

# CURRICULUM VITAE

(Emeritus Version)

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# 1 General Biographical Information

## 1.1 Basic Data

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My University Website:		<a href="http://faculty.washington.edu/forster">http://faculty.washington.edu/forster</a>

## 1.2 Educational History

Ph.D., Stanford University, Aeronautical Engineering, 1972

Dissertation: *The Effects of In-Vivo Strain on the Dynamic Behavior of Blood Vessels*

M.S., Stanford University, Aeronautical Engineering, 1968

B.S., University of Illinois, Aeronautical & Astronautical Engineering, 1966

## 1.3 Employment History

2006-present Emeritus Professor - Mechanical Engineering, University of Washington, Seattle, Washington.

1987-2006 Associate Professor - Mechanical Engineering, University of Washington, Seattle, Washington.

1984-1987 Research Associate Professor - Mechanical Engineering, Adjunct Research Associate Professor - Center for Bioengineering, University of Washington, Seattle, Washington.

1979-1984 Research Assistant Professor - Mechanical Engineering, Adjunct Research Assistant Professor - Center for Bioengineering, University of Washington, Seattle, Washington.

1977-1978 Research Engineer - Center for Bioengineering, University of Washington. Fluid mechanics aspects of ultrasonic duplex scanning instrument development project.

1974-1976 Postdoctoral Fellow - Center for Bioengineering, University of Washington, Seattle, Washington. Development of techniques to quantify blood flow disturbances with ultrasonic Doppler techniques.

1974 Project Engineer - MB Associates, San Ramon, California. Responsible for structural and aerodynamic development of military ordinance systems.

1971-1972 Research Assistant - Institut für biomedizinische Technik an der Universität und ETH Zürich. Investigations into the use of multi-channel Doppler flow meter techniques to detect vascular disease

1966-1969 Graduate Study Engineer - Lockheed Missile and Space Company, Sunnyvale, California. Structural design and analysis of aerospace vehicles and management of structural testing programs.

### 1.3.1 Areas of Current and Past Interest

- Micro fluid handling systems
- Physiological fluid dynamics
- Ultrasonic techniques for biological tissue characterization and flow measurements
- Acoustical characterization of materials
- Applications of engineering to medicine including analysis of electrocardiogram arrhythmias, noninvasive blood pressure measurement, aerosol deposition, wave propagation and large deformation elasticity

### 1.3.2 Topics Taught

- Fluid Mechanics
- Heat Transfer
- Thermodynamics.
- Continuum Mechanics
- Statics
- Dynamics
- Systems Analysis
- Acoustics
- Engineering Mathematics

## 2 Publications

Publications available on-line can be seen by clicking on any highlighted file name.

### 2.1 Archival and Proceedings Papers

Publications available on-line can be seen by clicking on any highlighted file name.

