

# CURRICULUM VITAE

Tai-Ran Hsu

Department of Mechanical and Aerospace Engineering

San José State University

San Jose, CA 95192, U.S.A

## EDUCATION:

Ph.D. McGill University, Montreal, Canada

M.Sc. University of New Brunswick, Fredericton, N.B., Canada

B.Sc. National Cheng Kung University, Tainan, Taiwan, Republic of China

All degrees were in mechanical engineering

## HONOR AND AWARDS:

- Newnan Brother Faculty Award for outstanding commitment to teaching, College of Engineering, San Jose State University, May 2007. 1,2007-May 31, 2010
- Elected to K.P. Chao High Tech Chair Professor by Zhejiang University, Hangzhou, China (June 1, 2007-May 31, 2010).
- Election to Fellow Grade, American Society of Mechanical Engineers, July 2004.
- Excellence in Scholarship Award, College of Engineering, San Jose State University, May 1998.
- Service Award, Division of Electrical and Electronics Division, American Society of Mechanical Engineers, 1997.
- Service Award, Division of Electrical and Electronics Division, American Society of Mechanical Engineers, 1995.
- Outstanding Service Award, Association of Professional Engineers of Manitoba, Province of Manitoba, Canada, 1988.

## POSITIONS HELD:

<u>Position</u>	<u>Employer</u>	<u>Year</u>
Professor and Chair	Department of Mechanical Engineering San Jose State University, San Jose, California, U.S.A.	2013 – present
Professor and Chair	Department of Mechanical and Aerospace Engineering, San Jose State University	2012-2013
Professor	Department of Mechanical and Aerospace Engineering, San Jose State University	1998 – 2012
Professor and Chair	Department of Mechanical and Aerospace Engineering, San Jose State University	1990 - 1998
Professor and Head	Department of Mechanical Engineering University of Manitoba, Manitoba Canada	1986 – 1990
Professor	Department of Mechanical Engineering University of Manitoba	1975 – 1986
Associate Professor	Department of Mechanical Engineering University of Manitoba	1971 – 1975

Development Engineer	Large Steam Turbine Division General Electric Company, Schenectady, New York, U.S.A.	1970 – 1971
Research Officer	Whiteshell Nuclear Research Establishment Atomic energy of Canada Ltd, Pinawa, Manitoba, Canada	1968 – 1970
Graduate student (Ph.D.)	Department of Mechanical Engineering McGill University, Montreal, Canada	1965 – 1968
Senior Design Engineer	Combustion Engineering-Canada Montreal, Quebec, Canada	1964 – 1965
Design Engineer	Montreal Locomotive Works Montreal, Quebec, Canada	1962 – 1964

## EXPERIENCES

### A. Academic Experience:

#### Taught the following courses:

- Microsystems Design and Manufacture (Graduate and senior year)
- Computer-Aided Design (Graduate)
- Advanced Engineering Analysis (Graduate and undergraduate levels)
- Introduction to Thermoelasticity (Graduate)
- Finite Element Method in Thermomechanics (Graduate)
- Mechanical Systems Design (senior year capstone)
- Senior Design Projects (senior year Fall and Spring semesters)
- Advanced Strength of Materials (senior year)
- Machine Design (senior year)
- Senior Design Projects (junior year, course coordinator)
- Mechanical Engineering Measurements (junior year)
- Engineering Mechanics-statics and dynamics (junior year)
- Dynamics (junior year)
- Fundamentals of Mechanical Engineering (junior year non-ME students)

#### Graduate students and full-time research staff supervised:

- Supervised and graduated 6 Ph.D. (from University of Manitoba, Winnipeg, Canada), 36 MS students (includes 22 MS students at SJSU since 1990).
- Supervised 18 research staff including research associates, post-doctoral fellows, visiting scholars and research technologists prior to joining the San Jose State University in 1990.

#### PhD Theses Supervised at University of Manitoba, Winnipeg, Canada:

- Young-jin Kim “Stable Crack Growth in Ductile Materials – a Finite Element Approach,” 1981.
- Eed Abdel Hafez A. Abdel Hadi “Computer Modeling of Underground Coal Gasification,” 1985
- Guoguan Chen “Creep Crack Growth under Cyclic Loading Conditions – a Continuum

- Damage Approach,” 1988
- Zhilong Gong “On the Constitutive Equations for Selected Engineering Materials Subject to Cyclic Creep,” 1990
- Nansheng Sun “The Analysis of the Thermomechanical Coupling Effect on Fractured Solids by Finite Element Method,” 1991
- Baoku Sun “Characterization of Creep Deformation and Damage of Metallic Materials at High Temperature,” 1994

