

Harish Narayanan

2 Risborough Close, Muswell Hill
London N10 3PL

+44 (0)7823 583186

mail@harishnarayanan.org
<https://harishnarayanan.org/>

Areas of Specialisation

Using continuum physics theory to model biological phenomena

Devising and implementing robust software for solving coupled equations

Building web-based platforms

Professional Experience

- 2013 – Technical Co-founder, *Edgefolio, London*
- 2012 – 2013 Founder, *Mechanics academy and thinkbot, Oslo*
- 2008 – 2012 Postdoctoral fellow, *Center for Biomedical Computing, Simula Research Laboratory, Oslo*
- 2002 – 2008 Research assistant, *Department of Mechanical Engineering, University of Michigan, Ann Arbor*

Education

- 2003 – 2007 Ph.D. in Mechanical Engineering and Scientific Computing, *University of Michigan*
- 2003 – 2006 M.S. in Mathematics, *University of Michigan*
- 2002 – 2003 M.S.E. in Mechanical Engineering, *University of Michigan*
- 1998 – 2002 B.E. in Mechanical Engineering, *University of Madras, India*
Awarded the *Sir C. P. Ramaswamy Aiyar Endowment Scholarship* in 2001–2002 for excellent academic performance

Publications & Communications

JOURNAL ARTICLES

H. Narayanan, S. N. Verner, K. L. Mills, R. Kemkemer, K. Garikipati, “In silico estimates of the free energy changes in growing, avascular, tumor spheroids,” *Journal of Physics: Condensed Matter*, vol. 22(19), 2010. [\[DOI\]](#) [\[PDF\]](#)

H. Narayanan, E. M. Arruda, K. Grosh, K. Garikipati, “The micromechanics of fluid-solid interactions during growth in porous soft biological tissue,” *Biomechanics and Modeling in Mechanobiology*, vol. 8(3), pp. 167–181, 2009. [\[DOI\]](#) [\[PDF\]](#)

K. Garikipati, M. Falk, M. Bouville, B. Puchala, **H. Narayanan**, “The continuum elastic and atomistic viewpoints on the formation volume and strain energy of a point defect,” *Journal of the Mechanics and Physics of Solids*, vol. 54(9), pp. 1929–1951, 2006. [\[DOI\]](#) [\[PDF\]](#)

K. Garikipati, J. Olberding, **H. Narayanan**, E. M. Arruda, K. Grosh, S. Calve, “Biological remodelling: Stationary energy, configurational change, internal variables and dissipation,” *Journal of the Mechanics and Physics of Solids*, vol. 54(7), pp. 1493–1515, 2006. [\[DOI\]](#) [\[PDF\]](#)

K. Garikipati, E. M. Arruda, K. Grosh, **H. Narayanan**, S. Calve, “A continuum treatment of growth in biological tissue: The coupling of mass transport and mechanics,” *Journal of the Mechanics and Physics of Solids*, vol. 52(7), pp. 1595–1625, 2004. [\[DOI\]](#) [\[PDF\]](#)

CHAPTERS IN BOOKS

H. Narayanan, “A computational framework for nonlinear elasticity,” in A. Logg, K-A. Mardal, G. N. Wells (Eds.), *Automated Solution of Differential Equations by the Finite Element Method*, chap. 27, pp. 527–544, 2012. [\[DOI\]](#) [\[PDF\]](#)

K. Valen-Sendstad, A. Logg, K-A. Mardal, **H. Narayanan**, M. Mortensen, “A comparison of some finite element schemes for the incompressible Navier-Stokes equations,” in A. Logg, K-A. Mardal, G. N. Wells (Eds.), *Automated Solution of Differential Equations by the Finite Element Method*, chap. 21, pp. 395–417, 2012. [\[DOI\]](#) [\[PDF\]](#)

E. M. Arruda, S. Calve, K. Garikipati, K. Grosh, **H. Narayanan**, “Characterization and modeling of growth and remodeling in tendon and soft tissue constructs,” in G. A. Holzapfel, R. W. Ogden (Eds.), *Mechanics of Biological Tissue*, chap. 5, pp. 63–75, 2006. [\[DOI\]](#) [\[PDF\]](#)

K. Garikipati, **H. Narayanan**, E. M. Arruda, K. Grosh, S. Calve, “Material forces in the context of biotissue remodelling,” in P. Steinmann, G. A. Maugin (Eds.), *Mechanics of Material Forces*, chap. 8, pp. 77–84, 2005. [\[DOI\]](#) [\[PDF\]](#)

CONFERENCE PROCEEDINGS

J. Ma, **H. Narayanan**, K. Garikipati, K. Grosh, E. M. Arruda, “Experimental and computational investigation of viscoelasticity of native and engineered ligament and tendon,” in K. Garikipati, E. M. Arruda (Eds.), *Cellular, Molecular and Tissue Mechanics*, IUTAM Symposium Bookseries, vol. 16, pp. 3–17, 2010. [\[DOI\]](#) [\[PDF\]](#)

H. Narayanan, K. Garikipati, A. Logg, “Collaborative computational frameworks and the growth problem,” in D. Ambrosi, K. Garikipati, E. Kuhl (Eds.), *The Mathematics of Growth and Remodelling of Soft Biological Tissues*, Mathematisches Forschungsinstitut Oberwolfach Reports, vol. 5, no. 3, pp. 2247–2249, 2008. [\[DOI\]](#) [\[PDF\]](#)