- [1] F. K. Forster and T. Walter. Design optimization of fixed-valve micropumps for miniature cooling system. In *IPACK 2007 Proceedings of the ASME InterPack Conference—2007*, volume 1, pages 137–145, Vancouver, B.C., July 8–12 2007. ASME, N.Y.  
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- [3] D. Faulkner, C. Ward, D. Gilbuena, R. Shekariz, and F. K. Forster. Fixed valve piezoelectric micropump for miniature thermal management module. In *Proceedings of the ASME Fluids Engineering Division Summer Meeting and Exhibition (Miami)*, Miami, June 17–20 2006.  
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- [5] A. R. Gamboa and F. K. Forster. Is there a best fixed-geometry valve for micropumps? In *Proceedings of the ASME Fluids Engineering Division 2004 (Anaheim)*, Anaheim, Nov. 13–19 2004.  
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- [6] Christopher J. Morris, Jone Y. Chung, Patricia E. Rahm, Fred K. Forster, Reza Shekariz, and Daniel Faulkner. Electronic cooling systems based on fixed-valve micropump networks. In *Solid-State Sensor, Actuator and Microsystems Workshop*, pages 152–155, Hilton Head Island, South Carolina, June 6–10 2004. Transducers Research Foundation, Inc.  
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- [7] C. J. Morris and F. K. Forster. Oscillatory flow in microchannels: comparison of exact and approximate impedance models with experiment. *Exp. Fluids*, 36(6):928–937, 2004.  
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- [8] D. Wittren, R. Shekariz, and F. K. Forster. Pulsed spray generation for microfluidic applications, paper imece2003-43943. In *Proceedings of the ASME Fluids Engineering Division 2003*, volume FED-Vol. 259, pages 613–618, Washington, D.C., 2003. ASME.  
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- [9] A. R. Gamboa, C. J. Morris, and F. K. Forster. Optimized fixed-geometry valves for laminar flow micropumps. In *Proceedings of the ASME Fluids Engineering Division 2003 (Washington, D.C.)*, volume FED-259, pages 525–534, Nov. 15–21 2003.  
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- [10] W. G. Guntheroth, F. K. Forster, and J. G. Stevenson. Cause of normal pulmonic velocity in fetal tetralogy. *Am. J. Cardiol.*, 92(December 15):1485–1487, 2003.  
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- [11] C. J. Morris and F. K. Forster. Low-order modeling of resonance for fixed-valve micropumps based on first principles. *J. Microelectromech. Syst.*, 12(3):325–334, 2003.  
Available on-line as [morris03a.pdf](#).
- [12] Fred K. Forster and Brian E. Williams. Parametric design of fixed-geometry microvalves—the Tesser valve. In A. Ogut, editor, *Proceedings of the ASME Fluids Engineering Division, International Mechanical Engineering Congress and Exposition (New Orleans)*, volume FED-258, pages 431–437, New Orleans, Nov. 17–22 2002. ASME.  
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- [13] T. T. Veenstra, N. R. Sharma, F. K. Forster, J. G. E. Gardeniers, M. C. Elwenspoek, and A. van den Berg. The design of an in-plane compliance structure for microfluidical systems. *Sens. and Act. B*, 81(2–3):377–383, 2002.  
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- [18] Christopher J. Morris and Fred K. Forster. The correct treatment of harmonic pressure-flow behavior in microchannels. In *Micro-Electro-Mechanical Systems (MEMS), 2000 ASME International Mechanical Engineering Congress and Exposition*, volume MEMS-2, pages 473–479, Orlando, Nov. 5–10, 2000.  
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- [19] Christopher J. Morris and Fred K. Forster. The design-fix for fixed-valve micropumps. In *Solid-State Sensor and Actuator Workshop, Late News Poster Session Supplemental Digest*, Hilton Head Island, June 4–8 2000. Transducers Research Foundation, Inc.  
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- [20] Ling-Sheng Jang, Nigel R. Sharma, and Fred K. Forster. The effect of particles on the performance of fixed-valve micropumps. In A. van den Berg, W. Olthuis, and P. Bergveld, editors, *Micro Total Analysis Systems 2000*, pages 283–286, Enschede, May 14–18 2000. Kluwer Academic Publishers.  
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- [21] Ling-Sheng Jang, Christopher J. Morris, Nigel R. Sharma, Ron L. Bardell, and Fred K. Forster. Transport of particle-laden fluids through fixed-valve micropumps. In A. P. Lee, F. K. Forster, Y. C. Lee, K. Goodson, and R. S. Keynton, editors, *Micro-Electro-Mechanical Systems (MEMS), ASME International Mechanical Engineering Congress and Exposition*, volume MEMS-1, pages 503–509, Nashville, November 14–19 1999. ASME.  
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- [22] P. Galambos and F. K. Forster. An optical micro-fluidic viscometer. In C. J. Kim et al., editors, *Micro-Electro-Mechanical Systems (MEMS), ASME International Mechanical Engineering Congress and Exposition (Anaheim)*, volume DSC-66, pages 187–191, New York, November 15-20 1998. ASME. Available on-line as [galambos98b.pdf](#).
- [23] R. Bardell and F. K. Forster. Impedances for design of microfluidic systems. In D. J. Harrison and A. van den Berg, editors, *Micro Total Analysis Systems (Banff)*, pages 299–302, Dordrecht, October 13-16 1998. Kluwer Academic Publishers. Available on-line as [bardell98.pdf](#).
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- [43] F. K. Forster, J. E. Olerud, G. R. Pomajevich, A. W. Holmes, and S. R. Sharar. High-frequency ultrasonic imaging and backscatter attenuation techniques for determination of thermal injury to the skin. In B. R. McAvoy, editor, *Ultrasonics Symposium Proceedings (Williamsburg)*, volume 2, pages 957–962, New York, November 17–19 1986. IEEE Cat. No. 86CH2375-4.  
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- [45] F. K. Forster, P. M. Chikos, and J. S. Frazier. Geometric modeling of the carotid bifurcation in humans: Implications in ultrasonic Doppler and radiologic investigations. *J. Clin. Ultrasound*, 13(6): 385–390, 1985.  
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- [46] N. L. Ricker and F. K. Forster. Pulse Doppler ultrasonic velocity measurement in aqueous pulp fiber suspensions. *TAPPI Journal*, 68(1):79–82, 1985.  
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- [47] F. K. Forster and D. Turney. Modeling the oscillometric method of blood pressure measurement. In D. Butler, T. K. Hung, and R. E. Mates, editors, *Biomechanical Symposium (Albuquerque)*, volume AMD-68/FED-21, pages 159–162, New York, June 24-26 1985. ASME.  
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- [48] F. K. Forster, J. E. Olerud, E. L. Gow, and M. A. Riederer-Henderson. Estimates of acoustic inhomogeneities in skin from the variation in backscatter efficiency at high ultrasonic frequencies. In B. R. McAvoy, editor, *Ultrasonics Symposium Proceedings (San Francisco)*, volume 2, pages 851–854, New York, October 16-18 1985. IEEE Catalog No. 85CH2209-5.  
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## 2.2 Patents

