Curriculum Vitae

Hratch G. Semerjian, Ph.D.

NIST Chief Scientist Emeritus

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Visiting Professor
Mechanical Engineering Department
Senior Research Scientist
Chemical and Biomolecular Engineering Dept.
University of Maryland
College Park, MD

EDUCATION:

University of Toronto, Toronto, Ontario, Canada, 1971-73
Post-Doctoral Research Fellow and Lecturer, Department of Chemistry

Brown University, Providence, RI, 1966-1971
Division of Engineering (Fluid Mech. & Thermo.)
Ph.D. in Engineering (awarded in 1972)
Major: Fluid Mechanics and Thermodynamics
Minors: Applied Mathematics, Electromagnetic Theory
Dissertation: "Spectroscopic Study of the Behavior of Xenon Behind a Shock Wave".
M.Sc. in Engineering (1968)
Thesis: "Design and Operation of a Cloud Chamber for Determination of Condensation and Nucleation Rates".

Robert College, (now Bosphorus Univ.) Istanbul, Turkey, 1961-1966
B.Sc. (Honors) in Mechanical Engineering (1966)

Primary (1950-55) and Secondary (1955-61) Education in the Armenian School System, Istanbul, Turkey; Diploma in Sciences with High Honors (1961)

PERSONAL:

Born October 22, 1943 in Istanbul, Turkey
U.S. Citizen, Naturalized 1976

PROFESSIONAL EXPERIENCE:

S&T CONSULTANT (Sept. 2010 – Present)

Areas of Expertise: Combustion (Gaseous Pollutant and Particulate Formation), Optical Diagnostics, Physical and Chemical Metrology, Renewable Energy, Greenhouse Gas Emissions, and Climate Change. **Recent Activities**: Consulting for NRCC (National Research Council of Canada), SASO (Saudi Arabian Standards Organization), PTB (Physikalisch-Technische Bundesanstalt – Germany), NIM (National Institute of Metrology – China), MSI Universal, The World Bank, NIST, and OAS (Organization of American States). Organized an ***International Conference on Biofuels Standards: Current Issues, Future Trends*** (ICBS-2012), November 2012. Organized a series of international workshops on ***Renewable Energy and Climate Science*** in the Americas (Mexico, Guatemala, Uruguay, Colombia, Jamaica) to promote expanded use of renewable resources and reducing our impact on global climate (2013-2015). Served on a National Academies Committee studying ***Low Carbon Aviation*** (2015)

THE COUNCIL FOR CHEMICAL RESEARCH, Washington, DC
President & Executive Director *(Sept. 2007 – Aug. 2010)*.

CCR is a nonprofit organization founded in 1979 to advance research in chemistry, chemical engineering, and related disciplines through leadership collaboration across discipline, institution, and sector boundaries. CCR representatives include research leaders from almost 200 member companies, universities, and government laboratories that conduct research in the chemical sciences. As President and Exec. Dir., was responsible for promoting partnerships, and advocating for R&D investments in chemical sciences. Organized CTO Roundtables on Manufacturing and Graduate Education; NIChE (New Industrial Chemistry and Engineering) Conferences on current topics such as Carbon Capture and Sequestration, MicroReactor Technologies, etc; workshops on assessment of economic impact of R&D investments and on ***Intellectual Property Issues Affecting Industry-University Partnerships***; and helped develop an industry roadmap on ***Sustainable Manufacturing*** by the Chemical Industry ***Vision 2020*** Technology Partnership.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (formerly National Bureau of Standards), Dept. of Commerce, Gaithersburg, MD (1977-2007):

NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. NIST carries out its mission through: a) the Measurement and Standards Laboratories; b) the Advanced Technology Program; c) the Manufacturing Extension Partnership Program; and d) the Baldrige National Quality Program. NIST had a total budget of about $800 million, a permanent staff of 2,800, as well as about 1,600 guest researchers from industry, academia, and other national metrology institutes from more than 70 countries. NIST has four Nobel Prize winners on its staff. More than 1,000 researchers also come to NIST to use the NIST Center for Neutron Research (NCNR) and the Center for Nanoscale Science and Technology (CNST). Most of the NIST researchers are located in two major campuses in Gaithersburg, MD and Boulder, CO. NIST also has four joint research institutes, including JILA with the Univ. of Colorado; IBBR (Institute for Bioscience and Biotechnology Research) with the Univ. of Maryland; the Hollings Marine Laboratory in Charleston, SC, with NOAA, So. Carolina Dept. Natural Resources, Medical Univ. of South Carolina, and the College of Charleston; JQI (Joint Quantum Institute) and JCQICS (Joint Center for Quantum Information and Computer Science) with the Univ. Maryland.

Chief Scientist, NIST (July 2006 – August 2007)

As NIST Chief Scientist, served as Senior Science Advisor to the NIST Director, and as a member of the NIST Senior Management Team; provided leadership, guidance and strategic direction throughout the Institute; was primarily responsible for: a) monitoring and guiding the quality of scientific and technical resources of NIST; coordination of external reviews of technical programs; developing and sharing best practices for program planning and management; b) identification and analysis of specific technology opportunities, and development of new initiatives; and participation in NIST-wide strategic planning efforts; c) expanding NIST outreach efforts and partnerships with industry, academia and other federal agencies; identifying new opportunities and facilitating interactions with appropriate NIST staff; d) articulating the impact of NIST programs; enhancing the visibility of NIST programs within U.S. industry; and promoting effective transfer of NIST technology to industry; e) promoting and planning of STEM education programs in support of NIST mission; and f) representing NIST in national and international science & technology forums.

As NIST Chief Scientist, served as the principal NIST representative in International Commissions and Treaty organizations (e.g., CIPM, SIM, IUPAC, etc.) and developed initiatives that would enhance NIST's effectiveness on a global basis in harmonizing standards, measurements, and databases, and implementing mutual recognition arrangements. Served as the NIST representative on the U.S.-Brazil, U.S.-China, U.S.-Pakistan, and U.S.-Japan Ministerial Level Joint Commission Meetings on S&T Collaboration. Also served on advisory boards for international organizations such as AIST (Japan), NRC/INMS (Canada), VSL/NMi (Netherlands), and PRONACOM (Guatemala). Responsible for maintaining effective liaison with the Department of Commerce and other Federal Agencies on S&T matters.

Deputy Director, NIST (July 2003 – July 2006); **Acting Deputy Director, NIST** (January – November 1997)

As Deputy Director of NIST, was responsible for overall operation of the Institute, effectiveness of technical programs, strategic planning, strategic partnerships, facilities planning and management, financial and human resource management, information technology systems, and international relationships. The third Nobel Prize received in 2005 by the NIST staff was a testament to the quality of NIST technical programs and staff.

Represented NIST and the U.S. in national and international organizations; expanded NIST interactions especially in Central and South America, and the Asia Pacific; signed MOUs with the Chinese Academy of Sciences (CAS), the Korean Research Institute of Standards and Science (KRISS), and the National Metrology Institute of Japan (NMIJ). Served as the U.S. representative in the InterAmerican Metrology System (SIM), an organization of 34 countries of the Americas; also served as the NIST representative in the International Committee of Weights and Measures (CIPM), a treaty organization with representatives from more than 75 countries. Have lectured extensively on scientific, economic and policy issues nationwide and in international circles, and served on several national and international advisory committees.

Was responsible for development and improvement of NIST facilities; establishment of facility requirements, construction and completion in 2004 of the $225 million Advanced Measurements Laboratory at NIST, the world's most sophisticated research facility. Also completed a reorganization of NIST, reducing number of management levels, consolidating and redefining reporting lines, flattening the administrative organization and increasing the staff-to-manager ratio.

