

## EDWARD R. DAMIANO

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### EDUCATION —

*Ph.D. Applied Mechanics*, Rensselaer Polytechnic Institute, Troy, NY, December 1993

*M.S. Mechanical Engineering*, Washington University, St. Louis, MO, May 1989

*B.S. Biomedical Engineering*, Rensselaer Polytechnic Institute, Troy, NY, August 1987

### EXPERIENCE —

September 2004 – present	<b>Boston University</b> <i>Associate Professor</i>	Boston, MA Department of Biomedical Engineering
March 2008 – present	<b>Massachusetts General Hospital</b> <i>Associate Biomedical Engineer</i>	Boston, MA Division of Medicine
March 1998 – August 2004	<b>University of Illinois at Urbana-Champaign</b> <i>Assistant Professor</i>	Urbana, IL Bioengineering Program
August 1997 – August 2004	<b>University of Illinois at Urbana-Champaign</b> <i>Assistant Professor</i>	Urbana, IL Department of Mechanical and Industrial Engineering
November 1994 – August 1997	<b>University of Virginia</b> <i>Postdoctoral Fellow</i>	Charlottesville, VA Department of Biomedical Engineering
March 1994 – September 1994	<b>University of Utah</b> <i>Postdoctoral Research Associate</i>	Salt Lake City, UT Department of Bioengineering
September 1990 – December 1993	<b>Rensselaer Polytechnic Institute</b> <i>Teaching Assistant</i>	Troy, NY Mathematical Sciences and Mechanical Engineering Departments
July 1989 – August 1990	<b>Arthur D. Little, Inc.</b> <i>Engineering Consultant</i>	Cambridge, MA Environmental, Health and Safety Practice

### ADMINISTRATIVE POSITIONS —

September 2007 – present	<b>Boston University</b> <i>Director, NIH QBP Training Grant</i>	Boston, MA Department of Biomedical Engineering
September 2005 – present	<b>Boston University</b> <i>Director, BME Graduate Admissions</i>	Boston, MA Department of Biomedical Engineering
September 2004 – present	<b>Boston University</b> <i>Director, Computational Simulation Facility</i>	Boston, MA Department of Biomedical Engineering

### JOURNAL PUBLICATIONS —

- EL-KHATIB, F. H., RUSSELL, S. J., NATHAN, D. M., SUTHERLIN, R. G. & DAMIANO, E. R. (2010) A bi-Hormonal closed-loop artificial pancreas for type 1 diabetes. *Science Trans. Med.* **2**, (to appear).
- POTTER, D. R., JIANG, J. & DAMIANO, E. R. (2009) The recovery time course of the endothelial-cell glycocalyx *in vivo* and its implications *in vitro*. *Circ. Res.* **104**, 1318–1325 (invited manuscript).
- EL-KHATIB, F. H., JIANG, J. & DAMIANO, E. R. (2009) A feasibility study of bihormonal closed-loop blood-glucose control using dual subcutaneous infusion of insulin and glucagon in ambulatory diabetic swine. *J. Diabetes Sci. Technol.* **3**, 789–803 (invited manuscript).
- SAVERY, M. D. & DAMIANO, E. R. (2008) The endothelial glycocalyx is hydrodynamically relevant in arterioles throughout the cardiac cycle. *Biophys. J.* **95**, 1439–1447.

- ROY, B. C. & DAMIANO, E. R. (2008) On the motion of a porous sphere in a Stokes flow parallel to a planar confining boundary. *J. Fluid Mech.* **606**, 75–104.
- POTTER, D. R. & DAMIANO, E. R. (2008) The hydrodynamically relevant endothelial-cell glycocalyx observed *in vivo* is absent *in vitro*. *Circ. Res.* **102**, 770–776.
- WEINBAUM, S., TARBELL, J. M. & DAMIANO, E. R. (2007) The structure and function of the endothelial glycocalyx layer. *Ann. Rev. Biomed. Eng.* **9**, 121–167.
- EL-KHATIB, F. H., JIANG, J., GERRITY, R. G. & DAMIANO, E. R. (2007) Pharmacodynamics and stability of subcutaneously infused glucagon in a type 1 diabetic swine model *in vivo*. *Diabetes Technol. Ther.* **9**, 135–144.
- EL-KHATIB, F. H., JIANG, J. & DAMIANO, E. R. (2007) Adaptive closed-loop control provides blood-glucose regulation using dual subcutaneous insulin and glucagon infusion in diabetic swine. *J. Diabetes Sci. Technol.* **1**, 181–192 (invited manuscript).
- DAMIANO, E. R. & STACE, T. M. (2005) Flow and deformation of the capillary glycocalyx in the wake of a leukocyte. *Phys. Fluids* **17**, 031509-1–031509-17 (invited paper for special section on Biofluid Mechanics).
- LONG, D. S., SMITH, M. L., PRIES, A. R., LEY, K. & DAMIANO, E. R. (2004) Microviscometry reveals reduced blood viscosity and altered shear rate and shear stress profiles in microvessels after hemodilution. *Proc. Natl. Acad. Sci. USA* **101**, 10060–10065.
- DAMIANO, E. R., LONG, D. S. & SMITH, M. L. (2004) Estimation of viscosity profiles using velocimetry data from parallel flows of linearly viscous fluids: Application to microvascular hemodynamics. *J. Fluid Mech.* **512**, 1–19.
- DAMIANO, E. R., LONG, D. S., EL-KHATIB, F. H. & STACE, T. M. (2004) On the motion of a sphere in a Stokes flow parallel to a Brinkman half space. *J. Fluid Mech.* **500**, 75–101.
- SMITH, M. L., LONG, D. S., DAMIANO, E. R. & LEY, K. (2003) Near-wall  $\mu$ -PIV reveals a hydrodynamically relevant endothelial surface layer in venules *in vivo*. *Biophys. J.* **85**, 637–645.
- EL-KHATIB, F. H. & DAMIANO, E. R. (2003) Linear and nonlinear analyses of pulsatile blood flow in a cylindrical tube. *Biorheology* **40**, 503–522.
- DAMIANO, E. R. & STACE, T. M. (2002) A mechano-electrochemical model of radial deformation of the capillary glycocalyx. *Biophys. J.* **82**, 1153–1175.
- STACE, T. M. & DAMIANO, E. R. (2001) An electrochemical model of the transport of charged molecules through the capillary glycocalyx. *Biophys. J.* **80**, 1670–1690.
- DAMIANO, E. R. (1999) A poroelastic continuum model of the cupula partition and the response dynamics of the vestibular semicircular canal. *J. Biomech. Eng.* **121**, 449–461.
- DAMIANO, E. R. (1998) The effect of the endothelial-cell glycocalyx on the motion of red blood cells through capillaries. *Microvasc. Res.* **55**, 77–91.
- DAMIANO, E. R., DULING, B. R., LEY, K. & SKALAK, T. C. (1996) Axisymmetric pressure-driven flow of rigid pellets through a cylindrical tube lined with a deformable porous wall layer. *J. Fluid Mech.* **314**, 163–189.
- DAMIANO, E. R. & RABBITT, R. D. (1996) A singular perturbation model of fluid dynamics in the vestibular semicircular canal and ampulla. *J. Fluid Mech.* **307**, 333–372.
- DAMIANO, E. R., WESTHEIDER, J., TÖZEREN, A. & LEY, K. (1996) Variation in the velocity, deformation, and adhesion energy density of leukocytes rolling within venules. *Circ. Res.* **79**, 1122–1130.
- RABBITT, R. D. & DAMIANO, E. R. A hydroelastic model of the macromechanics in the endolymphatic vestibular canal. *J. Fluid Mech.* **238**, 337–369.

