeting of the Society of Engineering Science*, October 26–28, 2015, College Station, Texas.

84. Nama, N., P.-H. Huang, F. Costanzo, and T. J. Huang (2015), “Numerical Analysis of Mixing by Sharp-Edge-Based Acoustofluidic Micromixer,” *68th Annual Meeting of the APS Division of Fluid Dynamics, American Physical Society*, November 22–24, 2015 Boston, Massachusetts.

85. Nama, N., R. Barnkob, C. J. Kähler, F. Costanzo, and T. J. Huang (2015), “Numerics of Surface Acoustic Wave (SAW) Driven Acoustic Streaming and Radiation Force,” *68th Annual Meeting of the APS Division of Fluid Dynamics, American Physical Society*, November 22–24, 2015 Boston, Massachusetts.

86. Costanzo, F. and S. T. Miller (2016), “A Mixture Theory Approach to the Modeling of Interstitial Fluid Flow in Brain: Formulation and Numerical Solutions,” *XII World Congress on Computational Mechanics (WCCMXII)*, International Association for Computational Mechanics (IACM), July 24–29, 2016, Seoul, Korea.

87. Barnkob, R., N. Nama, L. Ren, T. J. Huang, F. Costanzo and C. J. Kähler (2016), "Streaming direction and microparticle size effects in standing surface acoustic wave (SAW) devices," *The 20th International Conference on Miniaturized Systems for Chemistry and Life Sciences (MicroTAS)*, The Chemical and Biological Microsystem Society, October 9–13, 2016, Dublin, Ireland.

88. Nama, N., F. Costanzo, and T. J. Huang (2016), "Implementation of immersed finite element method for fluid-structure interaction applications", *COMSOL Conference 2016*, COMSOL, October 5–7, 2016, Boston, USA.

89. Nama, N., F. Costanzo, and T. J. Huang (2016), "Arbitrary Lagrangian-Eulerian (ALE) Formulation for Microacoustofluidics," *69th Annual Meeting of the APS Division of Fluid Dynamics*, American Physical Society, November 20–22, 2016, Portland, Oregon, USA.

90. Costanzo, F. and S. T. Miller (2016), "ALE-FEM for a Poroelasticity Problem from Mixture Theory," *5th International Conference on Computational & Mathematical Biomedical Engineering*, Computational and Mathematical Biomedical Engineering (CMBE), April 10–12, 2017, Pittshburgh, PA, USA.

91. Barnkob, R., N. Nama, L. Ren, T. J. Huang, F. Costanzo and C. J. Kähler (2016), "Acoustophoresis in Soft-Walled Microchannels Driven by Surface Acoustic Waves," *Flow17 for Microfluidics*, Annual Conference on the Fundamentals and Applications of micro- and nanofluidics, July 3–5, 2017, Paris-Sorbonne and Pierre-and-Marie Curie (UPMC) Universités, Paris, France.

92. Costanzo, F., N. Nama, and T. J. Huang (2017), "An Arbitrary Lagrangian-Eulerian Approach to Acoustic Streaming," *14th U.S. National Congress on Computational Mechanics (USNCCM)*, United States Association for Computational Mechanics (USACM), July 17–20, 2017, Montreal, Canada.

Lectures & Seminars

1. "Numerical Simulations of a Dynamically Propagating Crack with a Nonlinear Cohesive Zone," February 24, 1999, invited seminar, *Army Research Laboratory*, Aberdeen Proving Grounds, Aberdeen (MD).

2. "Numerical Simulations of a Dynamically Propagating Crack with a Nonlinear Cohesive Zone," April 4, 1999, invited seminar, *Aerospace Engineering Department*, Texas A&M University.

3. "Interactive Dynamics: A Model for Team-Based, Computer-Enhanced Learning," April 10, 1999, invited seminar, *ECSEL Coalition*, Texas A&M University.

4. "Continuum Mechanics Approach to the Development of Constitutive Theories for Cohesive Zone Models," May 1999, invited seminar, *Deparment of Structural Engineering*, Politecnico di Milano, Milano, Italy.

5. "Propagazione Dinamica di una Frattura in Regime Stazionario dipendente dalla Temperatura," May 25, 2001, invited seminar, *Facoltà di Ingegneria*, University of Trento, Trento, Italy.

6. "On the definition of effective stress and strain for large deformation homogenization problems ... and their relations to molecular dynamics," October 20, 2003, *Department of Mathematics*, Texas A&M University.

7. "On the Cohesive Zone Modeling of Cracks," November 3, 2004, invited seminar, *Department of Aerospace and Mechanical Engineering*, Rutgers University.

8. "On Stress-Deformation Behavior of Particle Systems," September 23, 2005, invited seminar, *Department of Mathematics*, Penn State University.

9. "Space-Time FEM for Modeling Dynamic Fracture in Thermo-Elastic Materials with Cohesive Zones," April 5, 2005, invited seminar, AFOSR, Kirtland AFB, Albuquerque, NM.

10. "A Discontinuous Galerkin Space-Time Formulation for Linear Elasto-Dynamics With Moving Surfaces of Discontinuities," December 8, 2005, invited seminar, *Department of Mathematics*, The University of California-Berkeley.

11. "On Stress-Deformation Behavior of Particle Systems—An introduction for classically trained mechanicians to computing mechanical properties via molecular dynamics," June 08, 2006, invited seminar, *Department of Structural Engineering*, Politecnico di Milano, Milano, Italy.

12. "A Continuum Homogenization Approach to the Determination of the Stress Response of Nanoscale Systems via Molecular Dynamics", March 22, 2007, invited seminar, *Department of Mechanical and Structural Engineering*, University of Trento, Trento, Italy.