Acting Director, NIST (February 2004 – July 2005)

As Acting Director of NIST, managed a multidisciplinary program that included research in electronics and electrical engineering, manufacturing engineering, chemical science and technology, physics, materials science and engineering, building and fire research, and information technology; was also responsible for oversight of extramural programs such as the Advanced Technology Program, the Manufacturing Extension Partnership (to provide technical assistance to small and medium sized enterprises to improve their competitiveness through more than 75 MEP Centers located in all 50 states), and the Baldrige National Quality Program (to promote and reward performance excellence in small and large business enterprises, service organizations, health care, education and non-profit organizations).

Was responsible for formulation and defense of the NIST budget; provided testimony in Congress and other government organizations on the NIST budget, NIST programs, and specific responsibilities assigned to NIST, such as the **National Construction Safety Team** (NCST) Act, **Help America Vote Act** (HAVA), **Federal Information Security Management Act** (FISMA), and **Presidential Directives on Homeland Security** (HSPD). Provided briefings for the Secretary of Commerce and Deputy Secretary, for OMB and OSTP staff, and for House and Senate Members and their staff. Developed new interdisciplinary research programs such as Quantum Information, Manufacturing Enterprise Integration, Nanomanufacturing, Biosystems and Health, Measurements and Standards for International Trade, Measurements and Standards for Public Safety and Security, Biometrics, Cybersecurity, etc.

Served as the Chair of the **Technical Guidelines Development Committee** (TGDC) that was charged by HAVA with providing guidelines on voluntary voting system standards for the Election Assistance Commission (EAC); provided oversight for the **World Trade Center Collapse** investigation, a responsibility assigned to NIST by the NCST Act; and responded to a Presidential Directive to develop Federal Information Processing Standards (FIPS) on **Personal Identity Verification**, a system to be used by all Federal Agencies. Initiated a new undertaking to develop standards for **Health Care Information Technology**, in collaboration with HHS, to facilitate information sharing and to help reduce health care costs. Responded to requests from DHS and DoJ to develop standards for biometrics, ionizing radiation, and infrastructure and fire safety, to strengthen the nation's homeland security efforts.

Initiated new strategic partnerships as well as nurtured existing partnerships with University of Colorado, the University of Maryland, NOAA, Medical Univ. of So. Carolina, and College of Charleston. Signed an MOU with the University of Maryland to establish a new joint effort on **Nanomanufacturing**; MOU with the National Cancer Institute (NCI) on **Nanobiotechnology**; expanded relationships with HHS, NIH, NIBIB, FDA, DOD, DOE, NSF, NOAA, DOT and DHS. NIST responded to a request from the **US Council on Automotive Research** (USCAR), which included all three major U.S. car manufacturers, to establish a collaborative research program to improve their competitiveness.

Director, Chemical Science and Technology Laboratory, NIST (April 1992 – July 2003);

As Director of the Chemical Science and Technology Laboratory (CSTL), at the time one of the seven Laboratories of NIST, was responsible for overall management and direction of a multidisciplinary program including research in analytical chemistry, physical chemistry, chemical kinetics, thermodynamics, surface chemistry, process technology, thermophysics and biotechnology. CSTL had a total budget of about $60 million, and a permanent staff of about 300 scientists and engineers, as well as approximately 100 postdoctoral research scientists and other temporary staff; 75% of the technical staff held Ph.D. degrees. CSTL was responsible for realization and dissemination of national standards for SI Units of temperature

and amount of substance (chemical composition), and derived units of pressure, vacuum, flow, liquid volume and density, humidity, and air speed. CSTL provided more than seventy-five percent of the SRMs and SRDs disseminated by NIST, as well as a significant fraction of the Calibration Services. Developed a strategic partnership with NOAA, South Carolina Dept. of Natural Resources, Medical Univ. of South Carolina, and College of Charleston, and established the **Hollings Marine Laboratory** in Charleston, SC. This Laboratory has become one of the world's leading research institutes on the marine environment and its impact on marine species. Was also responsible for management of the **Center for Advanced Research in Biotechnology** (CARB), a joint research institute between NIST and the University of Maryland.

As a Laboratory Director, was responsible for development of CSTL Strategic Plan. Implemented new programmatic initiatives on Environmental Technology, Biotechnology and BioInformatics, Semiconductor Metrology, High Performance Computing, Measurements & Standards for International Trade, Nanotechnology, and Meas'ts & Standards for Health Care; was successful in getting appropriated funding for the first major NIST program in **life sciences**. Provided Congressional testimony and interacted with Congressional staff to promote new programs and facilities, and to defend current programs. Developed plans for an **Advanced Chemical Sciences Laboratory**, an $80 million research facility, which led to the construction of an advanced laboratory for Biotechnology and Analytical Chemistry activities of CSTL.

Represented CSTL and NIST in national and international fora; interacted with a broad range of industries, industry groups and trade organizations (e.g., API, CCR, NCSL, SEMATECH, SIA, AIChE/DIPPR, GRI, BIO) and standards developing organizations such as ANSI, ASME, NCCLS, ASTM, etc., to assess industry's measurement and standards needs. Represented NIST and the U.S. in international organizations such as the **International Bureau of Weights and Measures** (BIPM) and **InterAmerican Metrology System** (SIM) that play a critical role in international trade and lowering of ***technical barriers to trade***. Interacted with national metrology institutes in numerous other countries.

Chief, Process Measurements Division, **CSTL** (formerly Center for Chemical Technology-CCT) (October 1987 - March 1992)

As a Division Chief, was responsible for overall supervision and direction of a large interdisciplinary technical staff (about 75 FTP and 20 others, including about 30 Ph.D.'s), involved in a wide range of research areas, including fluid mechanics, fluid flow metrology, bioprocess metrology, two-phase reacting and non-reacting flows, high temperature reacting flows, process sensing, computational fluid mechanics, modeling of reacting flows, development of instrumentation and measurement techniques for temperature, composition, velocity, flow rate, droplet/particle characterization, optical sensing techniques for reacting flows and bioreactors, hazardous waste combustion, solid state sensors, and superconductivity. Was responsible for realization and dissemination of national standards for temperature, pressure, vacuum, flow, humidity, liquid density and volume, and air speed.

Group Leader, High Temperature Reacting Flows, Chemical Process Metrology Division, CCT (1977-87)

As a Group Leader, was responsible for introduction of combustion research and laser diagnostics as new areas of research activity in the Center. Established internationally recognized laboratories on combustion controls, laser diagnostics, laser tomography, spray combustion, particulate formation and high temperature chemically reacting flows. The optical diagnostics efforts were extended to applications in bioreactors, chemical vapor deposition and metals processing. Acquired more than $10M of research funding from other federal agencies during this period.

UNITED TECHNOLOGIES CORPORATION, Pratt & Whitney Aircraft Division (CPD), **Research Engineer and Assistant Project Engineer,** ***Combustion Technology and Research Group, East Hartford, CT (1973-1977):***

Was responsible for development of analytical models to predict the IR radiation from gas turbine engines; managed an Air Force contract on Turbine Engine IR Signatures, and related experimental program on supersonic flow tests at AEDC, Arnold AFS, TN. In addition, was responsible for establishment of a Combustion Laboratory for investigation of flame stability and pollutant formation processes in gas turbine combustors, to support the development of PWA JT8D and JT9D engines installed on Boeing 737 and 747 aircraft. Also prepared major proposal to NASA on catalytic combustion, which was subsequently funded.