#### INVITED BOOK CHAPTERS —

- RABBITT, R. D., DAMIANO, E. R. & GRANT, J. W. (2004) Biomechanics of the semicircular canals and otolith organs. In *Springer Handbook of Auditory Research, Volume 19: The Vestibular System*. (eds. S. M. Highstein, R. R. Fay & A. N. Popper), pp. 153–201, Springer, New York.

#### PATENTS PENDING —

- EL-KHATIB, F. H. & DAMIANO, E. R. (2005) A fully automated closed-loop control system for type 1 diabetes (first provisional filing, May 13, 2005; second provisional filing, November 10, 2005, fully executed PCT (international) patent application entered national phase of prosecution, November 13, 2007).

## INVESTIGATIONAL DEVICE EXPEMPTIONS —

- *A Closed-Loop Glucose Control System for Type 1 Diabetes.* (2010) Investigational Device Exemption Application #G100062 (in review), submitted March 29, 2010 to the Food and Drug Administration. Indications for use: Intended to provide automated control of blood glucose in pediatric and adult subjects with type 1 diabetes using subcutaneous infusion of either insulin only or insulin and glucagon. Sponsor: E.R. Damiano.
- *Closed-Loop Glucose Control for Automated Management of Type 1 Diabetes.* (2008) Investigational Device Exemption Application #G080012, approved February 21, 2008 by the Food and Drug Administration. Indications for use: Intended to provide automated control of blood glucose in adult subjects with type 1 diabetes using subcutaneous infusion of insulin and glucagon. Sponsor: E.R. Damiano.

## GRANTS RECEIVED —

- *Clinical trials of a closed-loop control system for type 1 diabetes management.* (2009–12) National Institutes of Health (NHLBI, R01 DK085633, PI: E.R. Damiano), \$2,046,225.
- *In-patient trials of automated glucose control in children with type 1 diabetes.* (2010–2011) Leona M. and Harry B. Helmsley Charitable Trust (Research Grant, PI: E.R. Damiano), \$1,051,196.
- *Development and preclinical testing of a closed-loop control system for in-patient blood-glucose regulation.* (2010–2011) Wallace H. Coulter Translational Partners Grant (PI: E.R. Damiano), \$100,000.
- *Closed-loop glucose control for automated management of type 1 diabetes.* (2007–2010) Juvenile Diabetes Research Foundation (Clinical Investigations Research Grant, PI: E.R. Damiano), \$1,629,327.
- *Development and preclinical testing of a closed-loop control system for blood-glucose regulation in the ICU.* (2009–2010) Wallace H. Coulter Translational Partners Grant (PI: E.R. Damiano), \$100,000.
- *Investigations into the vasoprotective role of combined insulin and free-radical scavenger therapies in the treatment of diabetes.* (2008–09) Dean’s Catalyst Award, Boston University (PI: E.R. Damiano), \$10,000.
- *Bridge funding for BU/MGH closed-loop control trial.* (2008–2009) Wallace H. Coulter Translational Partners Grant (PI: E.R. Damiano), \$35,000.
- *Closed-loop blood-glucose regulation in type 1 diabetes: A clinical trial.* (2007) Wallace H. Coulter Translational Partners Grant (PI: E.R. Damiano), \$50,000.
- *Automated hemodynamic analysis in microvessels using  $\mu$ -particle image velocimetry.* (2006–09) National Institutes of Health (NHLBI, R21 HL082870, PI: E.R. Damiano), \$437,544.
- *Micro-viscometric studies of the ESL in microvessels.* (2004–09) National Institutes of Health (NHLBI, R01 HL076499, PI: E.R. Damiano), \$1,141,315.
- *Engineering a robust fully automated closed-loop control unit for glucose regulation in type 1 diabetes.* (2006–07) Wallace H. Coulter Translational Partners Grant (PI: E.R. Damiano), \$100,000.
- *The mechano-electrochemical behavior of the capillary glycocalyx.* (2001–07) National Science Foundation CAREER Award (BES-0093985, PI: E.R. Damiano), \$375,000.
- *The development of a semi-empirical basis to study microhemofluidics in post-capillary venules.* (2003–04) Whitaker Foundation Transitional Funding Award (TF-02-0024, PI: E.R. Damiano), \$80,000.
- *The role of the capillary glycocalyx in microvascular permeability, rheology, and exchange.* (1999–2002) Whitaker Foundation Biomedical Engineering Research Grant (RG-98-0524, PI: E.R. Damiano), \$210,000.
- *The application of mixture theory to some fluid–structure interaction problems arising in biomechanics.* (1998–99) UIUC Campus Research Board (PI: E.R. Damiano), \$16,000.
- *The role of the glycocalyx in microvascular rheology.* (1996–98) National Institutes of Health, Individual National Research Service Award (HL-09501, PI: E.R. Damiano, Sponsors: T.C. Skalak & B.R. Duling), \$58,500.