13. "Distributional Body Force Densities in Finite Element Approximations of Continuum Mechanics Problems, " April 17, 2007, invited seminar presented by L. Heltai,* *Center for Computational Mathematics and Applications*, Department of Mathematics, Penn State University.

14. "Finite Element Implementation of a Linear Thermoelastic Material with Damage", April 24, 2007, invited seminar presented by J. S. Pitt,† *Center for Computational Mathematics and Applications*, Department of Mathematics, Penn State University.

15. "A Discontinuous Galerkin Space-Time Formulation for Linear Elastodynamics with Moving Surfaces of Strain Discontinuity," May 8, 2007, invited seminar, *Center for Computational Mathematics and Applications*, Department of Mathematics, Penn State University.

16. "A Brittle Damage Model in Thermoelastodynamics: Theory and Simulation", April 15, 2008, invited seminar presented by J. S. Pitt,† *International School for Advanced Studies*, Trieste, Italy.

17. "Damage Mechanics in Brittle Graphite: Theory and Simulation", April 16, 2008, invited talk, *Center of Excellence in Structural Health Monitoring*, Penn State University.

18. "On the Cohesive Zone Modeling of Cracks,", April 23, 2008, invited seminar, *Interdisciplinary Seminar on PDEs and their Applications*, Mathematics and Statistics Department, Penn State Altoona.

*Post-doctoral fellow working under Prof. Costanzo's supervision.
†Ph.D. candidate working under Prof. Costanzo's supervision.

19. "Formulation of An Unconditionally Stable Space-Time Discontinuous Galerkin Method for Linear Thermo-Elasto-Dynamics with Propagating Weak Discontinuities," July, 7, 2008, invited seminar, *International School for Advanced Studies*, Trieste, Italy.

20. "Damage Mechanics: an Overview," July 10, 2008, invited talk given at the *Ben Franklin Center of Excellence in Structural Health Monitoring*, Penn State University.

21. "An Unconditionally Stable Space–Time Discontinuous Galerkin Method for Linear Thermo-Elasto-Dynamics with Propagating Weak Discontinuities," September 30, 2009, *Engineering Science and Mechanics Department*, The Pennsylvania State University.

22. "An Unconditionally Stable Space–Time Discontinuous Galerkin Method for Linear Thermo-Elasto-Dynamics with Propagating Weak Discontinuities," May 25, 2010, invited seminar, *Department of Structural Engineering*, Politecnico di Milano, Milano, Italy.

23. "Replacement of the Laplace Law for Simple Assessments of the Elastic Properties of the Esophagus", invited seminar, May 25, 2011, *International School for Advanced Studies*, Trieste, Italy.

24. "Replacement of the Laplace Law for Simple Assessments of the Elastic Properties of the Esophagus", invited seminar, May 30, 2011, *MOX/Department of Mathematics*, Politecnico di Milano, Milan, Italy.

25. "The Misuse of the Laplace Law for Estimating Stiffness of Biological Vessels and an Alternative Method," August 31, 2011, invited seminar, *Department of Mathematics*, The Pennsylvania State University.

26. "The Misuse of the Laplace Law for Estimating Stiffness of Biological Vessels and an Alternative Method," September 29, 2012, *Engineering Science and Mechanics Department*, The Pennsylvania State University.

27. "Variational Implementation of Immersed Finite Element Methods," March 30, 2012, invited seminar, *Department of Mathematics*, The Pennsylvania State University.

28. "The Misuse of the Laplace Law for Estimating Stiffness of Biological Vessels and an Alternative Method," April 3, 2012, invited seminar, *Department of Physics*, Lock Haven University.

29. "Overview of Current Fluid-Structure Interaction Problems in Brain Biomechanics," June 7, 2013, Workshop on Perspectives on Fluid-Structure Interaction in the Nervous System, *Center for Neural Engineering*, The Pennsylvania State University.

30. "An Immersed Finite Element Method for Fluid-Structure Interaction Problems and Applications to Hydrocephalus", October 10, 2013, invited seminar, *Fluid Dynamics Seminar Series—Fluid Dynamics Research Consortium*, The Pennsylvania State University.

31. "Computational Support for Brain Biomechanics at the PSU CNE: A Progress Report," invited seminar, *Center for Neural Engineering Seminar Series*, December 3, 2014, The Pennsylvania State University.

32. "Flow and Transport in Brain," invited seminar, *Penn State/Politecnico di Milano Workshop on Bridging and Enhancing Biomedical Engineering Research Through a Penn State and Politecnico di Milano Consortium*, January 18–21, 2015, Politecnico di Milano, Milano, Italy.

33. "Fluid Structure Interaction: Applications in the Brain and Microacoustofluidics," *Millennium Café*, Millennium Science Complex — Penn State, University Park, PA, 2 June 2015.

34. "Numerical Techniques for the Study of Flow and Transport Problems in Brain," Graduate Seminar Series, Engineering Science and Mechanics Department, State College, 9 December 2015.

35. "A Mixture Theory Approach to the Modeling of Interstitial Fluid Flow in Brain: Formulation and Numerical Solutions," invited seminar, Huazhong University of Science and Technology, Wuhan, China, 23 October 2016.

36. "Bio-Related Modeling of Flow and Transport," invited seminar, *Center for Neural Engineering Seminar Series*, The Pennsylvania State University, 20 April 2017.

Awarded Research Grants

"Sculptured Thin Films: Non-Linear Nanomechanics and Homogenization for a New Class of Engineered Thin Composites with Evolving Nanostructures;" Sponsor: NSF CAREER Award; Amount: $235,000; Role: PI. Start date: 4/15/1998; Duration: 4 years.