K. Garikipati, **H. Narayanan**, K. Grosh, E. M. Arruda, “Mathematical modelling of solid tumor growth,” in D. Ambrosi, K. Garikipati, E. Kuhl (Eds.), *The Mathematics of Growth and Remodelling of Soft Biological Tissues*, Mathematisches Forschungsinstitut Oberwolfach Reports, vol. 5, no. 3, pp. 2235–2238, 2008. [\[DOI\]](#) [\[PDF\]](#)

OTHER ACADEMIC WRITING

H. Narayanan, “A continuum theory of multiphase mixtures for modelling biological growth,” *Doctoral Dissertation*, University of Michigan, 2007. [DOI] [PDF]

H. Narayanan, “Variational level sets in shape reconstruction from unorganised data sets,” *Project Report*, University of Michigan, 2005. [PDF]

SELECTED TALKS

“A continuum model for the active mechanical response of the myocardium,” *Tenth World Congress on Computational Mechanics*, São Paulo, Brazil, July 2012. [SLIDES]

“The role of K⁺ channels in human articular chondrocyte electrophysiology,” *Cardiac Modelling Seminar at Simula Research Laboratory*, Oslo, Norway, July 2011. [SLIDES]

“An automated computational framework for hyperelasticity,” *Fourth European Conference on Computational Mechanics*, Paris, France, May 2010. [SLIDES]

“A goal-oriented error-controlled solver for biomedical flows,” *Fifth M.I.T. Conference on Computational Fluid and Solid Mechanics*, Cambridge, MA, June 2009. [SLIDES]

“Collaborative computational frameworks and the growth problem,” *Workshop on the Mathematics of Growth and Remodelling of Soft Biological Tissues*, Mathematisches Forschungsinstitut Oberwolfach, Germany, September 2008. [SLIDES]

“Reshaping tumour growth,” *University of Michigan Engineering Graduate Student Symposium*, Ann Arbor, MI, November 2007. [SLIDES]

“The numerical implications of multiphase mechanics assumptions underlying growth models,” *Ninth U.S. National Congress on Computational Mechanics*, San Francisco, CA, July 2007. [SLIDES]

“Finite element methods in general relativity,” *University of Michigan Engineering Graduate Student Symposium*, Ann Arbor, MI, November 2006. [SLIDES]

“Viscoelastic and growth mechanics in engineered and native tendons,” *43rd Annual Technical Meeting of the Society of Engineering Science*, University Park, PA, August 2006. [SLIDES]

“The numerical implications of fluid incompressibility in multiphase modelling of soft tissue growth,” *Seventh World Congress on Computational Mechanics*, Los Angeles, CA, July 2006. [SLIDES]

“Tendon growth and healing: The roles of reaction, transport and mechanics,” *15th U.S. National Congress on Theoretical and Applied Mechanics*, Boulder, CO, June 2006. [SLIDES]

“Computational modelling of mechanics and transport in growing tissue,” *Eighth U.S. National Congress on Computational Mechanics*, Austin, TX, July 2005. [SLIDES]

“Material forces in the context of biological tissue remodelling,” *Seventh U.S. National Congress on Computational Mechanics*, Albuquerque, NM, July 2003. [SLIDES]

Teaching Experience

- 2009 Invited Lecturer, *Simula Research Laboratory*
Conducted a lecture series on *Introductory Continuum Mechanics* for interested graduate students and researchers at the Department of Scientific Computing.
- 2008 – 2011 Ph.D. Co-Advisor, *Simula Research Laboratory*
Guided Kristoffer Selim, a Ph.D. student at the University of Oslo and Simula Research Laboratory, with his research on robust numerical methods for fluid-structure interaction problems.
- 2006 Graduate Student Instructor, *University of Michigan*
Assisted Prof. Ellen M. Arruda and Prof. J. Wayne Jones in teaching *Mechanical Behavior of Materials* [ME 382] to juniors at the Department of Mechanical Engineering.

Professional Development & Service

- 2012 Joined a select team at the *Third Virtual Physiological Human Study Group* at the Universitat Pompeu Fabra to work on tackling some grand challenges in the field of cardiovascular research.
- 2009 – 2010 Visited the Department of Engineering at the University of Cambridge for three months to collaborate with Dr. Garth N. Wells on error-controlled methods for multiphase flow through porous media.
- 2009 Participated and successfully completed the requirements of the course *Communicating Scientific Research* offered by Prof. Michael Alley from Pennsylvania State University.
- 2008 Attended a short course on *Nonlinear Finite Element Analysis* taught by Prof. Thomas J.R. Hughes and Prof. Ted Belytschko in Paris, France.
- 2007 – 2008 Served as a reviewer for articles on biological tissue growth for the *ASME Journal of Biomechanical Engineering* and *Philosophical Transactions of the Royal Society*.
- 2005 Recognised as an *Engineering Academic Scholar* by the office of the Associate Dean for Graduate Education, University of Michigan, after successfully completing the *Academic Careers in Engineering and Sciences* program.
- 2003 – 2008 Served as system administrator and webmaster for the *Computational Physics Group*, University of Michigan.
- 2003 – Associate member of the *Free Software Foundation*, and contributor to different free software projects. These include, currently, *The FEniCS Project* (patches, build system, website, applications) and *WordPress* (patches), and, historically, *The GIMP* (website, documentation).