UNIVERSITY OF TORONTO, Department of Chemistry, **Post-Doctoral Research Fellow and Lecturer in Chemistry,** ***Toronto, Ontario, CANADA (1971-1973):***

Initiated and directed research on experimental and theoretical studies of gaseous detonation waves and their limit behavior. Also supervised two doctoral students. Participated in teaching two undergraduate chemistry courses: Basic Concepts of Modern Chemistry and Physical Chemistry.

A. AWARDS AND HONORS:

Hagopian Scholarship (1961-65) awarded at Robert College, Istanbul, Turkey.

A.M.&F. Corporation Fellowship for Outstanding Scholarship in Mechanical Engineering (1965) awarded at Robert College, Istanbul, Turkey.

Fulbright Fellowship (1966) awarded for studies in the U.S.A. (one of four offered in Turkey) (declined).

C. B. Keen Fellowship (1969) awarded at Brown University, Providence, RI.

U.S. Department of Commerce **Silver Medal** for Meritorious Federal Service (1984) awarded at the National Bureau of Standards for "Outstanding research on optical diagnostic techniques".

U.S. Department of Commerce "**Federal Engineer of the Year**" (1991) awarded by the National Society of Professional Engineers for "Outstanding leadership in managing seminal engineering research efforts in combustion, thin film sensors and bioprocess engineering - research of vital importance to the Nation's competitive position".

U.S. Department of Commerce **Gold Medal** for Distinguished Achievement in the Federal Service (1995) awarded at the National Institute of Standards and Technology for "Managerial and scientific leadership as Director of the Chemical Science and Technology Laboratory".

NIST **Equal Employment Opportunity Award** (1995) for "...his concerted efforts in diversifying the Chemical Science and Technology Laboratory workforce".

Elected **Fellow**, the American Society of Mechanical Engineers (ASME International) (1996).

Brown University **Distinguished Engineering Alumni Medal** (1997).

Elected to the **National Academy of Engineering** (2000).

B. MEMBERSHIP IN PROFESSIONAL BODIES:

American Institute of Aeronautics and Astronautics, Washington, DC (since 1967)
The Combustion Institute, Pittsburgh, PA (since 1976)
American Society of Mechanical Engineers, New York, NY (since 1976)
American Institute of Chemical Engineers, New York, NY (since 1984)
American Chemical Society, Washington, DC (since 1992)
Council for Chemical Research, Washington, DC; CCR Governing Board (1993-96)
American Association for the Advancement of Science, Washington, DC (since 1988)
International Committee of Weights and Measures (CIPM), Paris, France;
Consultative Committee on Amount of Substance (CCQM); member 1996-2007;
Elected member of CIPM in 2003.
National Academy of Engineering (NAE) (2000); Chem. Engineering Peer Comm. (2001-2004)
Industrial Research Institute (IRI), Arlington, VA (2005-2007)

C. OTHER PROFESSIONAL ACTIVITIES:

Gas Research Institute (GRI) Research Coordination Council; member 1995 - 1998.
National Science and Technology Council (NSTC);
Committee on Technology; Member, Joint Subcommittee on Environmental Technology (1993-95)
President's Council on Sustainable Development; EcoEfficiency Task Force (1993-95)
DoC Environmental Technology Working Group (1993-96)
InterAmerican Metrology System (SIM), Rio de Janeiro, **Brazil (**U.S. Rep. : 1998-2007)
National Research Council (NRC) - Chemical Sciences Roundtable (1999-2002)
Government-University-Industry Research Roundtable (GUIRR) (2003-2005)
National Research Council of Canada (NRCC), Institute for National Measurement Standards (INMS) Advisory Board, Ottawa, **Canada** (2001-2009)
National Academy of Engineering (NAE);
Chemical Engineering Peer Committee; member (2001-2004);
Committee on Low Carbon Aviation; member (2015-2016).
U.S. Climate Change Science Program; Subcommittee on Global Change Research (2002-2005)
Board of Visitors, College of Chemical and Life Sciences, University of Maryland, College Park, MD; member (2004-2007).
Visiting Committee, Department of Mechanical Engineering, University of Maryland, College Park, MD (since 2004).
National Council for Advanced Manufacturing (NACFAM), Board of Directors (2005-2007)
Maryland Governor's Commission on Development of Advanced Technology Business (Pappas Commission); member (2005-2006).
National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, **Japan**; Member of the AIST Advisory Board (2006-2008)
National Institute of Metrology (NIM), Beijing, **China**; Member of the NIM International Advisory Board (2009-2014)
U.S National Committee for the **International Union of Pure and Applied Chemistry** (IUPAC), Member (2011- 2015)

Served on several other Advisory and Review Panels for DoE, NSF, EPA, IDA, DoD, NOAA; reviewed proposals for many other Federal agencies, and reviewed articles for several archival journals.

D. LIST OF PUBLICATIONS (Archival and Conference Proceedings):

1. Cole, J.E., Dobbins, R.A. and Semerjian, H.G., "Time-resolved measurement of droplet size and concentration in cloud chambers", *J. Appl. Meteorology*, Vol. 9, pp. 684-689 (1970).
2. Semerjian, H.G., "Spectroscopic study of the behavior of xenon behind a shock wave", Project SQUID Tech. Report BRN-22-PU (1972).
3. Goldberg, P., Segalman, I., Semerjian, H.G. and Levy, R., "An improved turbine engine infrared signature prediction model", Proc. AIAA/JANNAF Ninth Propulsion Mtng., pp. 33-56, Las Vegas, NV (1973).
4. Dove, J.E., Scroggie, B.J. and Semerjian, H.G., "Velocity deficits & detonability limits of hydrogen-oxygen gas detonations at low pressures", *Acta Astronautica*, Vol. 1, pp. 345-359 (1974).
5. Semerjian, H.G. and Dobbins, R.A., "Temperature measurements behind shock waves using a line radiation technique", *Physics of Fluids*, Vol. 17, pp. 2169-2175 (1974).
6. Semerjian, H.G., Segalman, I. and Goldberg, P., "Effect of mixer nozzles on the turbine engine plume IR signature", Proc. 12th IRIS Symp. on IR Countermeasures, Ft. Monmouth, NJ (1974).
7. Semerjian, H.G. and Segalman, I., "Validation of an IR prediction model with engine data", Proc. 13th IRIS Symp. on IR Countermeasures, Monterey, CA (1975).
8. Semerjian, H.G., Adams, N.G. and Segalman, I., "Turbine engine infrared signature program - Part IIIA: model improvement", UTC/PWA Tech. Report No. PWA-5274 (1975).
9. Ball, I.C., Braciak, S. and Semerjian, H.G., "A perfectly stirred reactor (PSR) model - user's manual", UTC/PWA Research Report No. BCT-76-08 (1976).
10. Segalman, I. and Semerjian, H.G., "Turbine engine infrared signature program - final report", UTC/PWA Tech. Report No. PWA-5351, AFAPL-TR-76-38 (1976).
11. Semerjian, H.G. and Segalman, I., "Turbine engine infrared signature program - user's manual", UTC/PWA Tech. Report No. PWA-5352 (1976).
12. Semerjian, H.G., Ball, I.C. and Braciak, S., "A plug flow reactor (PFR) model - user's manual", UTC/PWA Research Report No. BCT-76-09 (1976).
13. Semerjian, H.G. and Vranos, A., "NO_x formation in premixed turbulent flames", *16th Symp. (Int'l) on Combustion*, pp. 169-179, The Combustion Inst., Pittsburgh, PA (1977).
14. Semerjian, H.G. and Ball, I.C., "Potential reduction in NO_x emissions with premixed combustors", Proc. Combustion Institute/Central States Section Meeting, Cleveland, OH (1977).
15. Semerjian, H.G., Ball, I.C. and Vranos, A., "Pollutant emissions from partially mixed turbulent flames", *17th Symp. (Int'l) on Combustion*, pp. 679-687, The Combustion Institute, Pittsburgh, PA (1979).
16. Emmerman, P.J., Goulard, R., Santoro, R.J. and Semerjian, H.G., "Multiangular absorption diagnostics of a turbulent argon-methane jet", *J. Energy*, Vol. 4, pp. 70-77 (1980).
17. Santoro, R.J., Semerjian, H.G., Emmerman, P.J., Goulard, R. and Shabahang, R., "Multiangular absorption measurements in a methane-air diffusion jet", in ***Laser Probes for Combustion Chemistry***, Ed: D. Crosley, ACS Symp. Series No. 134, pp. 427-433, Amer. Chem. Soc., Washington, D.C. (1980).
18. Santoro, R.J., Semerjian, H.G., Emmerman, P.J. and Goulard, R., "Optical tomography for flow field diagnostics", *Int. J. Heat & Mass Transfer*, Vol. 24, pp. 1139-1150 (1981).
19. Semerjian, H.G. and Dove, J.E., "Predictions of pressure and composition effects on detonability limits for confined hydrogen-oxygen detonations", Proc. First Int'l Specialists Meeting of the Combustion Institute, pp. 455-460, Bordeaux, France (1981).