"Constituents Materials Properties and Belt Edge Durability of Radial Tires;" Sponsor: Pirelli Pneumatici S.P.A.; Amount: $299,428. Role: PI; Start date: 08/15/1999; Duration: three years. (Project transferred to F. Costanzo in 2002 from Prof. ByungLip Lee, who is no longer at Penn State, but currently at AFOSR.)

"CBNC Consortium," Sponsors: Kennametal, Balzers, and Sandvik; Amount: $75,000. Role: Co-PI (50%). Start date: 01/01/1999; Duration: one year (Industry-Sponsored Supplement to the NSF CAREER Award).

"CBNC Consortium," CAREER AWARD Year II matching funds accompanying industry-sponsored research. Sponsor: NSF; Amount: $25,000; Role: PI. Start date: 10/01/1999; Duration: one year.

"CBNC Consortium;" Sponsors: Kennametal and Balzers; Amount: $50,000. Role: Co-PI (50%). Start date: 01/01/2000; Duration: one year (Industry-Sponsored Supplement to the NSF CAREER Award).

"CAREER AWARD Equipment Grant," Sponsor: NSF CAREER Award and Penn State College of Engineering; Amount: $20,000. Role: PI. Start date: 01/01/2000; Duration: one year.

"Discontinuous Galerkin FEM for Dynamic Fracture with Cohesive Zones," Sponsor: U.S. Army, Army Research Lab, Aberdeen (MD). Amount: $25,000. Role: PI; Start date: 01/09/2000; Duration: one year.

"Modeling the Processing and Performance of Multi-layer Structures," Sponsor: Applied Research Laboratory Exploratory and Foundational Research Program, The Pennsylvania State University; Amount: $13,455/year. Role: Co-PI (50%); Start date: 8/14/2000; Duration: two and one half year.

"CBNC Consortium," CAREER AWARD Year III matching funds accompanying industry-sponsored research. Sponsor: NSF; Amount: $25,000; Role: PI. Start date: 03/07/2001; Duration: one year (Industry-Sponsored Supplement to the NSF CAREER Award).

"Model-Based Simulation to Engineer Nanoporous Thin Films;" Sponsor: AFOSR; Amount: \$299,428. Role: PI (with 1 Co-PI at 50%); Start date: 01/01/2002; Duration: three years.

"Dynamic Fracture In Temperature Sensitive Materials With Cohesive Zones: A Discontinuous Galerkin Approach;" Sponsor: AFOSR; Amount: \$191,567. Role: PI; Start date: 07/01/2002; Duration: 2.5 years.

"Modeling the Dynamic Response of Nanowire Structures for Integrated Nanomechanical Biosensor Arrays;" Sponsor: MRI/MRSEC; Amount: \$25,000. Role: Co-PI (50%); Start date: 09/15/2002; Duration: 1 year.

"Numerical Simulation of Dynamic Fracture in Temperature Sensitive Materials With Cohesive Zones" Sponsor: AFOSR; Amount: \$240,000. Role: PI; Start date: 12/01/2004; Duration: three years.

"Fundamental Understanding of Propellant/Nozzle Interaction to Mitigate Erosion for Very High Pressure Missile Propellant Applications;" Sponsor: Office of Naval Research (ONR) — Multi-University Research Initiative (MURI); Amount: \$5,097,998. Role: Co-PI; Start date: 07/01/2004; Duration: Five years. Professor Costanzo's involvement covered years 2 through 5 with a total dedicated budget of \$300,000.

"The Origin of Unpredictability in Damage Evolution Dynamics: Fundamental Limitations on SHM System Performance;" Sponsor: Siemens; Amount: \$85,000. Role: Co-PI (50%); Start date: 06/01/2008; Duration: one year.

"Computational Modeling of Clot Fracture Mechanics for the Surgical Therapy of Acute Stroke;" Sponsor: Penn State Clinical and Translational Science Institute (CTSI); Amount: \$40,000.00 total; Role: PI (with 2 Co-PIs). Start date: 04/01/2014; Duration: one year.

"Probing Mechanical Biomarkers with Microacoustofluidics: A Fluid-Structure Interaction Approach;" Sponsor: National Science Foundation; Amount: \$300,000; Role: PI (with one Co-PI at 30%); Start date: 10/01/2014; Duration: Three Years

"Waste Disposal" in the Brain: Fluid Exchange Mechanics in the Glymphatic System; Support: Penn State College of Engineering; Amount: \$45,334; Role: PI (with 4 Co-PIs); Start date: 08/01/2014; Duration: One year.

"Computational Prediction of Mechanical and Transport Response Evolution in Degrading Porous Scaffolds;" Sponsor: National Science Foundation; Amount: 2015

"From Cells to Societies: Fungi Controlling Ants;" Sponsor: National Institutes of Health; Amount: \$1,854,715; Role: co-Investigator (Summer salary support along with support for one Ph.D. student); Start date: 02/01/2016; Duration: Five years.

"Imaging and Modeling Fluid Mechanics of Metabolite Transport in the Brain Interstitium;" Sponsor: National Science Foundation; Amount: \$400,000; Role: PI (with other two co-PIs); Start date: 09/01/2017; Duration: Three years. **Recommended for funding, awaiting award reception at Penn State**.