## HONORS AND AWARDS —

- CAREER Award — National Science Foundation, 2001–07
- Named to “Incomplete List of Teachers Ranked Excellent by their Students,” University of Illinois, 2001
- Individual National Research Service Award – National Institutes of Health, 1996–98
- Cardiovascular Research Center Fellowship – University of Virginia, 1995–96
- Poster Award — Second World Congress of Biomechanics, 1994

## PROPOSAL AND PANEL REVIEW —

NSF CAREER Panel, Nano and Bio Mechanics of Materials Program, Civil and Mechanical System Division, Engineering Directorate, National Science Foundation, Washington, D.C., November 2005.

Biofluids Panel, Office of Biological and Physical Research, National Aeronautics and Space Administration, Washington, D.C., March 2003.

Biofluids Panel, Office of Biological and Physical Research, National Aeronautics and Space Administration, Washington, D.C., August 2001.

Ad hoc reviewer for National Science Foundation, U.S. Civilian Research and Development Foundation.

## MANUSCRIPT REVIEW —

American Journal of Physiology: Heart and Circulatory Physiology; Anesthesiology; Annals of Biomedical Engineering; Biophysical Journal; Biorheology; Cardiovascular Research; Circulation; Circulation Research; Diabetes Technology and Therapeutics; IEEE Transactions on Biomedical Engineering; Journal of Biomechanical Engineering; Journal of Biomechanics; Journal of Fluid Mechanics; Journal of the Society for Industrial and Applied Mathematics; Journal of Thrombosis and Haemostasis; Journal of Vestibular Research; Microcirculation; Microvascular Research; Physics in Medicine and Biology; Physics of Fluids; Proceedings of the National Academy of Sciences (USA)

## CHAIRED SESSIONS AT SCIENTIFIC MEETINGS —

Vascular Sessions, “Microvascular Glycocalyx and Molecular Fluid–Structure Interaction”, Co-Chair with T.W. Secomb, at *Fifth World Congress of Biomechanics*, Munich, Germany, June 2006.

Vascular Sessions, “Biomechanics of the Endothelial Surface Layer in the Microcirculation”, Co-Chair with T.W. Secomb, at *ASME Summer Bioengineering Conference*, Key Biscayne, FL, June 2003.

Soft Tissue Mechanics Sessions, “Soft Tissues of the Head and Neck”, Co-Chair with J. Wayne, at *ASME Summer Bioengineering Conference*, Sun River, OR, June 1997.

## COMMITTEE ASSIGNMENTS —

- Chair, Graduate Admissions Committee, Biomedical Engineering Department, Boston University, 2005–2010
- Member, Search Committee for the Director of the Animal Care Program, Office of the Provost, Boston University, 2009–2010
- Member, Biomedical Engineering Executive Committee, Biomedical Engineering Department, Boston University, 2005–09
- Member, Biomedical Engineering Chair Search Committee, College of Engineering, Boston University, 2007–08
- Member, Faculty Search Committee, Biomedical Engineering Department, Boston University, 2007–08
- Member, Mechanical Engineering Chair Search Committee, College of Engineering, Boston University, 2006–07
- Member, Faculty Search Committee, Biomedical Engineering Department, Boston University, 2006–07
- Chair, Faculty Search Committee, Biomedical Engineering Department, Boston University, 2005–06
- Member, Graduate Admissions Committee, Biomedical Engineering Department, Boston University, 2004–05
- Member, Undergraduate Programs Committee, Mechanical and Industrial Engineering Department, University of Illinois at Urbana-Champaign, 1997–2000

## TEACHING HISTORY —

- Boston University – Continuum Mechanics for Biomedical Engineers (AM/BE 521, graduate); Numerical Methods and Modeling in Biomedical Engineering (BE 703, graduate); Biomedical Transport Phenomena (BE 736, graduate); Fundamentals of Fluid Mechanics (BE 436)
- University of Illinois at Urbana-Champaign – Introduction to Biomechanics and Biofluid Dynamics (ME 393, graduate); Fluid Mechanics of Convective Heat Transfer (ME 308, graduate); Introductory Gas Dynamics (ME 211); Senior Mechanical Engineering Design Project (ME 280)
- Rensselaer Polytechnic Institute – Statics and Dynamics; Strength of Materials; Calculus and Analytic Geometry; Introductory Vector Calculus

## GRADUATE-STUDENT PLACEMENT —

POTTER, D. R. Postdoctoral Research Associate, Department of Physiology, University of Maastricht

EL-KHATIB, F. H. Senior Research Associate, Department of Biomedical Engineering, Boston University

STACE, T. M. Senior Lecturer, School of Mathematics and Physics, University of Queensland, Queensland, Australia

LONG, D. S. Lecturer, Department of Engineering Science and the Auckland Bioengineering Institute, University of Auckland, Auckland, New Zealand

## GRADUATE-STUDENT AND POSTDOCTORAL ADVISING —

*Current Postdoctoral* —

EL-KHATIB, F. H.

*Current Ph.D.* —

SAVERY, M. D. (expected 2010) Dissertation: Therapeutic interventions to protect the endothelial-cell glycocalyx in chronic hyperglycemia.

*Current M. S.* —

STETSYUK, A. (expected 2010) Thesis: Investigations of the endothelial-cell glycocalyx using intravital two-photon microscopy.

*Theses and Dissertation Accepted* —

POTTER, D. R. (2009) Dissertation: A comparison of the hydrodynamically relevant endothelial glycocalyx *in vivo* and *in vitro* using microparticle image velocimetry.

EL-KHATIB, F. H. (2005) Dissertation: System identification and adaptive closed-loop glucose control in a type 1 diabetic swine model.

LONG, D. S. (2004) Dissertation: Theoretical and experimental investigations of microvascular hemodynamics *in vivo* using micro-particle image velocimetry.

EL-KHATIB, F. H. (2001) Thesis: A non-Newtonian model of pulsatile blood flow in a cylindrical tube. M.S. thesis, University of Illinois at Urbana-Champaign, Urbana, Illinois.