MS Thesis Supervised at SJSU since 1990:

- Sreevani Abbaraju, "Numerical Simulation on the Fatigue Life Model of Ball Grid Array Solder Joints," December 2004.
- Say Wei Low, "Optimal thermal Conditions for Anodic Bonding of Microsystems," May 2004.
- Say Wei Low, "Thermal Effects on Anodic Bonding in MEMS Packaging," December 2003.
- Sean Matheson, "Impact to Dispersion and Variance of Species in Microflows Turns," August 2003.
- Chung-Chun Tseng, "Size Effects on Fracture Toughness of Plastic Molding Compounds," December 2002.
- Arif Halim, "On Micro Sensing Technology," September 2000.
- Peter Baum, "On Design of Micro Bearings," September 2000.
- Loay Elmorsy, "Theory, Design, Manufacturing and Packaging of Micro Accelerometers," December 2000.

**B. RESEARCH EXPERIENCES:**

Current Research Activities

- Green technologies in clean renewable energies, building energy efficiency and sustainable vehicle design (EV and HEV) with optimal recovery of regenerative energies
- Nanoscale engineering design
- Microelectromechanical systems (MEMS) design and packaging
- Modeling and simulation of micro – and nano-technology and engineering
- Reliability and assembly of microsystems
- Packaging and reliability of silicon solar photovoltaic cells and modules
- Computer-aided design for micro- and nano-scale systems.
- Residual stress and strain analyses and interfacial fracture in mechanical package design of microelectromechanical systems (MEMS) and devices
- Thermomechanics in micromachining
- Microelectronic packaging: moisture induced fracture of integrated circuits (“Popcorn failure” of integrated circuits)
- Analytical and experimental investigation of cyclic creep-fracture of solder alloys for microelectronic interconnect and reliability of integrated circuits.
- Concurrent engineering involving integrated design, manufacturing, human factors and manufacturing cultures

Cumulated research experience:

- Developed a finite element analysis code, TEPSAC (**T**hermo **E**lastic-**P**lastic **S**tress

- Analysis including Creep), for nonlinear thermomechanical analysis of structures
- Applied thermomechanical experience in:
  - a) Finite element analyses on thermomechanical behavior of nuclear reactor fuel Systems.
  - b) Solids involving heat, phase and mass transfer for ice structures, underground coal gasification and in-situ fracture of oil sands.
  - c) Fatigue, creep and fracture of structures under combined thermal and mechanical loading for aerospace engine components and microelectronic packaging
- Developed analytical models for reliability analysis of ceramic structures for high temperature applications.
- Implemented experimental studies on dimensional stability of fiber composite structures (e.g. satellite antenna) subject to changing thermal environment using laser holographic interferometry
- Developed computer simulation models for in-situ coal gasification with steam injection with experimental verifications
- Developed computer models for in-situ fracture of oil sand deposits for bitumen extraction

### **Research Grants and Contracts in Recent Years**

- Co-PI on “A Mobile Atmospheric Profiling System for Multi-campus Research and Education” A research grant from National Science Foundation MRI-R2 program (PI: Craig Clements, SJSU-Meteorology Department with another CO-PI: A Bridger) \$446,894 (Jul 2009 to Dec. 2012)
- Principle Investigator in research project on “Wind Powered Generator on Rooftop of High Rise Buildings in Urban Centers,” California Energy Commission, \$50000 (Sept. 2010 to Dec. 2011). Co-PIs: Drs. Craig Clements & Eugene Cordero, Dept. of Meteorology, SJSU.
- Principal Investigator in a student project on "Hybrid Powered Zero Emission Vehicle Development," College of Engineering, San Jose State University, \$36,229 (July 2006 - June 2007), \$41,000 (July 2007 - June 2008)
- Co-Principal Investigator in "Interdisciplinary & flexible Laboratory Experiments in Micro-Electro-Mechanical Systems," John (Sang-Joon) Lee, the Principal Investigator, National Science Foundation, \$115,564, August 2004-2006.
- Co-Principal Investigator in "Development of a Laboratory Curriculum Devoted to Thermal Management of Electronics," Nicole Okamoto, the Principal Investigator, National Science Foundation, \$ 105,757, July 2003-2006.
- Principal Investigator in "Feasibility Studies on Miniature Microphone Design," Industrial Technology Research Institute, San Jose, \$45,000, July-September 2004.

Please refer to Appendix 1 and 2 for grants and awards received in other research projects.