Teaching and Mentoring

Significant Accomplishments in Education

Professor Costanzo strongly believes that a good research program must be sustained by a companion strong effort in educating students both at the undergraduate and graduate level. Prof. Costanzo has been actively involved in education from the start of his career and has received various grants for the improvement of engineering education, with sponsorships by the US National Science Foundation and General Electric among them. His involvement in education reform has earned him several awards, including the *1999 American Society of Engineering Education Outstanding New Mechanics Educator Award* the *2007 Penn State Engineering Society Premier Teaching Award.*

As part of his achievements, in 2002 Prof. Costanzo, along with Prof. Gray (Penn State) and Prof. Plesha (University of Wisconsin Madison) was asked by The McGraw-Hill Publishing Co. to contribute to the creation of a new generation of sophomore-level engineering mechanics books in statics and dynamics. These are subjects that form the core foundation of engineering education in virtually all engineering majors. The author team has extensive experience not only in the classroom, but also in STEM research and they have written these books, now in their second edition, to provide a concrete realization of their research efforts in engineering eduction. These books were written to achieve various pedagogical objectives. Specifically,

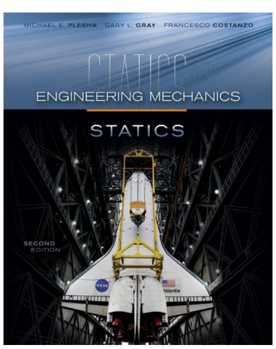
(i) Respecting a long-standing tradition, the books offer a rigorous coverage of the fundamentals of particle and rigid body statics and dynamics.

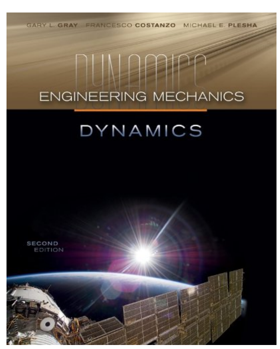
(ii) These books are meant to embody and support some of the new pedagogical paradigms that STEM research has identified as essential for improving student learning. No one disputes that a good conceptual understanding contributes to good problem solving skills. However, it is not necessarily true that practicing problem-solving improves conceptual understanding. In these books, conceptual understanding is given a special attention and it is fostered with specific sets of problems that are distinct from those meant to practice problem-solving.

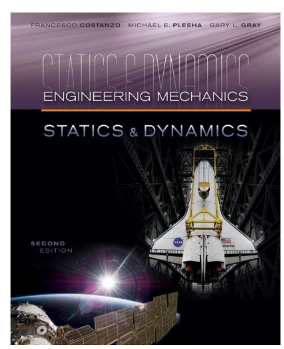
(iii) The presentation of the various traditional topics is tied by an underlying theme, namely, the construction of physical model, with the understanding that a model is built to provide a predictive capability and answer specific sets of questions.

(iv) A models always consists of a three components, namely, kinematics, balance laws, and constitutive equations, these elements have been used to create a systematic problem-solving approach Every example in these books is tackled using the same modeling paradigm.

Covers of the second edition of the textbooks:







Teaching Experience

Professor Costanzo has taught the following courses:

Course Number	Course Name	Institution
MATH 151[a]	Engineering Mathematics I	Texas A&M University
MATH 308[a]	Differential Equations	Texas A&M University
E MCH 211[a]	Statics	Penn State University
E MCH 212[a]	Dynamics	Penn State University
E MCH 213[a]	Strength of Materials	Penn State University
E MCH 446[a]	Mechanics of Viscoelastic Materials	Penn State University
E SC 497A[a]	Technical Documents with LaTeX	Penn State University
E MCH 500[b]	Solid Mechanics	Penn State University
E MCH 507[b]	Theory of Elasticity	Penn State University
E MCH 516[b]	Mathematical Theory of Elasticity	Penn State University
E MCH 540[b]	Introduction to Continuum Mechanics	Penn State University
E MCH 546[b]	Theory of Viscoelasticity and Applications	Penn State University
E MCH 560[b]	Finite Element Analysis	Penn State University

[a]Undergraduate level.
[b]Graduate level.

Graduate Student Supervision

Professor Costanzo has advised or is advising the following graduate students in Engineering Mechanics:

Student	Degree	Date of Degree	Title or Anticipated Title of Thesis	***Role***
Anthony A. Caiazzo	Ph.D.	5/99	Computational Methods for the Determination of the Effective Constitutive Relations of Composite Materials with Growing Cracks	Chair
Pedro Andia	M.S.	12/00	A Discrete-Continuum Approach to the Mechanical Properties of Thin Films	Chair
Hao Huang	Ph.D.	5/02	A Space-Time Finite Element Method for the Modeling of Dynamic Fracture In Elastic Materials with and without Cohesive Zones	Chair
Jaehoon Song	Ph.D	01/04	Fatigue of Cord-Rubber Composites	Co-Chair
Scott T. Miller	M.S.	8/04	A Space-Time Finite Element Method For Second Order Hyperbolic Problems	Chair
Pedro C. Andia	Ph.D.	5/05	Estimation of Continuum-Level Thermo-Elastic Properties of Thin Films From Molecular Dynamics Simulations	Co-Chair