20. Semerjian, H.G., Santoro, R.J., Goulard, R. and Emmerman, P.J., "Optical tomography for diagnostics in combusting flows", in ***Fluid Mechanics of Combustion Systems***, Eds: T. Morel, R.P. Lohmann and J.M. Rackley, pp. 119-129, Amer. Soc. of Mech. Eng., New York, NY (1981).
21. Presser, C., Semerjian, H.G. and Juberts, M., "Evaluation of O_2 and CO monitoring systems for combustion controls", ***Advances in Instrumentation***, ISA/82, Vol. 37, pp. 1515-1536 (1982).
22. Semerjian, H.G., Ray, S.R. and Santoro, R.J., "Laser tomography for diagnostics in reacting flows", AIAA/ASME Joint Thermophysics, Fluids, Plasma & Heat Transfer Conference, Paper No. AIAA-82-0854, St. Louis, MO (1982).
23. Semerjian, H.G., Santoro, R.J., Goulard, R. and Emmerman, P.J., "Laser tomography for temperature measurements in flames", in ***Temperature: Its Measurement and Control in Science and Industry***, Ed: J.F. Schooley, Vol. 5, pp. 649-660, Amer. Inst. of Phys., Washington, D.C. (1982).
24. Whetstone, J.R., Semerjian, H.G., Presser, C., Gaigalas, A.K. and Potzick, J., "Advanced sensor development program for the pulp and paper industry", Dept. of Energy Report DOE/PR/06010-T13, NBSIR 83-2744 (1982).
25. Goulard, R., Emmerman, P.J., Santoro, R.J. and Semerjian, H.G., "High speed three-dimensional diagnostics in Combustion", in ***Energy, Resources and Environment -First U.S.-China Conference***, Ed: S.W. Yuan, pp. 162-171, Pergamon Press, New York, NY (1982).
26. Presser, C., Semerjian, H.G. and Juberts, M., "Evaluation of O_2 and CO monitoring systems for combustion controls", Dept. of Energy Report DOE/PR/06010-T14, NBSIR 83-2721 (1983).
27. Santoro, R.J., Semerjian, H.G. and Dobbins, R.A., "Soot particle measurements in diffusion flames", *Combustion & Flame*, Vol. 51, pp. 203-218 (1983).
28. Dobbins, R.A., Santoro, R.J. and Semerjian, H.G., "Interpretation of optical measurements of soot in flames", in ***Combustion Diagnostics by Nonintrusive Methods***, Eds: T.D. McCay and J.A. Roux, Progress in Astronautics and Aeronautics, Vol. 92, pp. 208-237, Amer. Inst. of Aero. & Astro., New York, NY (1984).
29. Goulard, R., Emmerman, P.J., Santoro, R.J. and Semerjian, H.G., "Three-Dimensional Diagnostics of Transport Phenomena", *Annals of the New York Academy of Sciences*, Vol. 404, p. 347 (1983).
30. Presser, C. and Semerjian, H.G., "Evaluation of industrial combustion control systems", Dept. of Energy Report DOE/CS/40521-T1 (1984).
31. Ray, S.R. and Semerjian, H.G., "Laser tomography for simultaneous concentration and temperature measurement in reacting flows", in ***Combustion Diagnostics by Nonintrusive Methods***, Eds: T.D. McCay and J.A. Roux, Progress in Astronautics and Aeronautics, Vol. 92, pp. 300-324, Amer. Inst. of Aero. & Astro., New York, NY (1984).
32. Whetstone, J.R., Semerjian, H.G., Gaigalas, A.K., Charagundla, S.R. and Potzick, J., "Advanced sensor development program for the pulp and paper industry", Dept. of Energy Report DOE/PR/06010-T33 (1984).
33. Clay, D.T., Grace, T.M., Kapheim, R.J., Semerjian, H.G., Macek, A., and Charagundla, S.R., "Fundamental studies of black liquor combustion", Dept. of Energy Report DOE/CE/40637-T1 (1985).
34. Presser, C., Gupta, A.K., Santoro, R.J. and Semerjian, H.G., "Droplet size measure- ments in a swirling kerosene spray flame by laser light scattering", Proc. Third Intern. Conf. on Liquid Atomization and Spray Systems (ICLASS-85), Vol. 2, pp. VIIC/2/1-13, The Institute of Energy, London (1985).
35. Preston, R.E., Lettieri, T.R. and Semerjian, H.G., "Characterization of single levitated droplets by Raman spectroscopy", *Langmuir - The ACS J. of Surfaces and Colloids*, Vol. 1, No. 3, pp. 365-367 (1985).