### **ADMINISTRATIVE EXPERIENCE AND SERVICES AT UNIVERSITY LEVELS:**

- Chair, Department of Mechanical and Aerospace Engineering, San Jose State University, San Jose California (December 1, 2012-present)
- Member, Senate Institutional Review Board, San Jose State University (2000-2003)
- Member, Senate Human Subject Review Board, San Jose State University (2000-2003)
- Chair, Department of Mechanical and Aerospace Engineering, San Jose State University, San Jose, California (1990-1998)

- Member, Senate Program Planning Committee, San Jose State University, San Jose, California (1996-1998)
- Member, Senate Government and Organization Committee, San Jose State University, San Jose, California (1996-1999)
- Member, Senate Professional Standards Committee, San Jose State University, San Jose, California (1995-1996)
- Member, Senate Planning and Priority Committee, San Jose State University, San Jose, California (1994-1995)
- Member, Research and Graduate Studies Committee, San Jose State University, San Jose, California (1991-1993)
- Head, Department of Mechanical Engineering, University of Manitoba, Winnipeg, Manitoba, Canada (1986- 1990) (please refer to Appendix No.2 for the performance record)
- Member, Bargaining Team representing university management on contract negotiation with Union of Technical Staff, Faculty of Engineering, University of Manitoba (1989-1990)
- Member, University of Manitoba Senate Admissions Committee (1981-1990)
- Member, President's Advisory Committee on Sustainable Development, University of Manitoba (1989-1990)
- Member, University of Manitoba Senate Research Committee (1987-1989)
- Member, University of Manitoba Committee on Aging Curricula (1988-1989)
- Member, University Senate Ad Hoc Committee on TOEFL Tests (1983-1984)
- Member, Presidential Advisory Committee on Computer Usage (1982)
- Member, Faculty Ad Hoc Committee on Outside Professional Activities (1976-1977)
- Member, Faculty Graduate Studies Committee (1973-1975)

## **INDUSTRIAL EXPERIENCE:**

- Computer simulation on thermomechanical behavior (creep-fatigue-fracture) of machines at high temperature (University of Manitoba, Winnipeg, Manitoba, Canada, 1971-1980)
- Development of SANFRAC code for Alberta Oil Sand Technology and Research Authority for in-situ fracture of oil sand deposits (University of Manitoba, Winnipeg, Manitoba, Canada, 1983-88)
- Development of TEPSAC code as the base code for FULMOD and FAXMOD codes for Atomic Energy of Canada Ltd. for reactor fuel behavioral simulations (University of Manitoba, Winnipeg, Manitoba, Canada, 1971-80)
- On thermal and mechanical stress analyses of large steam turbine components (General Electric Company, Schenectady, N.Y., 1970-71)
- Development of design methodology for reliability assessment for ceramic (brittle) nuclear reactor core components. Also established a High Temperature Structure Reliability Laboratory using laser holographic interferometry as the principal deformation measurement technique (Atomic Energy of Canada Ltd., Pinawa, Manitoba, Canada, 1968-70)
- Designed large steam and nuclear power plants and developed analytical methodology for high temperature superheater stress analysis (Combustion Engineering-Canada, Montreal, Canada, 1964-65)
- Designed heat exchangers and subway trains (Montreal Locomotive Works, Montreal, Canada 1962-64)

## **INTERNATIONAL EXPERIENCE:**

### ***A. International appointments***

- KP Chao High Tech-chair professor on micro- and nano-scale engineering at Zhejiang University, Hangzhou, Zhejiang, China (June 1, 2007- May 31, 2010)
- Senior Adviser, Microsystems technology, Industrial Technology Research Institute (ITRI), Inc., San Jose, California, USA (2001-present)
- Chair, Program Review Panel for Mechanical Engineering at National Tsinghua University Hsinchu, Taiwan Republic of China (May 7-9, 2007)
- Member of Advisory Committee, Mechanical Industrial Research Laboratories, specialized in microtechnology, Industrial Technology Research Institute (ITRI), Taiwan (1999-2006)
- Founding Chair, "Trans-Pacific Workshop on Mechatronics Technology" funded by the Division of International Programs of the National Science Foundation in Washington, D.C.. This first Workshop was convened in San Jose, California, September 15-18, 1996. The 1997 Workshop was held in Yokohama, Japan under Japanese government sponsorship. The 1998 Workshop and the expanded International Conference on Mechatronics Technology (ICMT) was held in Taiwan, November 1998 with support of the government of Taiwan, the 1999 ICMT was held in Singapore, with subsequent ICMT held in Korea in 2001 and Japan in 2002. The 2003 conference was hosted by Taiwan in November.
- Appointed as a Specialist on a mission to assist Romanian government in nuclear fuel design and testing by the International Atomic Energy Agency (IAEA) of the United Nation. The service was performed at the Romania Nuclear Power Station in Petiti, Romania, July-September 1992
- Member of Canadian delegation to workshop on Reactor Core Technology, Spatin, Norway, November 1983