Charles L. Randow	Ph.D	12/05	Nonlinear Elastic and Cosserat Deformation Theory of Thin Films	Co-Chair
Thomas J. Yurick	Ph.D	12/05	Molecular Dynamics for the Prediction of the Morphology and Mechanical Properties of Thin Films	Co-Chair
Jonathan S. Pitt	Ph.D	08/09	A Brittle Damage Model in Thermoelastodynamics	Chair
Saswati Roy	Ph.D	12/12	Numerical Simulation Using the Generalized Immersed Finite Element Method: An Application to Hydrocephalus	co-Chair
Nitesh Nama	Ph.D	12/17	Immersed Finite Element Methods in Computational Microacoustofluidics for the Determination of Cell Mechanical Biomarkers	co-Chair
Zhangming Mao	Ph.D	12/17	3D Manipulation of Cells using Microacoustofluidics	co-Chair
Devon Boyd	M.Eng.	12/17	Evolution of the Mechanical and Transport Properties of Scaffolds for Nerve Regeneration during Biodegradation	Chair
Sen Lin	M.S.	12/17*	Monolithic ALE Scheme Using the Deal.II Library	co-Chair
Amel Awadelkarim	M.S. (IUG)†	8/17*	FEM Modeling of Blood Clot Response during Acute Stroke	Chair
Eric Abercrombie	M.S.	12/18*	To be determined in the field of 3D Droplet Contact Angle Control via Microacoustofluidics	Chair
Nabankur Dasgupta	Ph.D.	12/19*	To be determined in the field of Molecular Dynamics Applications in Chemistry	co-Chair
Priyanka Patki	PhD.	12/19*	Evolving Mechanical and Transport Properties of Scaffolds for Nerve Regeneration during Biodegradation	Chair
Ravi Teja	PhD.	12/20*	Imaging and Modeling Fluid Mechanics of Metabolite Transport in the Brain Interstitium	Co-Chair

*Expected graduation date.

†IUG stands for Integrated Undergraduate-Graduate Program. Ms. Awadelkarim will complete her undergraduate baccalaureate degree in May 2016 and continue directly with her M.S. degree to be completed May 2017.

Postdoctoral Fellows Supervision

Professor Costanzo has advised the following postdoctoral fellows:

1. Dr. Dinara K. Khalmanova, Ph.D. in Mathematics in 2004; thesis advisor: Prof. Jay R. Walton, Department of Mathematics, Texas A&M University, USA. Current Position: Geomechanicist and Petrophysicist at Shell.

2. Dr. Luca Heltai, Ph.D. in Mathematics in 2006; thesis advisor: Prof. Daniele Boffi, Dipartimento di Matematica, Università degli Studi di Pavia, Pavia, Italy. Current Position: Assistant Professor (Ricercatore) at SISSA, The International School for Advanced Studies, Trieste, Italy.

Thesis Committee Membership

At Penn State, Professor Costanzo has served or is serving as a committee member on the following graduate thesis committees.

Student	Degree	Department
David R. Campbell III	Ph.D.	Engineering Science and Mechanics
David Chelidze	Ph.D.	Engineering Science and Mechanics
Andrea J. Frohman Ciasullo	Ph.D.	Mechanical Engineering
Saiganesh Iyer	Ph.D.	Engineering Science and Mechanics
John P. Medzorian	Ph.D.	Engineering Science and Mechanics
Yusuf Metha	Ph.D.	Civil Engineering
Albert Niessner	M.S.	Engineering Science and Mechanics
Osvaldo Pensado	Ph.D.	Engineering Science and Mechanics
Vijayakumar C. Venugopal	M.S.	Engineering Science and Mechanics
Jian Li	Ph.D.	Engineering Science and Mechanics
Mokin Lee	Ph.D.	Engineering Science and Mechanics
Xin Lei	Ph.D.	Engineering Science and Mechanics
Omer F. Yalcin	M.S.	Engineering Science and Mechanics
Matthew D. Toniolo	M.S.	Engineering Science and Mechanics
Joseph A. Sherwin	Ph.D.	Engineering Science and Mechanics
Andrew M. Poillucci	M.S.	Engineering Science and Mechanics
Sudip Kuman Ghosh	Ph.D.	Mechanical Engineering
Guodong Cai	Ph.D.	Engineering Science and Mechanics
Ying Shan	Ph.D.	Engineering Science and Mechanics
Yulia Gorb	Ph.D.	Mathematics
Lulin Shen	M.S.	Engineering Science and Mechanics
Michael L. Merrick	Ph.D.	Chemical Engineering
Shih-Horng Tsau	Ph.D.	Mechanical Engineering
Qiang Li	Ph.D.	Engineering Science and Mechanics
Nestor Z. Handy	Ph.D.	Mathematics
Yuqing Liu	Ph.D.	Engineering Science and Mechanics
Joby John	Ph.D.	Engineering Science and Mechanics
Yunrong Zhu	Ph.D.	Mathematics
Michael Higley	Ph.D.	Mathematics
Xiang Xu	Ph.D.	Mathematics

Raghavan Balaji	Ph.D.	Mechanical Engineering
Xiaoliang Qin	Ph.D.	Mechanical Engineering
Chandan Kumar	Ph.D.	Engineering Science and Mechanics
Xiang Xu	Ph. D.	Mathematics
Brian Evans	Ph.D.	Mechanical Engineering
Massimiliano Tulipano Andreoli	M.S.	Structural Engineering (Politenico di Milano)
Eunhye Kim	Ph.D.	Energy and Mineral Engineering
Donjin Won	Ph.D.	Materials Science and Engineering
Jason Fritz	M.S.	Engineering Science and Mechanics
Melisa Steighner-Yashinski	Ph.D.	Materials Science and Engineering
Daniel Leonard	Ph.D.	Engineering Science and Mechanics
Arjun Roy	Ph.D.	Engineering Science and Mechanics
Vamshi Chillara	M.S.	Engineering Science and Mechanics
Jason Sheldon	M.S.	Engineering Science and Mechanics
Jason Sheldon	Ph.D.	Engineering Science and Mechanics
Theodore S. Worosz	Ph.D.	Nuclear Engineering
Arkadz Kirshtein	Ph.D.	Mathematics
Yajie Zhang	Ph.D.	Mathematics
Huilong Hou	Ph.D.	Engineering Science and Mechanics
Matthew Bernard	Ph.D.	Nuclear Engineering
Michael Bell	Ph.D.	Chemical Engineering
Aniruddh Vashisth	M.S.	Engineering Science and Mechanics
Qingtian Zhang	Ph.D.	Mathematics
Alireza Ostadhossein	Ph.D.	Engineering Science and Mechanics
Tanmay Mathur	Ph.D.	Mechanical Engineering
Kenneth Aycock	Ph.D.	Biomedical Engineering
Justin Kauffman	Ph.D.	Engineering Science and Mechanics
Xiaokun Ma	Ph.D.	Nuclear and Mechanical Engineering
Bicheng Chen	Ph.D.	Meterology
Tianwu Chen	Ph.D.	Engineering Science and Mechanics
Po-Hsun Huang	Ph.D.	Engineering Science and Mechanics