Publications available on-line can be seen by clicking on any highlighted file name.

- [1] B. H. Weigl, P. Yager, J. Brody, M. R. Holl, F. K. Forster, E. Altendorf, P. C. Galambos, M. Kenny, D. Shutte, G. Hixson, D. Zebert, A. Kamholz, and C. Wu. Microfabricated devices and methods. U. S. Patent No. 6,454,945, September 24 2002.  
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## 2.3 Books and Editing

### 2.3.1 Chapters in Edited Books

1. Baker, D. W., Forster, F. K., and Daigle, R. (1978) "Doppler principles and techniques," in *Ultrasound: Its Application in Medicine and Biology*, Part I, Vol. 3 of *Methods and Phenomena: Their Application in Science and Technology*, F. B. Fry, ed., Elsevier Publishing Co. pp. 161-287.

### 2.3.2 Books Edited

1. *Micro-Electro-Mechanical Systems (MEMS) 2000*, ASME International Mechanical Engineering Congress and Exposition (Orlando) MEMS-Vol. 2, Lee, A. P.; Forster, F. K.; Lee, Y. C.; Goodson, K.; Keynton, R. S., Eds., ASME, New York, 2000.
2. *Micro-Electro-Mechanical Systems (MEMS) 1999*, ASME International Mechanical Engineering Congress and Exposition (Nashville) MEMS-Vol. 1, Lee, A. P. and Forster, F. K. and Lee, Y. C. and Goodson, K. and Keynton, R. S. Eds., ASME, New York, 1999.
3. *Micro-Electro-Mechanical Systems (MEMS) 1998*, ASME International Mechanical Engineering Congress and Exposition (Anaheim) DSC-Vol. 66, L. Lin, F.K. Forster, N.R. Aluru and X. Zhang, Eds., ASME, New York, 1998.

### 2.3.3 Abstracts and Non-refereed Papers

1. Gu, S., Orr, J., Yan, J., Forster, F., and Johnson, R. (1993) "Neural network and physical model can accurately estimate continuous cardiac output," *Anesthesiology*, Vol. 79:3A, pg. A467.
2. Forster, F. K., Cullen, G. V., and Wang, T. H. (1992) "Limitations of diffraction correction techniques in the estimation of acoustic attenuation in biological media," *J. Acoust. Soc. Am.*, Vol. 92, No. 4, pg. 2377.
3. Holmes, A. W., Forster, F. K., Olerud, J. E. and Sharar, S. R. (1988) "Acoustical quantification of thermal injury," *J. Acoust. Soc. Am.*, Vol. 83, pg. S110.
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12. Forster, F.K., Garbini, J.L. and Jorgensen, J.E. (1975) "Hemodynamic turbulence measurements using ultrasonic techniques, *Biotelemetry*, Vol. 2, No.s 1-2, pp. 84-85.

## 3 Other Scholarly Activity

### 3.1 Invited Lectures and Seminars

3rd Annual MEMS Technology Seminar, ASME Continuing Education Institute, “Active Microfluidic Devices and Systems Parts I and II,” Los Angeles, May 20, 2003

Joint ASME/European Fluids Engineering Division Summer Conference. “Workshop on Nano and Microfluid Dynamics,” Montreal, July 17, 2002

2nd Annual MEMS Technology Seminar, ASME Continuing Education Institute, “Active Microfluidic Devices and Systems Parts I and II,” Boston, June 18, 2002

University of Sydney, Sydney, Australia, School of Aerospace, Mechanical and Mechatronic Engineering, “MEMS and the Growth of Microfluidics,” May 2, 2001.