STACE, T. M. (1999) Thesis: An electrochemical model of the diffusion of charged molecules through the capillary glycocalyx. Honours thesis, University of Western Australia, Perth, Australia. *Awarded "Year 2000 Malcolm Baron Imperial College Prize for best engineering honours thesis in any discipline of engineering" by the Imperial College Alumni Association, Perth.*

*Doctoral Committee Member* —

David S. Long (Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign); Dmitri O. Pushkin (Theoretical and Applied Mechanics, University of Illinois at Urbana-Champaign); Firas H. El-Khatib (Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign); Min Tang (Biomedical Engineering, Boston University); Kenneth Chrobak (Biomedical Engineering, Boston University); Kenneth Halvorsen (Biomedical Engineering, Boston University); Wynter J. Duncanson (Biomedical Engineering, Boston University); Steven Meyers (Biomedical Engineering, Boston University); Andrew Golden (Biomedical Engineering, Boston University); Daniel R. Potter (Molecular Biology, Cell Biology, Biochemistry Program, Boston University); Michele D. Savery (Biomedical Engineering, Boston University); Prashant Bansal (Biomedical Engineering, Boston University); Catherine Calabro (Biomedical Engineering, Boston University); Michele D. Savery (Biomedical Engineering, Boston University); Jesse Locke (Biomedical Engineering, Boston University)

*Masters Committee Member* —

Deanna Behrens (Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign); Alex Stetsyuk (Biomedical Engineering, Boston University)

**OUTREACH ACTIVITIES** —

DAMIANO, E. R. An academic research career in the biomedical sciences. *Acton-Boxborough Regional High School Career Breakfast*, Acton, Massachusetts, March 2008.

DAMIANO, E. R. An academic research career in the biomedical sciences. *Acton-Boxborough Regional High School Career Breakfast*, Acton, Massachusetts, December 2009.

**SOCIETY AFFILIATIONS** —

American Diabetes Association (ADA); Biomedical Engineering Society (BMES); Microcirculatory Society (MCS)

**INVITED SEMINARS** —

DAMIANO, E. R. Closing in on closed-loop control. *JDRF – Canadian Chapter Annual Meeting*, Toronto, Canada, September 2009.

DAMIANO, E. R. The role of the endothelial glycocalyx in cardiovascular health and disease. *Center for Engineering in Medicine, Shriners Hospitals for Children*, Boston, Massachusetts, December 2008.

DAMIANO, E. R. Closed-loop studies using insulin and glucagon. *FDA/NIH/JDRF Workshop, "Towards An Artificial Pancreas,"*, Bethesda, Maryland, July 2008.

DAMIANO, E. R. Closing in on closed-loop control. *JDRF – New England Chapter Annual Meeting*, Worcester, Massachusetts, June 2008.

DAMIANO, E. R. Closing in on closed-loop control. *JDRF – North Central Connecticut Chapter Annual Meeting*, Hartford, Connecticut, June 2008.

DAMIANO, E. R. The role of the endothelial glycocalyx in cardiovascular health and disease. *Vascular Biology and Therapeutics Program, Yale University*, New Haven, Connecticut, April 2008.

DAMIANO, E. R. Closing in on closed-loop control. *MicroCHIPS, Inc.*, Bedford, Massachusetts, September 2007.

DAMIANO, E. R. Closing in on closed-loop control. *Endocrinology Grand Rounds, University of Massachusetts Medical School*, Worcester, Massachusetts, June 2007.

DAMIANO, E. R. Analysis of the microfluidics near vascular endothelium in vivo and in vitro reveals inadequacies of the endothelial-cell culture model. *Division of Engineering, Brown University*, Providence, Rhode Island, April 2006.

DAMIANO, E. R. Automated adaptive blood-glucose control using dual subcutaneous insulin and glucagon infusion in diabetic swine. *Joslin Diabetes Center*, Boston, Massachusetts, April 2006.

DAMIANO, E. R. Analyzing particle image velocimetry data using kinematic viscometry: Application to microvascular hemodynamics. *Hatsopoulos Microfluids Laboratory, Massachusetts Institute of Technology*, Cambridge, Massachusetts, March 2005.

DAMIANO, E. R. Using micro-viscometry to extract physiologically relevant information from microvessels *in vivo*. *Department of Mechanical and Aerospace Engineering, Rutgers University*, Piscataway, New Jersey, November 2004.

DAMIANO, E. R. Using micro-viscometry to extract physiologically relevant information from microvessels *in vivo*. *Department of Biomedical Engineering, University of North Carolina at Chapel Hill*, Chapel Hill, North Carolina, May 2004.

DAMIANO, E. R. Extracting physiologically relevant information from microhemofluidic studies in microvessels *in vivo*. *Department of Biomedical Engineering, University of Minnesota*, Minneapolis, Minnesota, May 2004.

DAMIANO, E. R. Extracting physiologically relevant information from microhemofluidic studies in microvessels *in vivo*. *Department of Biomedical Engineering, Boston University*, Boston, Massachusetts, April 2004.

DAMIANO, E. R. Extracting physiologically relevant information from microhemofluidic studies in microvessels *in vivo*. *Department of Engineering Science and Mechanics, Virginia Polytechnic Institute and State University*, Blacksburg, Virginia, September 2003.

DAMIANO, E. R. Toward a new understanding of the interface between blood and the vascular endothelium. *Department of Biomedical Engineering, University of Virginia*, Charlottesville, Virginia, September 2003.