Undergraduate Teaching Interns and University scholars

At Penn State, Professor Costanzo has served as a mentor to four teaching interns as part of the *College of Engineering Undergraduate Teaching Intern Program.* Also, he has supervised the thesis of four Honor Students in Engineering Science:

Student	Degree	Date of Degree	Title of Thesis	Role
Matthew Toniolo	B.S.	12/97	A Virtual Laboratory for Engineering Materials	Co-Supervisor
Andrew Arvin	B.S.	5/02	Visualizing Deformations within the Virtual Laboratory	Supervisor
Scott T. Miller	B.S.	5/02	Quantification of Thin Film Morphologies: Application to Experimental and Simulated Data	Co-Supervisor
Patrick Nollen	B.S.	5/16	Zombie Ants: Modeling Fungi Spore Ground Coverage	Co-Supervisor
Amel Awadelkarim	B.S.	5/16	FEM Modeling of Blood Clot Response during Acute Stroke	Supervisor
Eric Abercrombie	B.S.	5/17	Considerations of Acoustic Streaming in Three Dimensional Spaces	Supervisor

Educational Research Grants

“A Virtual Laboratory for Engineering Materials: Experimental Activity Simulation for the Study of Materials Behavior using *Mathematica* and MATLAB,” Office of the Associate Dean for Undergraduate Studies, Penn State College of Engineering, May 1996 ($6000). Role: PI.

“Pathways to Effective Learning in Engineering Using Information Technology,” GE Fund via the College of Engineering–Year I, January 1997–January 1998 ($30,000). Role: Co-PI (50%).

”Grant from the Schreyer Institute for Innovation in Learning for a Teaching Intern in Interactive Dynamics,” Fall 1998 ($1250). Role Co-PI (50%).

“Implementation of the Interactive Classroom into Undergraduate Mechanics and a Corresponding First-Year/Freshman Seminar,” Fund for Excellence in Learning and Teaching (FELT), IDP Center for Excellence in Learning and Teaching, The Pennsylvania State University, 1998 ($8,120). Role: Co-PI (50%).

Equipment Grant from the Commonwealth of Pennsylvania in the form of matching funds to enhance education, 1998 ($30,000). Role: Co-PI (50%).

“Pathways to Effective Learning in Engineering Using Information Technology,” GE Fund via the College of Engineering–Year II, January 1998–January 1999 ($30,000). Role: Co-PI (50%).

Grant from the Penn State College of Engineering Tuition Surcharge Fund to enhance the Interactive Mechanics Classroom, January 1999 ($29,000). Role: Co-PI (50%).

"Pathways to Effective Learning in Engineering Using Information Technology," GE Fund via the College of Engineering–Year III, January 1999–January 2000 ($35,000). Role: Co-PI (50%).

"Instructional Materials for Engineering Mechanics Using Problem-Based Learning;" Sponsor: National Science Foundation, CCLI-Educational Materials Development; Amount: $120,259; Role: Co-PI (50%); Start date: 02/01/2002; Duration: 18 months.

"A Cognitive Study of Modeling During Problem-Solving: Accelerating Progress Toward Expert-Like Performance," Sponsor: NSF; Amount: $539,645. Role: Investigator with summer salary support; Start date: 05/01/2006; Duration: 3 years.

Courses Developed or Revised

Engineering Mechanics 212 — *Dynamics*

Starting in the Spring of 1997, Prof. Costanzo began collaborating with Prof. Gray (Penn State Engineering Science and Mechanics Department) to enhance introductory mechanics courses by introducing modern engineering tools and collaborative learning into the classroom. The undergraduate dynamics course E MCH 212 for students in the College of Engineering was completely revised and offered accordint to a studio-based approach. The revised course was dubbed "Interactive Dynamics" covered the same material as the traditional course but presented it so as to engage students in a collaborative environment in which all students have easy access to an array of technological tools. Students use these tools to:

- analyze data (often generated in real time in class);
- observe graphic representations of the data; and
- construct as well as interact with simulations.

In Interactive Dynamics, students spend large portions of their class time learning *actively* by

- working in small collaborative groups to analyze physical phenomena (sometimes captured on videotape);
- using elements of numerical analysis to study and visualize the motion of objects; and
- presenting their findings in graded reports required to be professionally written.

Interactive Dynamics is therefore a guided, inquiry-based learning environment where all the activities are designed to develop and sharpen the engineering skills of the students as well as their critical thinking and communication.

The project has also included the assembly of a new classroom containing 40 computers arranged in a manner to allow students to work individually or in teams of 2–3 students. The room also had a workstation for the instructor, and computer-video projector. This new learning environment was designed to support a guided, inquiry-based, hands-on learning process. Student learning was made active by letting students be both the suppliers and the receivers of information, that is:

- students collect the information to be learned in various ways, including (simple) real experiments, Internet resources, making and/or viewing videos, and computer simulations;
- students analyze the gathered information using a variety of computer tools including motion analyzers, computer graphics tools, and virtual laboratory experiment simulations;

- students present the outcome of their analysis using spreadsheets and word processors.