University of Alberta, Edmonton, Alberta, Canada, Department of Chemistry, “Transport in Microdevices—a Mechanical Engineering View,” April 10, 2001.

Northwestern University, Evanston, IL, Technological Institute, “Microfluidics—A Short History and Examples of Innovation,” January 12, 2001.

International Mechanical Engineering Congress and Exposition, Fluids Engineering Division Plenary Lecture, Orlando, FL, “Micro Fluid Mechanics — What is Left to Do?” November 6, 2000.

Motorola, Laboratories, “Fixed-Valve Micropump Technology,” November, 11, 2000.

DARPA MicroFluidic Molecular Systems Principal Investigators’ Meeting, Tucson, AZ, “A Microfluidic Sample Preconditioning System for CBW Agent Detection and Quantification,” January 19-21, 2000. Similar format talks also given in Pittsburgh, PA, July, 1999, San Diego, CA, December, 1998, Hilton Head, SC, June, 1998 and San Diego, CA, December, 1997.

Lucas Nova Sensors, Fremont CA, “Transport of Particle-Laden Fluids in Micro Fluidic Systems for Separation and Detection of CBW Agents,” September 1, 1999.

BCI 4th Annual Conference on Microfabrication & Microfluidic Technologies, San Francisco, CA, “Microtechnologies for Sample Handling of Particulates with Pressure-Driven Flow,” August 2-3, 1999.

American Organization of Analytical Chemists International (AOAC), Pacific Northwest Regional Meeting, Opening Address, University of Puget Sound, Tacoma, WA, “Microfluidic Technology – Advances by Thinking Small,” June 17, 1999.

University of Washington, Department of Chemistry, “What does Microfluidics Mean to a Mechanical Engineer?” April 29, 1999.

University of Minnesota, Department of Bioengineering, “Focusing on Things You Can Do by Understanding Fluid Mechanics & Thinking Small,” April 26, 1999.

Center for Process Analytical Chemistry (CPAC), Summer Institute, University of Washington, “Focusing on Things You Can Do by Understanding Fluid Mechanics and Thinking Small,” July, 1998.

Center for Process Analytical Chemistry (CPAC), Summer Institute, University of Washington, “Micropumps,” July, 1997.

### 3.2 Additional Scholarly Activity

#### 3.2.1 Book Review Activities

*Non-Equilibrium Electrokinetics for the Design of Microfluidic Devices* by Hsueh-Chia Chang and Leslie Yeo, Springer Verlag, 2005.

*Fluid Mechanics: Fundamentals and Applications, 2nd Ed.* by Y.A. Çengel and J.M. Cimbala, McGraw-Hill, 2004.

*Fundamentals of Fluid Mechanics, 5th Ed.* by B.R. Munson, *et al.*, John Wiley & Sons, 2004.

*Advanced Fluid Mechanics* by William P. Graebel, CRC Press, 2003.

*Fluid Mechanics: Fundamentals and Applications, 2nd Ed.* by Y.A. Çengel and J.M. Cimbala, McGraw-Hill, 2002

*Fundamentals of Fluid Dynamics* by Andreas N. Alexandrou, Prentice Hall, 2000.

*Fluid Mechanics: Theory and Applications* by Aaron D. Deutschman, Oxford University Press, 1998.

### **3.2.2 Manuscript Review Activities**

For the review of individual manuscripts, journals are listed in order of most recent reviews. Each year noted means one or more reviews were performed:

Lab on a Chip

2008

Journal of Micromechanics and Microengineering

2009, 2008, 2006, 2005, 2002

Journal of Applied Physics

2008

Microfluidics and Nanofluidics

2007, 2004

Journal of Microelectromechanical Systems

2009, 2007, (2002-2005 Associate Editor), 2002, 2001, 2000, 1999, 1998

Langmuir

2007

Sensors and Actuators Series A

2006, 2004, 2002, 2000, 1999, 1997

Experiments in Fluids 2006, 2004

Applied Physics Letters

2006

Biomedical Microdevices

2006

Canadian Journal of Chemical Engineering

2006

Measurement Science and Technology

2006

Smart Materials and Structures

2006

Journal of Fluids Engineering, Transactions of the ASME

2005, 2004, 2002

IEE Proc. Science, Measurement & Technology

2005, 2004

BioTechniques

2004

Journal of Colloid and Interface Science

2003

Microscale Thermophysical Engineering

2003

Analytical Chemistry

2002, 2001

Annals of Biomedical Engineering

2002, 2001, 2000, 1999, 1998, 1997, 1996, 1995, 1994, 1993

Sensors and Actuators Series B

2002

ElectroChemical Society Letters

1999

Journal of the Electrochemical Society

1999

Computational Fluid Dynamics

1997

IEEE Trans. Ultrasonics, Ferroelectrics, and Frequency Control

1996, 1995, 1989, 1988, 1986, 1985

Journal of Biomechanical Engineering, Transactions of ASME

1995, 1983

IEEE Transactions on Medical Imaging

1994, 1993, 1987

Journal of Radiology

1989

American Society of Heating Refrigeration and Air Conditioning (ASHRAE)

1988

IEEE Transactions on Biomedical Engineering

1986, 1985

Atherosclerosis

1985, 1982, 1981

IEEE Trans. Sonics and Ultrasonics

1984, 1982, 1980, 1979

Ultrasonic Imaging

1981

Ultrasound in Medicine and Biology

1978



## 4 Service

### 4.1 Professional Society, Conference Organization, Journal Editorship

#### 4.1.1 Professional Societies

American Society of Mechanical Engineers (ASME), Fluids Engineering Division:

Member, Awards Committee 2002–2006

Chair, Micro and Nano Fluid Dynamics Technical Committee, 2001–2004

Founded Micro and Nano Fluid Dynamics Technical Committee, 2001

Fluid Mechanics Technical Committee, 1994–2001

American Society of Mechanical Engineers, MEMS Division

Executive Committee, 1999–2000

Technical Committee, 2000–2003

Micro-Electro-Mechanical Systems Proceedings Editor, 1998, 1999, 2000

Acoustical Society of America

Committee on Education in Acoustics 1993–1996

American Heart Association

Council on Basic Science 1983–1995

Acoustical Society of America

Committee on Education in Acoustics 1993–1996

American Society of Mechanical Engineers, Division of Bioengineering

Fluid Mechanics Committee, 1989–1995

#### 4.1.2 Conference Organization

2004 International Mechanical Engineering Congress & Exposition, Washington D.C., November 15–21, 2004. Member of technical committee for Symposium Micro Nano Fluid Mechanics.

2003 International Mechanical Engineering Congress & Exposition, Washington D.C., November 15–21, 2003. Member of technical committee for Symposium on the Application of Micro-Fabrication to Fluid Mechanics.

ITherm 2002, Eighth Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems, Reviewer for BioMEMS contributions.

2002 International Mechanical Engineering Congress & Exposition, New Orleans, November 11–16, 2002. Member of technical committee for Symposium on the Application of Micro-Fabrication to Fluid Mechanics.

2001 International Mechanical Engineering Congress & Exposition, New York, November 15–20, 2001. Member of technical committee for Symposium on the Application of Micro-Fabrication to Fluid Mechanics.

2000 International Mechanical Engineering Congress & Exposition, Orlando, Florida, November 5–10, 2000. Chaired ten-member organizing committee for the Symposium on the Application of Micro-Fabrication to Fluid Mechanics, chaired a ten-member Technical Committee, editor of the Micro-Electro-Mechanical Systems Proceedings, MEMS-Vol. 2.

1999 International Mechanical Engineering Congress & Exposition, Nashville, Tennessee, November 14–19, 1999. Chaired ten-member organizing committee for the Application of Micro-Fabrication to Fluid Mechanics, editor of the Micro-Electro-Mechanical Systems Proceedings, MEMS-Vol. 1.

1998 International Mechanical Engineering Congress & Exposition, Anaheim, California, November 15–20, 1998. Chaired four-member organizing committee for the Application of Micro-Fabrication to Fluid Mechanics, editor of the Micro-Electro-Mechanical Systems Proceedings, DSC-Vol. 66.

1996 International Mechanical Engineering Congress & Exposition, Atlanta, Georgia, November 12-17, 1996. Session chair, “Applications of Microfabrication to Fluid Mechanics I,”

American Society of Mechanical Engineers 115th Winter Annual Meeting, Chicago, Illinois, November 6-11, 1994. Session Co-chair, “Doppler Ultrasound Applications in Cardiovascular Fluid Mechanics” and “MRI/Doppler Ultrasound Applications in Cardiovascular Fluid Mechanics.”