- DAMIANO, E. R. Extracting physiologically relevant information from microhemofluidic studies in microvessels *in vivo*. *Department of Theoretical and Applied Mechanics, University of Illinois at Urbana-Champaign*, Urbana, Illinois, September 2003.
- DAMIANO, E. R. Microhemofluidics in fuzzy-walled venules determined from intravital micro-particle image velocimetry. *Fluid, Thermal and Chemical Processes group, Division of Engineering, Brown University*, Providence, Rhode Island, April 2003.
- DAMIANO, E. R. Microhemofluidics in fuzzy-walled venules determined from intravital micro-particle image velocimetry. *Department of Biomedical Engineering, Washington University*, St. Louis, Missouri, April 2003.
- DAMIANO, E. R. Microhemofluidics in fuzzy-walled venules determined from intravital micro-particle image velocimetry. *Department of Bioengineering, Rice University*, Houston, Texas, March 2003.
- DAMIANO, E. R. Microhemofluidic studies in post-capillary venules using intravital micro-particle image velocimetry. *Department of Bioengineering, University of Utah*, Salt Lake City, Utah, November 2002.
- DAMIANO, E. R. Toward a new understanding of the interface between blood and the vascular endothelium. *Department of Bioengineering, University of California, San Diego*, La Jolla, California, March 2002.
- DAMIANO, E. R. Toward a new understanding of the interface between blood and the vascular endothelium. *Center for Computational Medicine and Biology, The Johns Hopkins University*, Baltimore, Maryland, March 2002.
- DAMIANO, E. R. Toward a new understanding of the interface between blood and the vascular endothelium. *Department of Bioengineering, Pennsylvania State University*, University Park, Pennsylvania, November 2001.
- DAMIANO, E. R. Mechano-electrochemical dynamics of cell interactions with the extracellular matrix at the luminal surface of capillary endothelial cells. *Department of Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign*, Urbana, Illinois, February 2001.
- DAMIANO, E. R. A mathematical model of red-cell motion through capillaries lined with an endothelial-cell glycocalyx. *Department of Mechanical Engineering/Biomedical Engineering Program, University of Rochester*, Rochester, New York, April 1997.
- DAMIANO, E. R. Fluid–structure interactions of blood with a macromolecular surface layer lining the capillary wall. *Department of Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign*, Urbana, Illinois, April 1997.
- DAMIANO, E. R. Fluid–structure interactions of blood with a macromolecular surface layer lining the capillary wall. *Department of Biomedical Engineering, University of Michigan*, Ann Arbor, Michigan, April 1997.
- DAMIANO, E. R. Fluid–structure interactions of blood with a macromolecular surface layer lining the capillary wall. *School of Mechanical Engineering, Purdue University*, West Lafayette, Indiana, March 1997.
- DAMIANO, E. R. Fluid–structure interactions of blood with a macromolecular surface layer lining the capillary wall. *Department of Engineering Science and Mechanics, Virginia Polytechnic Institute and State University*, Blacksburg, Virginia, February 1997.
- DAMIANO, E. R. Fluid–structure interactions in vestibular and microvascular biomechanics. *Department of Mechanical Engineering, State University of New York at Stony Brook*, Stony Brook, New York, May 1996.
- DAMIANO, E. R. Three-dimensional fluid mechanics in the vestibular semicircular canals. *Department of Biomedical Engineering, University of Virginia*, Charlottesville, Virginia, January 1996.
- DAMIANO, E. R. Three-dimensional fluid mechanics in the vestibular semicircular canals. *Department of Mechanical, Aeronautical and Nuclear Engineering, University of Virginia*, Charlottesville, Virginia, September 1994.
- DAMIANO, E. R. A singular perturbation model of fluid dynamics in the vestibular canal. *Department of Mechanical Engineering, Washington University*, St. Louis, Missouri, January 1994.
- DAMIANO, E. R. A singular perturbation model of fluid dynamics in the vestibular canal. *Department of Mechanical Engineering, University of Rochester*, Rochester, New York, October 1993.

#### ABSTRACTS & CONFERENCE PROCEEDINGS ( \* denotes invited ) —

- DAMIANO\*, E. R. (2009) Model predictive closed-loop control with insulin and glucagon. 45th Annual Meeting of the European Association for the Study of Diabetes, Vienna, Austria, September 29–October 2, 2009.
- DAMIANO\*, E. R. (2009) Closing in on closed-loop control. Friends for Life Conference and Expo, National Children with Diabetes Conference, Orlando, FL, July 7–12, 2009.