The role of the course instructor was largely limited to guiding the students' inquiry. The instructor's leadership is exerted by channeling the students' inquiry through a sequence of learning units referred to as *activities* that include a set of experiments, real or virtual, designed to introduce topics as research tasks.

Physics 201 — General Physics (Mechanics)

Professor Costanzo was a member of a team of faculty in the College of Engineering working on a General Electric sponsored program including a collaboration with faculty in the College of Science. They contributed ideas for the enhancement of Physics 201 and team-taught a section of Phys 201 during the Fall 1997 semester.

Engineering Mechanics 213 — Strength of Materials

Professor Costanzo was member of a team of faculty in the Department of Engineering Science and Mechanics for the introduction of Design Projects in E MCH 13. The team-work was coordinated by Professor N. J. Salamon. Professor Costanzo contributed problem statements for two Design Projects.

Virtual Laboratory

In 1998 Prof. Costanzo received an NSF CAREER award, entitled "Sculptured Thin Films: Non-Linear Nanomechanics and Homogenization for a New Class of Engineered Thin Composites with Evolving Nanostructures," for the theoretical and numerical determination of the mechanical properties of nano-engineered thin films. As required by NSF, any CAREER award must include a significant effort in developing new course materials related to the scientific component of the project. As part of the educational component of his CAREER award, Prof. Costanzo has developed a project called a Virtual Laboratory. The Virtual Laboratory is a computer-based simulation environment for material characterization, that is, a piece of software that allows a student to perform, on a computer, virtual experiments similar to those necessary to find the constitutive properties of a material. The essential feature of the program is to easily visualize the stress and deformation response of a material specimen subjected to an assigned load history. The Virtual Laboratory offers support in the teaching of those Engineering Mechanics courses dealing with the behavior of materials, such as E MCH 13 (Strength of Materials), E MCH 215 (Mechanical Response of Engineering Materials) and more advanced courses such as E MCH 408 (Elasticity and Engineering Applications) and E MCH 471 (Engineering Composite Materials). At the graduate level the Virtual Laboratory will find applications in E MCH 546 (Theory of Viscoelasticity and Applications) and E MCH 540 (Introduction to Continuum Mechanics).

Dynamics Concept Inventory

Between 2002 and 2010, Professor Costanzo was a member of a five-member team of faculty members at various institutions for the creation of the Dynamics Concept Inventory (DCI) test. This test has been designed so as to provide a quantitative assessment tool for measuring the conceptual understanding of students taking sophomore-level dynamics (a required course for most engineering majors). The DCI has been developed under the sponsorship of the National Science Foundation through the Foundation Coalition at the Arizona State University. The DCI has been developed using sophisticated methods and it has undergone scientific validity and reliability trials and, as of January 1, 2005, has been made available for nation-wide distribution.

Engineering Mechanics 516 — Mathematical Theory of Elasticity

Prof. Costanzo has implemented substantial course content renewal starting with the offering during the Spring 2008 semester. E MCH 516 has been a course that was typically devoted to an analytical treatment of the Theory of Elasticity and its applications to traditional structural mechanics problems such as fracture and composites. In the Spring 2008 semester he revised the course content to better support the goals of his department and better prepare graduate students explore cutting edge applications of the Theory of Elasticity in bio-medical applications. The course was refocused toward the development of the field equations using general curvilinear coordinate systems for nonlinear elasticity and large deformations as well as the discussion of the constitutive modeling of soft tissues as can be found in the modeling of muscle and arterial tissue response. The enrollment in the course increased over previous semesters and was fairly regularly attended by one faculty in the Penn State Mechanical Engineering and, once the applications portion of the course started, by a faculty in the Penn State Mathematics Department. The course was well received although perceived as being very challenging from the mathematical viewpoint.

Engineering Mechanics 560 — Finite Element Analysis

At Penn State this course has been taught starting from traditional applications in structural mechanics (beams, isotropic linear elasticity) and heat transfer. This emphasis resulted in the perception on the part of many students that the finite element method (FEM) is synonymous with structural mechanics without any awareness that the FEM is generally applicable to any system of partial differential equations, regardless of the field of application. Furthermore, by focusing on traditional applications with well known closed-form solutions, this course did not provide students with any notion of numerical accuracy and the know-how to estimate convergence rates regardless of the availability of closed-form solutions. I have revised this upper-level course to focus on partial differential equations in general. Informed by the approach presented in the book by Prof. Hughes of the Institute for Computational Engineering and Sciences at the University of Texas at Austin, I have introduce basic notions concerning Sobolev spaces, convergence, mixed and penalty methods for constraints such as incompressibility, along with the discussion of solvability concerns for constrained problems. Students applied these notions in projects of their choice.

Institutional and Professional Service

Membership in Professional Society and Service to the Profession

ASME: Member since 1994; Fellow since 08/2015

Technical Divisions:

- Applied Mechanics
- Bioengineering
- Fluids
- Materials
- Aerospace

Other contributions:

- Co-organizer of the symposium on ”Homogenization and Micromechanics of Composites,” in the 1997 Joint ASME/ASCE/SES Summer Meeting, June 29–July 2, 1997, at Northwestern University, Evanston (Il).
- Reviewer for the ASME Journal of Applied Mechanics.

SES (1996–Present)

Co-organizer of the symposium on “Crack Growth in Viscoelastic Media” in the SES (Society of Engineering Science) 33rd Annual Technical Meeting, October 20–23, 1996, at the Arizona State University, Tempe (AZ).