American Society of Mechanical Engineers 113th Winter Annual Meeting, Anaheim, California, November 8-13, 1992. Chaired “Fluid Mechanics Issues in Ultrasonic Flow Measurement Techniques” and vice-chaired “Heart Valve Fluid Dynamics/Ultrasound.”

International Continence Society Halifax, Nova Scotia, August 31-September 1, 1992. Co-chaired Workshop on Urethral Obstruction.

115th Meeting of the Acoustical Society of America, Seattle Washington, May 16-20, 1988. Member of the local organizing committee.

1986 Devices and Technology Branch Contractors Meeting, Heart, Lung, and Blood Institute, National Institutes of Health Bethesda, Maryland, December 8-10, 1986. Chaired, Plaque Characterization Program.

American Society of Mechanical Engineers 99th Winter Annual Meeting, San Francisco, California, December 10-15, 1978. Vice-chaired Session on Non-invasive Measurement Techniques.

#### **4.1.3 Journal Editorships**

Associate Editor, Journal of Microelectromechanical Systems, 2002–2005, Richard Muller, Editor-in-Chief.

### **4.2 Community Service**

Microfluidics work contributed to local community news. The Seattle Post Intelligencer, October 16, 1996, front page and February 2, 1997, Pg. E2 and numerous other regional papers such as the Bellingham Herald, Eugene Register-Guard and Skagit Valley Herald have published coverage on my work.

My work in microfluidics has also been reported nationally in a number of professional magazines such as Small Packages, by R.B. Peterson, *Mechanical Engineering*, June 2001, pp. 58–61, *New Scientist*, July 11, 1998, pg.28, *New Scientist*, March 1, 1997, pg. 19 and *Engineering*, February, 1997, pg. 73.

I have consulted for over 25 companies, law firms and individuals since 1980. I have provided expertise primarily in the areas of biomedical device development and microelectro-mechanical systems, including international litigation as an expert on biomedical devices.

### **4.3 National or Governmental Service**

#### **4.3.1 Panels and Study Sections**

National Science Foundation, FY 2005 Fluid Dynamics and Hydraulics Program Unsolicited Proposal evaluation panel for the Fluid and Particle Processes Program, sub-element “Fluid Dynamics and Hydraulics”. Michael W. Plesniak, Program Manager, Washington D.C., December 6–7, 2004.

National Science Foundation, Division of Design, Manufacture, and Industrial Innovation, Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR) Biochips II Panel, Om P. Sahai, Program Manager, Washington D.C., April 5–6, 2004.

National Science Foundation Panel, Division of Chemical and Transport Systems, Fluid and Particle Processes Program, Fluid Dynamics and Hydraulics, Fiscal Year 2003 Faculty Early Career Development (CAREER) Panel, Michael W. Plesniak, Program Manager, Washington D.C., November 12–13, 2002.

National Science Foundation Workshop on Manufacturing of Micro-Electro-Mechanical Systems, Orlando, FL, November 6-7, 2000. The final report “NSF 2000 Workshop on Manufacturing of Micro-Electro-Mechanical Systems,” is in a special issue in *Journal of Materials Processing and*

*Manufacturing Science* (2000) Vol. 8, No. 4, pp. 292-360. It may also be available for a limited time at <http://www.eas.asu.edu/~nsf2000/>.

National Institutes of Health, National Heart, Lung, and Blood Institute, Special Study Section Eight, SBIR Program, Washington D.C., November 9–10, 1987.

National Institutes of Health, National Heart, Lung, and Blood Institute, Special Study Section Eight, ad hoc review group member for SBIR program, Bethesda Maryland July 12-14, 1987. *Chairman for July 12 session.*

National Institutes of Health, National Heart, Lung, and Blood Institute, Special Study Section Eight ad hoc site visit team member for SBIR program, Lebanon, New Hampshire, June 12–13, 1986.

National Institutes of Health, National Heart, Lung, and Blood Institute, Special Study Section Eight ad hoc review group member for SBIR program, Washington, D. C., December, 1986.

National Institutes of Health, National Cancer Institute, ad hoc technical review group member for Small Business Innovative Research (SBIR) program, Chevy Chase Maryland, May 6–8, 1985.