36. Santoro, R.J. and Semerjian, H.G., "Soot formation in diffusion flames: flow rate, fuel species and temperature effects", *20th Symp. (Int'l) on Combustion*, pp. 997-1006, The Combustion Institute, Pittsburgh, PA (1985).
37. Santoro, R.J., Yeh, T.T. and Semerjian, H.G., "The transport and growth of soot particles in laminar diffusion flames", in ***Heat Transfer in Fire and Combustion Systems***, Eds: C.K. Law, Y. Jaluria, W.W. Yuen and K. Miyasaka, pp. 57-69, Amer. Soc. of Mech. Eng., New York, NY (1985).
38. Charagundla, S.R. and Semerjian, H.G., "A remote sensing technique for combustion gas temperature measurement in black liquor recovery boilers", Proc. SPIE 1986 International Symposium, ***Optical Techniques for Industrial Inspection***, Vol. 665, pp. 298-305 (1986).
39. Horvath, J.J. and Semerjian, H.G., "Laser excited fluorescence studies of black liquor", Proc. SPIE 1986 Int'l Symposium, ***Optical Techniques for Industrial Inspection***, Vol. 665, pp. 258-264 (1986).
40. Presser, C., Gupta, A.K., Santoro, R.J. and Semerjian, H.G., "Velocity and droplet size measurements in a fuel spray", AIAA 24th Aerospace Sciences Meeting, Paper No. AIAA-86-0297, Reno, NV (1986).
41. Presser, C., Gupta, A.K., Santoro, R.J. and Semerjian, H.G., "Laser diagnostics for characterization of fuel sprays", Proc. 5th Int'l Congress on Appl. of Lasers and Electro-Optics (ICALEO '86), Vol. 58, pp. 160-167, Arlington, VA (1986).
42. Presser, C., Gupta, A.K., Semerjian, H.G., and Santoro, R.J., "Droplet/air interaction in a swirl-stabilized spray flame", Proc. 2nd ASME/JSME Therm. Eng. Joint Conf., Vol. 1, pp. 73-83, Amer. Soc. of Mech. Eng., New York, NY (1987).
43. Santoro, R.J., Yeh, T.T., Horvath, J.J. and Semerjian, H.G., "The transport and growth of soot particles in laminar diffusion flames", *Comb. Sci. and Tech*., Vol. 53, pp. 89-115 (1987).
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45. Presser,C., Gupta, A.K. and Semerjian, H.G., "Examination of liquid fuel spray structure using laser diagnostics", Proc. First Ann. Conf. on Liquid Atomization and Spray Systems (ILASS Americas '87), Madison, WI (June 1987).
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93. Semerjian, H.G., "A Global View of Chemical Metrology: Recent Developments and Basic Concepts," in ***Metrology in Chemistry: A New Challenge for the Americas***, Proc. the First Inter-American Workshop on Metrology in Chemistry, pp. 45-70, Rio de Janeiro, Brazil (1997).
94. Semerjian, H.G., "Technology Vision for the U.S. Chemical Industry in the 21st Century," Proc. the Sixth International Symposium on New Chemistry, p. 45, Assoc. Progress of New Chemistry, Makuhari, Japan (1997).
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97. Semerjian, H.G., "Economic Impact of Metrology Programs"***,*** Proc. International Conference on Metrology, pp.29-36, Jerusalem, Israel, (May 2000).
98. Semerjian, H.G. and Beary, E.S., ***"***Metrology: Its Impact on the Economy, Quality of Life and International Trade," ***Metrologia 2000***, Sao Paulo, Brazil, December 2000.
99. Semerjian, H. G. and Beary, E.S., "Mutual Recognition of Measurements", *IVD Technology*, Vol. 7, No. 4 (May 2001).
100. Semerjian, H.G., "Celebrating One Hundred Years of Chemistry at the National Institute of Standards and Technology"***,*** NISTIR 6388 (2001).
101. Semerjian, H.G. and Beary, E.S (Editors), Proc. of the Workshop on Measurement Traceability for Clinical Laboratory Testing and In Vitro Diagnostic Test Systems, NISTIR 6742 (May 2001).

102. Semerjian, H. G. and Beary, E.S., "Impact of Metrology on the Economy and International Trade," Proc. Metrology Society of Australia, Biennial Meeting (October 2001).
103. Semerjian, H.G. and Beary, E.S., "Impact of Metrology on the Economy and Quality of Life," Proc. International Symposium on Measurement Standards 2002, Tokyo, Japan (April 2002).
104. Semerjian, H.G. and Beary, E.S., "Temperature Metrology and Its Impact on Industry", in ***Temperature: Its Measurement and Control in Science and Industry***, Vol. 7, pp. 1-6, Eds: D.C. Ripple et al., AIP Conference Proceedings, Melville, NY (2003).
105. Semerjian, H.G., "NIST – Promoting Innovation, Competitiveness, and Facilitating Trade", in ***INFOSIM***, p. 14-20 (November 2006).
106. Semerjian, H.G., "Role of Metrology in Promoting Innovation, Competitiveness, and International Trade – A U.S. Perspective", in ***METROCHEM IV – Building Competence in Chemical Metrology for the Brazilian Society***, pp. 34-42, Ed: Vera Ponçano, Sao Paulo, Brazil (July 2007).
107. Semerjian, H.G., "Intellectual Property Issues Affecting Industry-University Partnerships", Council for Chemical Research Workshop Report (December 2009).
108. Semerjian, H.G., Editor, "Proc. 4th International Conference on Biofuels Standards: Current Issues, Future Trends", November 13-15, 2012, Gaithersburg, MD; http://www.nist.gov/mml/biofuels-standards.cfm
109. National Academies of Sciences, Engineering and Medicine, (Contributor) "***Commercial Aircraft Propulsion and Energy Systems Research-Reducing Global Carbon Emissions***", Washington, DC 2016 doi:10.17226/23490
110. Semerjian, H.G., ***NIST – The Crown Jewel of the Federal S&T Enterprise: A Brief History***, book to be published in 2017; about 1,000 pages.

E. INVITED TALKS:

"Environmental Technologies at NIST", *Environmental Tech Transfer '92*, Crystal City, VA, November 10, 1992.

"Environmental Management through Chemical Metrology", Conference on Metrology for Environmental Management, April 14, 1993.

"Environmental Technologies at NIST", NIST/NOAA Workshop on Environmental Technologies, NIST, Gaithersburg, MD, April 26, 1993.

"Environmental Technologies – NIST Strategic Plan", Workshop on Identification of Critical Measurement Needs for Waste Minimization in Industrial Processes, NIST, Gaithersburg, MD, September 15, 1993.

"Environmental Standards to Improve Quality Control", ENVIROMEX '93 Conference, Monterey, Mexico, September 22, 1993.

"The Government's New S&T Power Structure…How Can CCR Make an Impact", Council on Chemical Research Meeting, Washington, DC, February 10, 1994.

"Chemical Science and Technology at NIST", 1994 Symposium on MASINT Research & Development for Proliferation Management, Patrick Air Force Base, FL, February 22, 1994.

"Environmental Technologies and Related Standard Reference Data and Standard Reference Materials", U.S.-China S&T Joint Commission Meeting, Gaithersburg, MD, April 11, 1994.

"Environmental Technologies in CSTL", NIST/NOAA Meeting on Environmental Technologies, NIST, Gaithersburg, MD, August 29, 1994.

"NIST Industrial Interactions", Industrial Research Fellows Affiliates Meeting, Rochester, NY, October 17, 1994.

"The Federal Role in Technology", AIChE Annual Meeting, San Francisco, CA, November 15, 1994.

"Environmental Technologies: Measurement and Standards Needs", 21st Annual RREL Research Symposium, EPA, Cincinnati, OH, April 4, 1995.

"Coordination of North American Metrology Programs", Planning Meeting for North American Environmental Quality Assurance Program, NOAA, Silver Spring, MD, May 2, 1995.

"NIST and US Industry - Natural Partners", American Economic Development Council Meeting, Washington, DC, February 1, 1996.

"Bilateral Cooperation - Enhanced Regional Cooperation", Fifth U.S.-Italy Bilateral Seminar, NIST, February 26, 1996.

"Technology Vision 2020: A Chemical Industry Technology Roadmap", 211th ACS Meeting, New Orleans, LA, March 25, 1996.

"Global Measurement Comparability and Traceability", CITAC/EURACHEM Workshop on Chemical Measurement Traceability, Noordwijkerhout, **Netherlands**, September 5, 1996.

"Technology Vision 2020: A Chemical Industry Technology Roadmap-Chemical Measurements", Council on Chemical Research, 18th Annual Meeting, Wilmington, DE, September 30, 1996.

"NIST Laboratory Programs and Manufacturing", Senate Task Force on Manufacturing, Gaithersburg, MD, November 15, 1996.

"Overview of NIST Laboratory Programs", NRC Board on Assessment, Washington, DC, January, 1997.

"Technology Vision 2020: A Chemical Industry Technology Roadmap", PITTCON '97, Atlanta, GA, March 12, 1997.

"NIST Benchmark Project ", INMETRO, Rio de Janeiro, **Brazil,** May 12, 1997.

"NIST Benchmark Project ", Joint Meeting of NRLM, NIMC and ETL, Tsukuba, **Japan**, May 20, 1997.