- RUSSELL, S. J., EL-KHATIB, F. H., NATHAN, D. M., SUTHERLIN, R. G. & DAMIANO, E. R. (2009) A clinical feasibility trial of bi-hormonal closed-loop blood glucose control for type 1 diabetes. 69th Scientific Sessions of the American Diabetes Association, San Francisco, CA, June 5–9, 2009.
- EL-KHATIB, F. H., JIANG, J., NATHAN, D. M., RUSSELL, S. J. & DAMIANO\*, E. R. (2008) Closed-loop blood-glucose control using dual subcutaneous infusion of insulin and glucagon in ambulatory diabetic pigs. Eighth Annual Diabetes Technology Meeting, Bethesda, MD, November 13–15, 2008.
- POTTER, D. R., JIANG, J. & DAMIANO, E. R. (2008) The recovery time course of the endothelial glycocalyx after enzymatic and cytokine degradation. Proceedings of the 2008 BMES Annual Fall Meeting, St. Louis, MO, October 2–4, 2008.
- SAVERY, M. D., JIANG, J. & DAMIANO, E. R. (2008) A vasoprotective role for free-radical scavenger therapies in chronically hyperglycemic NOD mice. Proceedings of the 2008 BMES Annual Fall Meeting, St. Louis, MO, October 2–4, 2008.
- DAMIANO\*, E. R. (2008) Closing in on closed-loop control. Friends for Life Conference and Expo, National Children with Diabetes Conference, Orlando, FL, July 23–27, 2008.
- POTTER, D. R., JIANG, J. & DAMIANO\*, E. R. (2008) Restoration of the hydrodynamically relevant endothelial glycocalyx after enzymatic-, cytokine-, and free-radical-mediated degradation *in vivo*. 13th International Congress of Biorheology and 6th International Conference on Clinical Hemorheology, Penn State University, State College, PA, July 9–13, 2008.
- EL-KHATIB, F. H., JIANG, J. & DAMIANO, E. R. (2008) Closed-loop blood-glucose control using dual subcutaneous infusion of insulin and glucagon in ambulatory diabetic pigs. 68th Scientific Sessions of the American Diabetes Association, San Francisco, CA, June 6–10, 2008.
- SAVERY, M. D., JIANG, J. & DAMIANO, E. R. (2008) Using  $\mu$ -PIV to assess the role of insulin and free radical scavenger therapies in treating the effects of chronic hyperglycemia on the microvascular glycocalyx of NOD mice. Experimental Biology 2008, San Diego, CA, April 5–April 9, 2008.
- POTTER, D. R., JIANG, J. & DAMIANO, E. R. (2008) The recovery time course of the endothelial glycocalyx after enzymatic and cytokine degradation. Experimental Biology 2008, San Diego, CA, April 5–April 9, 2008.
- SAVERY, M. D. & DAMIANO, E. R. (2008) Using  $\mu$ -PIV to interrogate the endothelial surface layer in arterioles *in vivo*. Experimental Biology 2008, San Diego, CA, April 5–April 9, 2008.
- SAVERY, M. D. & DAMIANO\*, E. R. (2007) Using  $\mu$ -PIV to interrogate the endothelial surface layer in arterioles *in vivo*. 41st Asilomar Conference on Signals, Systems and Computers, Pacific Grove, CA, November 4–7, 2007.
- EL-KHATIB, F. H., JIANG, J. & DAMIANO, E. R. (2007) Closed-loop blood-glucose control using dual subcutaneous infusion of insulin and glucagon in ambulatory diabetic pigs. Seventh Annual Diabetes Technology Meeting, San Francisco, CA, October 25–27, 2007.
- SAVERY, M. D. & DAMIANO, E. R. (2007) Using  $\mu$ -PIV to interrogate the endothelial surface layer in arterioles *in vivo*. 2007 BMES Fall Annual Meeting, Los Angeles, CA, September 27–29, 2007.
- SAVERY, M. D., JIANG, J. & DAMIANO, E. R. (2007) Using  $\mu$ -PIV to examine the effects of hyperglycemia on the ESL in venules of NOD mice *in vivo*. 2007 BMES Fall Annual Meeting, Los Angeles, CA, September 27–29, 2007.
- RICHTER, V., PRIES, A. R., GASSMANN, M. & DAMIANO, E. R. (2007) Microrheology in skeletal muscle vessels upon increased erythropoietin (EPO) levels. 2007 BMES Fall Annual Meeting, Los Angeles, CA, September 27–29, 2007.
- YAO, Y., CIESLEWICZ, M., HUANG, H., DAMIANO, E. R. & DEWEY, C. F. (2007) Dynamics of the endothelial glycocalyx layer subjected to unsteady flow. 2007 BMES Fall Annual Meeting, Los Angeles, CA, September 27–29, 2007.
- DAMIANO\*, E. R. (2007) Closing in on closed-loop control. Friends for Life Conference and Expo, National Children with Diabetes Conference, Orlando, FL, July 11–15, 2007.
- EL-KHATIB, F. H., JIANG, J. & DAMIANO, E. R. (2007) Adaptive closed-loop control provides robust blood-glucose regulation using dual subcutaneous insulin and glucagon infusion in ambulatory diabetic swine. 67th Scientific Sessions of the American Diabetes Association, Chicago, IL, June 22–26, 2007.
- POTTER, D. R. & DAMIANO, E. R. (2007) Using micro-particle image velocimetry to interrogate the endothelial-cell glycocalyx *in vitro* after hyaluronin and hyaluronidase treatments. Experimental Biology 2007, Washington, DC, April 28–May 2, 2007.
- ROY, B. C., TRONGNETRPUNYA, A., JIANG, J. & DAMIANO, E. R. (2007) Microhemoviscometric analysis of blood flow in glass tubes. Experimental Biology 2007, Washington, DC, April 28–May 2, 2007.
- SAVERY, M. D. & DAMIANO, E. R. (2007) Using fluorescent micro-particle image velocimetry to interrogate



- the endothelial surface layer in arterioles , *in vivo*. Experimental Biology 2007, Washington, DC, April 28–May 2, 2007.
- SAVERY, M. D., JIANG, J. & DAMIANO, E. R. (2007) Using fluorescent micro-particle image velocimetry to examine the effects of chronic hyperglycemia on the endothelial surface layer in venules of NOD mice *in vivo*. Experimental Biology 2007, Washington, DC, April 28–May 2, 2007.
- EL-KHATIB, F. H., JIANG, J. & DAMIANO\*, E. R. (2006) Closed-loop blood-glucose control using dual subcutaneous insulin and glucagon infusion *in vivo*. Sixth Annual Diabetes Technology Meeting, Atlanta, GA, November 2–4, 2006.
- EL-KHATIB, F. H., JIANG, J., GERRITY, R. G. & DAMIANO, E. R. (2006) Pharmacodynamics and stability of subcutaneously infused glucagon in a type 1 diabetic swine model *in vivo*. Fifth Annual Diabetes Technology Meeting, Atlanta, GA, November 2–4, 2006.
- POTTER, D. R., TIEN, J. & DAMIANO\*, E. R. (2006) Using near-wall microfluidics and micro-PIV to interrogate the glycocalyx on HUVECs *in vitro*. 2006 BMES Fall Annual Meeting, Chicago, IL, October 11–14, 2006.
- EL-KHATIB, F. H., JIANG, J. & DAMIANO, E. R. (2006) Closed-loop blood-glucose control using dual subcutaneous insulin and glucagon infusion *in vivo*. 2006 BMES Fall Annual Meeting, Chicago, IL, October 11–14, 2006.
- POTTER, D. R., TIEN, J. & DAMIANO\*, E. R. (2006) Using fluorescent micro-particle image velocimetry to interrogate the surface glycocalyx on cultured endothelial cells in collagen microchannels. 5th World Congress of Biomechanics, Munich, Germany, July 29–August 4, 2006.
- EL-KHATIB, F. H., JIANG, J. & DAMIANO, E. R. (2006) Optimized, self-learning, *in vivo* blood-glucose control using dual subcutaneous infusion in a type 1 diabetic swine model. 66th Scientific Sessions of the American Diabetes Association, Washington, DC, June 9–13, 2006.
- EL-KHATIB, F. H., JIANG, J. & DAMIANO, E. R. (2006) Closed-loop blood-glucose control using dual subcutaneous insulin and glucagon infusion *in vivo*. Massachusetts Biotechnology Council Diabetes Summit Conference, Boston, MA, May 31, 2006.
- POTTER, D. R., TIEN, J. & DAMIANO, E. R. (2006) Using fluorescent micro-particle image velocimetry to interrogate the surface glycocalyx on cultured endothelial cells in collagen microchannels. Experimental Biology 2006, San Francisco, CA, April 1–5, 2006, (Abstr).
- DAMIANO, E. R., RICHTER, V. & PRIES, A. R. (2005) Microviscometric analysis of venular blood flow in Epo-mice before and after isovolemic hemodilution. 2005 BMES Fall Annual Meeting, (Abstr).
- DAMIANO, E. R., POTTER, D. R. & TIEN, J. (2005) Using fluorescent micro-particle image velocimetry to interrogate the surface glycocalyx on cultured endothelial cells in collagen microchannels. Experimental Biology 2005 (Abstr).
- LONG, D. S., SMITH, M. L., PRIES, A. R., LEY, K. & DAMIANO, E. R. (2004) Micro-viscometry reveals reduced blood viscosity in microvessels after isovolemic hemodilution. *Proceedings of the 2004 BMES Fall Annual Meeting*, 6.P5.133, p. 116, Philadelphia, PA, October 13–16, 2004, (Abstr).
- DONG, G., SMITH, M. L., LEY, K., DAMIANO, E. R. & ACTON, S. T. (2004) Detection of microspheres in venules for automated particle image velocimetry. *The 17th IEEE Symposium on Computer-Based Medical Systems*, Bethesda, MD.
- LONG, D. S., SMITH, M. L., PRIES, A. R., LEY, K. & DAMIANO, E. R. (2004) Micro-viscometry reveals reduced blood viscosity in microvessels after isovolemic hemodilution. *FASEB J.*, (Abstr).
- LONG, D. S., SMITH, M. L., PRIES, A. R., LEY, K. & DAMIANO, E. R. (2003) A micro-viscometric method predicts viscosity and hematocrit profiles in venules using  $\mu$ -PIV. *Proceedings of the 2003 BMES Fall Annual Meeting*, 6.P5.133, p. 116, Nashville, TN, October 1–4, 2003 (Abstr).
- LONG, D. S., SMITH, M. L., LEY, K., PRIES, A. R. & DAMIANO, E. R. (2003) Microhemofluidics in post-capillary venules determined from fluorescent intravital micro-particle image velocimetry. *Proceedings of the 2003 Bioengineering Conference*, pp. 799–800, Key Biscayne, FL, June 25–29, 2003 (Abstr).
- SMITH, M. L., LONG, D. S., DAMIANO, E. R. & LEY, K. (2003) High-resolution near-wall fluorescent micro-particle image velocimetry reveals the presence of a hemodynamically relevant endothelial surface layer in microvessels *in vivo*. *Proceedings of the 2003 Bioengineering Conference*, pp. 383–384, Key Biscayne, FL, June 25–29, 2003 (Abstr).
- VINK, H., STACE, T. M. & DAMIANO, E. R. (2003) High-resolution three-dimensional intravital fluorescence microscopy reveals partial exclusion of polyanionic plasma tracers near the capillary wall and predicts glycocalyx fixed-charge density. *Proceedings of the 2003 Bioengineering Conference*, pp. 387–388, Key Biscayne, FL, June 25–29, 2003 (Abstr).
- LONG, D. S., SMITH, M. L., LEY, K., PRIES, A. R. & DAMIANO, E. R. (2003) Estimation of cross-