Co-organizer of the symposium on “Dynamic Fracture”, in the *39th Annual Technical Meeting of the Society of Engineering Science*, October 13–16, 2002, University Park (PA).

Co-organizer of the symposium entitled “Discrete to Continuum: Mechanical Modeling Across Scales”, in the *39th Annual Technical Meeting of the Society of Engineering Science*, October 13–16th, 2002, University Park (PA).

Co-chair and co-technical chair for the *43rd Annual Technical Meeting Society of Engineering Science*, held at The Pennsylvania State University on August 13–16, 2006.

ASEE (1999–present)

Divisions and Service:

- Biomedical
- Mechanics
- Executive Committee of the Mechanics Division of ASEE (2010–2011).
- ASEE Conference: Reviewer for the Mathematics Division

SIAM (2010–present)

Member

TMS & ASM

Key Reader for the *Metallurgical and Materials Transactions*, a joint publication of the Minerals, Metals & Materials Society (TMS) and of the ASM International. September 2008–Present.

Additional Service to the Profession: Workshops & Conferences Organization

Co-Organizer and moderator for the “Workshop on Reform of Undergraduate Mechanics Education,” August 16–18, 1998, The Pennsylvania State University.

Member of the organizing committee of the *2010 U.S. National Congress on Theoretical and Applied Mechanics*.

Co-organizer (along with Prof. J. Brasseur) of the symposium entitled “Nonlinear Modeling of Muscle and Soft Tissue,” part of the *2010 U.S. National Congress on Theoretical and Applied Mechanics*.

Co-organizer (with Prof. C. S. Drapaca) of the “Workshop on Perspectives on Fluid-Structure Interaction in the Nervous System,” sponsored by *The Penn State Center for Neural Engineering*, 7 June 2013, Millennium Science Complex, Penn State University Park Campus, and Hospital Auditorium, Penn State Milton S. Hershey Medical Center, Hershey, PA.

Additional Service to the Profession: Editorship and Reviewing

- NSF Graduate Research Fellowship Program Review Panelist, February 2001.
- NSF Graduate Research Fellowship Program Review Panelist, February 2000.
- NSF Proposal Review Panelist, June 1998, December 2014, May 2015, January 2016, February 2016.
- Reviewer for the *International Journal for Numerical Methods in Engineering*.
- Reviewer for *Modelling and Simulation in Materials Science and Engineering*.
- Reviewer for *Engineering Fracture Mechanics*.
- Reviewer for the *Journal of Engineering Materials and Technology*.
- Reviewer for the *International Journal of Fracture*.
- Reviewer for the *Mechanics of Materials*.
- Reviewer for the *International Journal of Solids and Structures*.
- Reviewer for the *ASCE Journal of Engineering Mechanics*.
- Reviewer for the *International Journal of Engineering Education*.
- Reviewer for the *Journal of Sound and Vibration*.

- Reviewer for the *European Journal of Mechanics - A/Solids*.
- Reviewer for the *MacArthur Fellows Program* (John D. and Catherine T. MacArthur Foundation, 140 S. Dearborn Street, Suite 1100, Chicago, IL 60603), 2000.
- Reviewer for the Moldovan-U.S. Bilateral Grants Program, 2000.
- Reviewer for the *Workshop on Reform of Undergraduate Mechanics Education*, held at The Pennsylvania State University, August 16–18, 1998.
- Reviewer for the Addison-Wesley Longman Computer and Engineering Publishing Group. Book Reviewed: W. B. Bickford, "Advanced Strength of Materials," 1998.

Service to the University (Penn State)

- Penn State College of Engineering Research Computing Committee, 2015–Present.
- College of Engineering Promotion and Tenure Committee, Chair, 2015–Present.
- College of Engineering Promotion and Tenure Committee, Member, 2014.
- Office of Student Conduct, Administrative Hearing Officer/Member of the Title IX Panel, August 2013–Present.
- University Faculty Senate, Member, Spring 2006–Spring 2013.
- Firewall Implementation Committee, College of Engineering. Spring 2004–Present.
- University Appeals Board. Fall semester 1996–Fall 1997.
- University Hearing Board. Fall 1997–Fall 2006, Chair (the UHB has several faculty members whose task is to serve as Chair of the board when the UHB is in session).
- University Graduate Council and University Graduate Council Committee on Program and Courses, member, Fall 1997–Spring 1999.
- Penn State Undergraduate Student Fulbright Scholarship Selection Committee, Fall 2000–Present.

Honors and Awards

- Fulbright Scholarship, 1989.
- NSF CAREER Award, 1998.
- Awarded a 1% salary increase for the 1998 Collaborative and Curricular Innovations Special Recognition Program by the Provost of The Pennsylvania State University.
- First prize co-winner of the General Electric Learning Excellence Award, 1998. The award includes $10,000 for the enhancement of Educational related activities.
- American Society of Engineering Education Outstanding New Mechanics Educator Award, 1999.
- Penn State Engineering Society Outstanding Teaching Award, 2000.
- Second prize co-winner the General Electric Learning Excellence Award, 2003. The award includes $5,000 for the enhancement of Educational related activities.
- Best Paper Award - Mechanics Division — I and my co-authors were awarded the Best Paper Award for the Mechanics Division of ASEE. The paper is question was entitled “The Dynamics Concept Inventory Assessment Test: A Progress Report and Some Results” (June 2005)
- Overall Best Paper Presentation - Mechanics Division: “The Dynamics Concept Inventory Assessment Test: A Progress Report and Some Results” in Session 3268 at the 2005 Annual Conference of the American Society of Engineering Education, June 2005.
- Penn State Engineering Society Premier Teaching Award, 2007.
- Fellow of the American Society of Mechanical Engineers, 2015.