"Technology Vision 2020: A Chemical Industry Technology Roadmap", CCR Steering Committee Meeting, Washington, DC, May 30, 1997.

"Role of Metrology in International Trade", SIM General Assembly Meeting, Queretaro, **Mexico**, September 1997.

"Technology Vision 2020: A Chemical Industry Technology Roadmap", CCR 19th Annual Meeting, St. Louis, MO, September 28, 1997.

"Technology Vision 2020: A Chemical Industry Technology Roadmap", ISA Tech '97, Anaheim, California, October 7, 1997.

"Technology Vision 2020: The U.S. Chemical Industry in the 21st Century", Sixth International Symposium on New Chemistry, Makuhari, **Japan**, October 15, 1997.

"A Global View of Chemical Metrology: Recent Developments & Basic Concepts", Workshop on Metrology in Chemistry, Rio de Janeiro, **Brazil**, November 3, 1997.

"Role of Metrology in International Trade", Instituto Nacional de Tecnologia Industrial, Buenos Aires, **Argentina**, November 6, 1997.

"Chemical Science & Technology at NIST", Chemical Engineering Department, Purdue University, Lafayette, IN, December 11, 1997.

"Technology Vision: The U.S. Chemical Industry in the 21st Century", IFPAC '98, Orlando, FL, January 15, 1998.

"Technology Vision 2020: U.S. Industry Needs for Chemical Measurement", PITTCON '98, New Orleans, LA, March 1, 1998.

"Technology Vision: The U.S. Chemical Industry in the 21st Century", Plenary Address at the Analytical & Physical Measurements Symposium at Union Carbide, Charleston, WV, April 21, 1998.

"Leveraging R&D: Research Partnerships" (Keynote Address), Dow Chemical Spring Science and Technology Meeting, Midland, MI, May 19, 1998.

"Metrology: Impact on National Economy and International Trade" (Keynote Address), PTB Seminar on the Role of Metrology in Economic and Social Development," Braunschweig, **Germany**, June 16, 1998.

"Technology Vision 2020: A Chemical Industry Technology Roadmap", ACS Meeting, Boston, MA, August 25, 1998.

"Chemical Metrology: Impact on National Economy and International Trade", Seminar on "Metrology in the New Millenium," San Jose, **Costa Rica**, September 20, 1998.

"CSTL 'Best' Management Practices", Presentation to the NIST Visiting Committee on Advanced Technology, Gaithersburg, MD, December 8, 1998.

"Chemical Metrology: Impact on National Economy and International Trade" (Keynote Address), INTEC, Santiago, **Chile**, November 17, 1998.

"Chemical Metrology at NIST", INTEC, Santiago, **Chile**, November 17, 1998.

"Chemical Technology in the 21st Century – What's NIST's Role?", AIChE National Capital Section Meeting, January 27, 1999.

"Chemical Metrology and Its Impact on International Trade", Symposium Honoring Robert Kaarls held at Netherlands Meetinstituut, Delft, **Netherlands**, February 5, 1999.

"CSTL and Its Impact on U.S. Industry", Symposium for 5th Anniversary of CENAM, Queretaro, **Mexico**, April 27, 1999.

"Chemical Metrology in the U.S.: National Traceability & International Comparability Issues"(Keynote Address), at EURACHEM 10th Anniversary Meeting, Helsinki, **Finland**, June 16, 1999.

"Chemical Measurement Traceability: The Role of Reference Materials and Other Approaches" CITAC '99 Japan Symposium, Tsukuba, **Japan**, November 10, 1999.

"Chemical Science and Technology at NIST", DuPont, Wilmington, DE, December 13, 1999.

"Chemical Science and Technology at NIST", Air Products, Allentown, PA, February 16, 2000.

"Economic Impact of Metrology Programs**,"** International Conference on Metrology, Jerusalem, **Israel**, May 16, 2000.

"Importance of Chemical Metrology for Economic Growth", UME-NIST Workshop on Chemical Metrology, Gebze, **Turkey**, June 19, 2000.

"Mutual Recognition of Measurement Capabilities – Role of Quality Systems: The SIM and NIST Approach", NCSL Symposium, Toronto, **Canada,** July 18, 2000.

"Chemical Metrology: Its Impact on the Economy and Quality of Life", SIM Meeting, Ocho Rios, **Jamaica**, September 7, 2000.

"Mutual Recognition of Measurement Capabilities and International Standardization", IVD Traceability Workshop, NIST, Gaithersburg, MD, November 2, 2000.

"Metrology: Its Impact on the Economy, Quality of Life and International Trade,**"** Metrologia 2000, Sao Paulo, **Brazil**, December 6, 2000.

"Chemical Science and Technology at NIST: Looking to the Future", PITTCON 2001, New Orleans, LA, March 6, 2001.

"Metrology: Its Impact on the Economy and Quality of Life", PITTCON 2001, New Orleans, LA, March 6, 2001.

"Setting the Standard – NIST/NBS at 100 Years", PITTCON 2001, New Orleans, LA, March 7, 2001.

*"*Mutual Recognition of Measurements", Workshop on Measurement Traceability for Clinical Laboratory Testing and In Vitro Diagnostic Test Systems, NIST, Gaithersburg, MD, May 2001.

"Metrology: Its Impact on the Economy and Quality of Life" (Keynote Lecture), International Seminar on Metrology, Trade and Society, Quito, **Ecuador**, June 26, 2001.

"CIPM MRA: Its Implications for Chemical Metrology", NCSLI 2001 Workshop and Symposium, Washington, DC, August 1, 2001.

"Impact of Metrology on the Economy and International Trade", NCSLI 2001 Workshop and Symposium, Washington, DC, August 1, 2001.

"Chemical Metrology: Future Developments", NCSLI 2001 Workshop and Symposium, Washington, DC, August 2, 2001.

"Analytical Chemistry at NIST over the Past 40 years: from Meinke to May", Fall ACS Meeting, Chicago, IL August 28, 2001.

"Role of Reference Materials in Measurement Traceability and Proficiency Testing", National Association of Testing Authorities, Brisbane, **Australia**, October 1, 2001.

*"*Impact of Metrology on the Economy and International Trade" (Keynote Address), Metrology Society of Australia Biennial Meeting, Gold Coast, **Australia,** October 2, 2001.

"CSTL Overview", Food and Drug Administration, Rockville, MD, November 15, 2001.

"Celebrating One Hundred Years of Chemistry at the National Institute of Standards and Technology", National Chemical Landmark, NIST Centennial Symposium, December 2001.

"Impact of Metrology on the Economy and Quality of Life" (Keynote Address), International Symposium on Measurement Standards, Tokyo, **Japan**, April 12, 2002.

"Temperature Metrology and Its Impact on Industry" (Keynote Address), 8th International Temperature Symposium, Chicago, IL, October 21, 2002.

"Chemical Metrology: Its Impact on Trade, Productivity and Quality of Life", SIM Metrology Seminar, Santiago, **Chile**, October 28, 2002.

"NIST Activities Related to Global Climate Change", Workshop on Satellite Instrumentation Calibration for Measuring Global Climate Change, Univ. Maryland, College Park, MD, November 13, 2002.

"Role of Metrology in Economic Development: Its Impact on Trade, Productivity and Quality of Life" (Keynote Address), Metrology Symposium 2003, Deep Bay, **Antigua,** January 14, 2003.

"CIPM MRA: Its Implications for Measurement Traceability and Trade", Metrology Symposium 2003, Deep Bay, **Antigua,** January 15, 2003.

"Metrology: Its Impact on the Economy, International Trade and Quality of Life", University of Maryland, College Park, MD, March 14, 2003.