- sectional viscosity and hematocrit profiles and other rheological parameters in smooth glass tubes using fluorescent micro-particle image velocimetry. *FASEB J.*, **17**, A129–A130 (Abstr).
- LONG, D. S., SMITH, M. L., LEY, K. & DAMIANO, E. R. (2003) Estimation of cross-sectional viscosity and hematocrit profiles and other rheological parameters in venules using intravital fluorescent micro-particle image velocimetry. *FASEB J.*, **17**, A129 (Abstr).
- SMITH, M. L., LONG, D. S., DAMIANO, E. R. & LEY, K. (2003) High-resolution near-wall fluorescent micro-particle image velocimetry reveals the presence of a hemodynamically relevant endothelial surface layer in microvessels *in vivo*. *FASEB J.*, **17**, A130 (Abstr).
- VINK, H., STACE, T. M. & DAMIANO, E. R. (2003) High resolution 3D intravital fluorescence microscopy reveals partial exclusion of anionic tracers within a 1 micron thick capillary endothelial cell glycocalyx. *FASEB J.*, **17**, A70 (Abstr).
- LONG, D. S., SMITH, M. L., LEY, K. & DAMIANO, E. R. (2002) Theoretical and experimental investigations into the motion of neutrally buoyant microspheres in the plasma-rich layer of venules. *FASEB J.*, **16**, A518 (Abstr).
- LONG, D. S., SMITH, M. L., LEY, K. & DAMIANO, E. R. (2002) A semi-empirical approach to determining the cross-sectional viscosity distribution and other rheological parameters *in vivo*. *FASEB J.*, **16**, A519 (Abstr).
- SMITH, M. L., LONG, D. S., DAMIANO, E. R. & LEY, K. (2002) Evidence for an endothelial-cell glycocalyx layer from high-resolution velocity profiles measured in venules *in vivo*. *FASEB J.*, **16**, A518 (Abstr).
- VINK, H., STACE, T. M. & DAMIANO, E. R. (2002) Partial exclusion of polyanionic dextran- and ficoll-sulfate tracers near the capillary wall predicts endothelial-cell glycocalyx fixed-charge density *in vivo*. *FASEB J.*, **16**, A511 (Abstr).
- EL-KHATIB, F. H. & DAMIANO, E. R. (2001) A numerical study of a non-Newtonian model for blood under pulsatile flow in a cylindrical tube. *Ann. Biomed. Eng.*, **29**, Supp. 1, S-78 (Abstr).
- LONG, D. S., SMITH, M. L., LEY, K. & DAMIANO, E. R. (2001) Flow of microspheres in the plasma layer of venules: Theory versus experiment. *Ann. Biomed. Eng.*, **29**, Supp. 1, S-27 (Abstr).
- SMITH, M. L., LONG, D. S., DAMIANO, E. R. & LEY, K. (2001) Experimental and theoretical analysis of shear rate and apparent viscosity of blood flow in venules. *Ann. Biomed. Eng.*, **29**, Supp. 1, S-73.5 (Abstr).
- VINK, H., SPAAN, J. A. E., STACE, T. M. & DAMIANO, E. R. (2001) Analysis of the charge-mediated exclusion of polyanionic plasma tracers by the capillary glycocalyx. *Ann. Biomed. Eng.*, **29**, Supp. 1, S-73.5 (Abstr).
- VINK, H., DAMIANO, E. R. & SPAAN, J. A. E. (2001) Spatial analysis of the distribution of charged plasma tracers across the capillary glycocalyx. 7th World Congress for Microcirculation, Sydney, Australia (Abstr).
- DAMIANO, E. R., STACE, T. M. & VINK, H. (2001) Theoretical and experimental investigations of the fixed-charge density of the capillary glycocalyx. *FASEB J.*, **15**, A42 (Abstr).
- DAMIANO\*, E. R. & STACE, T. M. (2000) Mechanics of the capillary glycocalyx and its influence on electrophoretic molecular mobility: A mechano-electrochemical model. *Ann. Biomed. Eng.*, **28**, Supp. 1, S-71 (Abstr).
- STACE, T. M. & DAMIANO, E. R. (2000) On the electrochemical diffusion of charged molecules through the capillary glycocalyx. *FASEB J.*, **14**, A27 (Abstr).
- DAMIANO, E. R. & STACE, T. M. (2000) A model of the mechano-electrochemical dynamics of the capillary glycocalyx. *FASEB J.*, **14**, A7 (Abstr).
- STACE, T. M. & DAMIANO\*, E. R. (1999) On the electrochemical diffusion of charged molecules through the capillary glycocalyx. EMBEC '99.
- STACE, T. M., PUSHKIN, D. O. & DAMIANO, E. R. (1999) A model of the electrochemical equilibrium configuration of the capillary glycocalyx. 1999 BMES/EMBS Fall Annual Meeting. *Ann. Biomed. Eng.*, **27**, Supp. 1 (Abstr).
- STACE, T. M. & DAMIANO, E. R. (1999) A mechano-electro-chemical model of flow, deformation, and molecular diffusion in the capillary glycocalyx. *FASEB J.*, **13**, (Abstr).
- DAMIANO\*, E. R. (1998) A tertiary mixture model of blood flow in glycocalyx-lined microvessels. 1998 BMES Fall Annual Meeting. *Ann. Biomed. Eng.*, **26**, Supp. 1, S-29 (Abstr).
- DAMIANO, E. R. (1998) Blood flow in microvessels lined with a poroelastic wall layer. In *Poromechanics*. (eds J.-F. Thimus, Y. Abousleiman, A.H.-D. Cheng, O. Coussy & E. Detournay) pp. 403–408, Balkema.
- DAMIANO\*, E. R. (1998) A mathematical theory of blood flow in microvessels lined with an endothelial-cell glycocalyx. In *Proceedings of the 20th European Conference on Microcirculation*. (eds P.H. Carpentier,