"SIM Quality System Review Process", APMP-SIM QS Workshop, Ottawa, **Canada**, July 30, 2003.

"From Cubits to Qubits – New Trends in Metrology" (Keynote Address), SIM Symposium on Metrology in the Americas, Panama City, **Panama**, September 16, 2003.

"From Cubits to Qubits - New Trends in Metrology" (Keynote Address), 2nd International Meeting on Metrology and Innovation for Competitiveness, Sao Paolo, **Brazil**, November 5, 2003.

"NIST Pay for Performance System", CHCO Retreat, Federal Executive Institute, Charlottesville, VA, November 21, 2003.

"Metrology in the 21st Century: NIST Role", Measurement Science Conference, Anaheim, CA, January 16, 2004.

"Chemical Metrology and It's Impact on Productivity, Trade and Quality of Life" (Keynote Address), SIM Chemical Metrology Awareness Seminar, San Jose, **Costa Rica**, February 2, 2004.

"Metrology in the 21st Century: NIST Role", JTCG-CMT Meeting, NIST Gaithersburg, MD, February 5, 2004.

"NIST – An Overview", NanoHealth Alliance, Houston, TX, April 19, 2004.

"NIST...Enabling the Future...Innovation, Trade, Safety and Security...and Jobs", IRI Annual Meeting 2004, Marco Island, FL, May 16, 2004.

"NIST...Enabling the Future...Innovation, Trade, Safety and Security...and Jobs", United Technologies Research Center, East Hartford, CT, June 2, 2004.

"NIST…Providing Infrastructure for Homeland Security", Panel on Science & Technology, Rhode Island Homeland Security Conference and Expo, Newport, RI, June 7, 2004.

"NIST Contributions to Manufacturing and the Economy", Dept. of Commerce, Washington, DC, June 28, 2004

"Advanced Measurements Laboratory: A Research Facility for the 21st Century", NCSL International Conference, Salt Lake City, UT, July 12, 2004.

"From Bumper to Bumper: How NIST Helps America's Automotive Industry", U.S. Council for Automotive Research (USCAR), Detroit, MI, September 28, 2004.

"Role of Metrology in Economic Development" (Keynote Address), Symposium for 50th Anniversary of NIM, Beijing, **China**, October 20, 2004.

"From Bumper to Bumper: How NIST Helps America's Automotive Industry", US A-TEAM Executive Steering Group Meeting, USCAR, Southfield, MI, December 10, 2004.

"NIST ... Enabling the Future ... Innovation, Trade, Security ... and Jobs", Agilent Technologies, Palo Alto, CA, January 12, 2005.

"NIST - Cornerstone of the U.S. Innovation Infrastructure", Bucknell University, Lewisburg, PA, March 29, 2005.

"Innovating Innovation (Now There's a Good Idea!)", 2005 Ralph B. Derr Memorial Lecture, Bucknell University, Lewisburg, PA, March 29, 2005.

"NIST...Enabling the Future...Innovation, Trade, Safety and Security...and Jobs", Engineering R&D Symposium, Washington, DC, April 6, 2005.

"Nation's Innovation Agenda: ...NIST Contributions" (Keynote Address), IEEE – National Capital Area Awards Banquet, Vienna, VA, April 16, 2005.

"NIST...Enabling the Future...Innovation, Trade, Safety and Security...and Jobs", 2005 NIST State Forum, NIST, Gaithersburg, MD, April 28, 2005.

"NIST...Enabling the Future...Innovation, Trade, Security and Safety", Science-Engineering-Technology Working Group Congressional Visits Day, Washington, DC, May 10, 2005.

"Innovation and You…the Future of Our Country", Commencement Address, A. James Clark School of Engineering, University of Maryland, College Park, MD, May 22, 2005.

"NIST - Cornerstone of the U.S. Innovation Infrastructure", State Department Conference on Environment, Science, Technology, and Health, International Trade Center, Washington, DC, June

22, 2005.

"NIST...Enabling the Future...Innovation, Trade, Safety and Security...and Jobs", ASME Hill Briefing Day Conference, Washington, DC, June 28, 2005.

"Metrology and Innovation", President's Address, 90th Annual National Conference of Weights and Measures, Disney World, Orlando, FL, July 12, 2005.

"Improving Environmental Monitoring and Management by ... Building a Robust Measurement Infrastructure" (Keynote Address), National Environmental Monitoring Conference, Washington, DC., July 26, 2005.

"Expanding the Frontiers of Measurement" (Keynote Address), NCSL International, Washington, DC, August 8, 2005.

"NIST – Cornerstone of the U.S. Innovation Infrastructure", Chinese Academy of Sciences, Beijing, **China**, September 2, 2005.

"Then and Now: NIST and Metrology for the 21st Century" (Keynote Address), Symposium in Commemoration of the 30th Anniversary of KRISS, Jeju, **Korea**, September 6, 2005.

"A NIST Overview", USMS Workshop on Measurement and Standards Needs in Nanobiotechnology, Rice University, Houston, TX, January 19, 2006.

"Nanotechnology at NIST – A new Center for Nanoscale Science and Technology", NASA Inter-Organizational Nanotechnology Development Meeting, University of Maryland, College Park, MD, January 23, 2006.

"NIST Role in Advancing Innovation", 2006 APS March Meeting, Baltimore, MD, March 15, 2006.

"Innovation – the Engine Driving the U.S. Economy", Mechanical Engineering Research Day, University of Maryland, College Park, MD, March 23, 2006.

"President's FY 2007 Budget Request for NIST – Part of the President's American Competitiveness Initiative", Engineering R&D Symposium, Washington, DC, May 18, 2006.

"Impact of Metrology on Innovation and the Economy" (Keynote Address), Metrology Symposium, Guatemala City, **Guatemala**, July 19, 2006.

"US - Brazil Interactions in Metrology", US-Brazil Joint Commission Meeting on S&T Cooperation, Washington, DC, July 21, 2006.

"Measurements and Standards for Biofuels: Enabling a Transition from Petroleum as a Vehicular Energy Source" (Keynote Address), Joint INMETRO-NIST Workshop, Rio de Janeiro, **Brazil**, September 14, 2006.

"Nanoscience, Nanotechnology and Measurement Standards at NIST", US-China JCM on S&T, Beijing, **China**, October 18, 2006.

"NIST – Promoting Innovation, Competitiveness, and Trade" (Keynote Address), CENAM Symposium on Metrology, Queretaro, **Mexico**, October 25, 2006.

"Impact of Metrology on Innovation and the Economy", Libyan National Center for Standardization and Metrology, Tripoli, **Libya**, November 13, 2006.

"Overview of DoC Activities on Biofuels", Federal Biofuels Posture Plan Workshop, Washington, DC, November 28, 2006.

"Overview of NIST Activities related to the Biofuels Initiative – Thermochemical Conversion Technologies", Federal Biofuels Posture Plan Workshop, Washington, DC, Nov. 29, 2006.

"Measurements and Standards for Biofuels", Dept. of Commerce, Washington, DC, Jan. 26, 2007.

"US-Pakistan Interactions in Standards and Measurement Science", (via video conferencing to Pakistan) Washington, DC, February 13, 2007

"Innovation – Response to the *Gathering Storm*?", 2007 Larry A. Kennedy Lecture of the College of Engineering, University of Illinois at Chicago, March 22, 2007.

"A Report on the International Conference on Biofuels Standards", ANSI-NIST Meeting on Biofuels Standardization, Washington, DC, March 28, 2007.

"A Conceptual Roadmap for Compatible Biofuels Standards", ANSI-NIST Meeting on Biofuels Standardization, Washington, DC, March 28, 2007.

"Biofuels Standards Roadmap", ANSI-NIST Meeting on Biofuels Standardization, Washington, DC, March 28, 2007.

"Innovation – Response to the *Gathering Storm*?", Distinguished Scholar Series at the New Hampshire Institute of Politics at Saint Anselm College, Manchester, NH, April 17, 2007.

"International Drivers: South America/Brazil", ANSI Biofuels Standards Panel Meeting, Arlington, VA, May 9, 2007.

"NIST: An Overview", ASTM International Open House for Sub-Saharan Africa, Philadelphia, PA, May 17, 2007.

"Symposium on Biofuels: Measurements and Standards to Facilitate the Transition to a Global Commodity" (organizer), Green Chemistry and Engineering Conference, Washington, DC, June 27-29, 2007.

"International Cooperation to Ensure Comparability of Chemical Measurements Worldwide", ACS Symposium on "Creating and Sustaining International Research Collaborations", ACS National Meeting, Boston, MA, August 21, 2007.

"Impact of Chemical Metrology on Trade, Innovation and Quality of Life", SIM Chemical Measurements Working Group Meeting, Ottawa, **Canad**a, September 25, 2007.

"The Role of Standards in Promoting Expanded Use of Biofuels", Symposium on Chemical Measurement Needs for Emerging Technologies, Ottawa, **Canada**, September 26, 2007

"CCR – A Leadership Organization", ACS Society, Science and the Congress Project, Washington, DC, March 14, 2008.

"Economic Impact of Investments in Chemical Sciences", Univ. Notre Dame, South Bend, IN, July 7, 2008.

"Economic Impact of NMI Metrology Programs", Symposium Celebrating10th Anniversary of the CIPM MRA, Paris, **France**, October 8, 2009.

"Economic Impact of Chemical Metrology", Senior Policy Makers Dialogue Forum, Rio de Janeiro, **Brazil**, Nov. 5, 2009

"Sustainable U.S. Manufacturing – A Route to Immediate Energy Savings", Alliance to Save Energy, Washington, DC, March 19, 2010.

"Sustainable U.S. Manufacturing – A Route to Immediate Energy Savings", Agenda 2020 CTO Meeting, , American Forest and Paper Association, Washington, DC, June 8, 2010.

"NIST: Promoting US Innovation and Industrial Competitiveness", Saudi Arabian Standards Organization (SASO), Riyadh, **Saudi Arabia**, Dec. 12, 2010.

"Chemical Metrology: What is it? Why should you invest in it?", SIM Chemical Metrology Working Group Meeting, San Jose, **Costa Rica**, May 9, 2011.

"The Role of Chemical Metrology in Food Safety and International Trade", Conference on Strengthening Quality Infrastructure, Yerevan, **Armenia**, November 3, 2011.

"Strategic Planning at NIST", NIM International Advisory Board Meeting, National Institute of Metrology, Beijing, **China**, August 28-29, 2012

"Workshop on Measurements and Standards for Climate Change", Organizer, National Institute of Metrology, Beijing, **China**, September 3-4, 2012.

"4th International Conference on Biofuels Standards: Current Issues, Future Trends", Organizer, NIST, Gaithersburg, MD, November 13-15, 2012.

"Impact of CCQM Activities on Industry and Society", BIPM Symposium: 20 Years of CCQM, BIPM, Paris, **France**, April 17, 2013.

"Innovation and Manufacturing: The Future of USA", Board of Visitors Meeting, Clark School of Engineering, Univ. Maryland, College Park, MD, April 29, 2013.

"Renewable Energy and Climate Science: International Perspectives", Federal Interagency Chemistry Representatives (FICR) Meeting 2013, NIST, Gaithersburg, MD, June 4, 2013.

"Renewable Energy and Climate Science for the Americas: Metrology and Technology Challenges", Workshop Organizer, CENAM, Queretaro, **Mexico**, October 8-9, 2013.

"Climate Science and Greenhouse Gas Measurements", NIM International Advisory Board Meeting, National Institute of Metrology, Beijing, **China**, August 27-28, 2014

"Metrology and Information Technology: Driving Innovation", (Keynote Address) Conference on Disruptive Innovation in Information Technology 2016, Xi'an, **China**, October 25, 2016.

"NIST – Cornerstone of the U.S. Innovation Infrastructure", (Keynote Address) 3rd Annual Intelligence Community Academic Research Symposium (ICARS), Washington, DC, September 27, 2017.

"Data Activities at NIST", SRD Workshop: Past, Present, Future, NIST, Gaithersburg, MD, October 17, 2017.

"Metrology – Its History, Impact and Future", (Keynote Address) World Metrology Day 2018 Symposium, Beijing, **China**, May 20, 2018.

"NIST – A Historical Overview", (Keynote Address) NIM Scientific Week Celebrations, National Institute of Metrology, Beijing, **China**, May 22, 2018.

"Metrology – Its History, Impact and Future", (Keynote Address) Shanghai Institute of Measurement and Testing Technology, Shanghai, **China**, May 23, 2018.

F. CONGRESSIONAL AND OTHER TESTIMONY:

U.S. House Science Committee, Subcommittee on Technology, Environment, and Aviation (Rep. Morella) hearing on the Role of NIST in U.S. Technology Policy, NIST, Gaithersburg, MD, July 26, 1993 ("Measurement Methods and Reference Materials Re: Lead Pollution in the Environment").

U.S. House Science Committee, Subcommittee on Technology (Rep. Morella) hearing on the "Assessment of NIST Laboratory Programs", May 2, 1996.

U.S. House Science Committee, Subcommittee on Environment, Technology and Standards (Rep. Ehlers) hearing on "Testing and Certification for Voting Equipment: How can the Process be Improved?", June 24, 2004.

U.S. House Government Reform Committee, Subcommittee on Technology, Information Policy, Intergovernmental Relations and the Census (Rep. Putnam) hearing on "Defining Federal Information Technology Research and Development: Who? Where? What? Why?", July 7, 2004.

U.S. House Government Reform Committee, Subcommittee on Technology, Information Policy, Intergovernmental Relations and the Census (Rep. Putnam) hearing on "The Science of Voting Machine Technology: Accuracy, Reliability and Security", July 20, 2004.

U.S. House Science Committee, Subcommittee on Environment, Technology and Standards (Rep. Ehlers) hearing on "China, Europe and the Use of Standards as Trade Barriers: How Should the U.S. Respond?", May 11, 2005.

U.S. Senate Commerce, Science and Transportation Committee, Subcommittee on Technology, Innovation and Competitiveness (Sen. Ensign) hearing on "Health Information Technology", June 30, 2005

U.S. Senate Commerce, Science and Transportation Comm., Subcommittee on Disaster Prevention and Prediction (Sen. DeMint) hearing on "Civilian R&D in Support of Homeland Security", June 8, 2005.

U.S. Senate Committee on Homeland Security and Governmental Affairs, Subcommittee on Oversight of Government Management, the Federal Workforce and the District of Columbia (Sen. Voinovich) hearing on "Alternative Personnel Systems: Assessing Progress in the Federal Government", September 27, 2005.

Election Assistance Commission (Chair: G. Hillman) hearing on the Voluntary Voting System Guidelines (VVSG) issued by the Technical Guidelines Development Committee, Cambridge, MA, April 26, 2005.

Virginia State Committee, Hearing on Voting Standards, Richmond, VA, August 22, 2005

Briefings for many Senators and Congressmen on Help America Vote Act (HAVA), Technical Guidelines Development Committee (TGDC), Biometrics, Personal Identification Standards, Manufacturing, Health Care IT Systems, the World Trade Center Investigation, RI Station Club Fire Investigation, and NIST Programs and Budget.