- E. Vicaut & J-L. Guilmot) pp. 157–164, Monduzzi Editore.
- DAMIANO, E. R. & PRICE, R. J. (1998) A semi-empirical model of blood flow in glycocalyx-lined microvessels. *FASEB J.*, **12**, A10 (Abstr).
- DAMIANO, E. R. (1997) An axisymmetric model of red blood cell motion through capillaries lined with a glycocalyx. 1997 BMES Fall Annual Meeting. *Ann. Biomed. Eng.*, **25**, Supp. 1, S-39 (Abstr).
- DAMIANO, E. R. (1997) A biphasic model of the cupula and the response dynamics of the vestibular semicircular canal. 1997 BMES Fall Annual Meeting. *Ann. Biomed. Eng.*, **25**, Supp. 1, S-58 (Abstr).
- DAMIANO, E. R. (1997) A two-dimensional model of red-cell motion between parallel plates coated with biphasic macromolecular surface layers. *Proceedings of the 1997 Bioengineering Conference*, ASME BED-Vol. **35**, 541–542.
- DAMIANO, E. R. (1997) A biphasic model of the cupula and the low-frequency mechanics of the vestibular semicircular canal. *Proceedings of the 1997 Bioengineering Conference*, ASME BED-Vol. **35**, 61–62.
- DAMIANO, E. R. (1997) A two-dimensional mathematical model of red-cell motion between parallel plates lined with macromolecular surface layers. *Vascular Biology '97, Microcirculation*, **4**, 165 (Abstr).
- DAMIANO, E. R., DULING, B. R., LEY, K. & SKALAK, T. C. (1996) Fluid–structure interactions of the endothelial-cell glycocalyx, blood cells, and plasma in the microcirculation. 1996 Euromech 344, *Fluid–structure interactions in Biomechanics*, London, UK (Abstr).
- DAMIANO, E. R., DULING, B. R., LEY, K. & SKALAK, T. C. (1995) Fluid–structure interactions of the endothelial-cell glycocalyx and blood in the microcirculation. *Ann. Biomed. Eng.*, **23**, Supp. 1, S-22 (Abstr).
- RABBITT, R. D. & DAMIANO, E. R. (1995) Fluid–structure interaction in the ampullary region of the vestibular semicircular canal. *Proceedings of the 1995 Bioengineering Conference*, ASME BED-Vol. **29**, 317–318.
- DAMIANO, E. R., DULING, B. R. & SKALAK, T. C. (1995) A continuum model of the interaction between the endothelial-cell glycocalyx and blood: Implications for microcirculatory rheology. 42nd Annual Meeting, Microcirculatory Society. Atlanta, Georgia.
- WESTHEIDER, J., TÖZEREN, A., DAMIANO, E. R. & LEY, K. (1995) Adhesion (fracture) energy density of rolling leukocytes. 42nd Annual Meeting, Microcirculatory Society. *Microcirculation*, **2**, 106 (Abstr).
- RABBITT, R. D., BOYLE, R., HIGHSTEIN, S. M. & DAMIANO, E. R. (1994) Macromechanical endolymph pressure and flow describe responses to step mechanical indentation of the fish vestibular labyrinth. 24th Annual Meeting, *Soc. for Neuroscience*, Miami Beach, Florida.
- DAMIANO, E. R. & RABBITT, R. D. (1994) Mechanics of motion transduction by the semicircular canals. *Second World Congress of Biomechanics*, Amsterdam, The Netherlands.
- RABBITT, R. D., DAMIANO, E. R., HIGHSTEIN, S. M., BOYLE, R. & STEINACKER, A. (1994) Theory of the origins of the vestibular semicircular canal dynamics in the toadfish, *Opsanus tau*. Midwinter Meeting, *Assoc. for Res. in Otolaryngology*, St. Petersburg, Florida.
- RABBITT, R. D. & DAMIANO, E. R. (1990) Macromechanics of the endolymphatic semicircular canal. *First World Congress of Biomechanics*, La Jolla, California.