### ***B. International Academic Activities:***

- Invited speaker on a tutorial lecture on "Introduction to Reliability in MEMS Packaging," International Symposium for Testing & Failure Analysis, San Jose, November 5, 2007
- KP Chao Chair Professor, delivered a series of 12 special lectures on "MEMS and Nanoscale Engineering" at Zhejiang University, Hanzhou, China, June 1 - July 31, 2007
- Keynote Lecturer on "Micromechatronics - A vital technology for industrialized nations in the new century," 2<sup>nd</sup> Congreso de Mecatronica, San Luis Potosi, Mexico, August 27, 2005
- Keynote Lecturer on "Micro Assembly - A technology on the frontier of industrial automation," 8th International Conference on Automation Technology, Taichung, Taiwan, May 5, 2005
- Keynote Lecturer on "Micromechatronics - a core technology in industrial revolution in miniaturization at the International Congress on Mechatronics, San Luis Potosi, Mexico, March 4, 2005
- Invited Speaker on "On the Integration of Micro and Nano Scale Engineering," 20<sup>th</sup> Modern Engineering and Technology Seminars, Taipei, Taiwan, November 15, 2004
- Keynote Lecturer on "Micro and Nano Scale Engineering - Design, Fabrication and Packaging," 6th CASPA Workshop on Equipment and Processes, Hsinchu, Taiwan, September 7, 2004
- Keynote Lecturer on "Miniaturization - a paradigm shift in advanced manufacturing and education, " 2002 International Conference on Advanced Manufacturing and Education

for the 21<sup>st</sup> Century”, Chia-yi, Taiwan, August 12-15, 2002

- Tutorial lectures on "Microsystems Design, Manufacture and Packaging Technology," Industrial Technology Research Institute, Hsinchu, Taiwan, January 7-9, 2002 (attended by 170 plus engineers and scientists from Taiwan industry, government laboratories and universities)
- Tutorial lectures on "Microsystems Technology," Ngee Ann Polytechnic of Singapore, June 18-23, 2001
- Planetary lecturer on "MEMS and Microsystems Technology - the present and future," Ngee Ann Polytechnic, Singapore, June 22, 2001
- Plenary lecture on "Mechanical Engineering – '20/20' and Beyond," University Saskatchewan, Saskatoon, Canada, March 26, 2001

### **PROFESSIONAL SERVICES:**

- Chair, Microelectromechanical Systems (MEMS) Committee, International Reliability Physics Symposium, Phoenix, AZ, April-May 2008
- Chair, Selection Committee, ASME Triodyne Safety Award (1999- 2004)
- Member, ASME Design Education Committee (1993- 2004)
- Guest Editor for a special section on microsystems packaging in IEEE transactions on CPMT-B: Advanced Packaging (1998-2000)
- Associate Editor (Western US), International Journal of Microelectronic Packaging, Gordon and Breach Science Publishers, Switzerland (1993-2000)
- Member, Review Panel on "Nanoscale Simulation and Modeling", National Science Foundation, Washington, DC, June 1 and 2, 2000
- Member, Review Panel on "XYZ-on-a-Chip Program," National Science Foundation, Washington, DC, July 14, 2000
- External Evaluator to the mechanical and electrical engineering graduate programs at the Edward Air Force Base, Mojave Desert, California, for California State University at Fresno, April 13-15, 1998
- Guest Editor for a special section on Mechatronics in IEEE Transactions on CMPT-C: Manufacturing (1994 -1996)
- Director, Board of Chinese Institute of Engineers, U.S.A. (1994- 1996), (2002-2004)
- Organizer of the Sessions on "Success in Design Education" in the 1995 and 1997 ASME International Congress and Exposition, San Francisco, CA, November 11-17, 1995
- Chair, Program Committee, InterPack'95, an international electronic packaging conference sponsored by ASME, JSME and IEEE, Maui, Hawaii, March 25-29, 1995
- Organizer of the Session on "Finite Element Analysis in Design" the 1995 ASME National Engineering Design Conference, Chicago, March 13-17, 1995
- Member, Grant Review Panel for the Instrumentation and Laboratory Improvement Program, National Science Foundation, Washington, D.C., January 1991 and 1998
- Reviewer, Grant applications for National Science Foundation in the fields of computers and intelligent systems and solid mechanics (1980-1990).
- Vice-President (Prairie Region), Canadian Society of Mechanical Engineers (1988 -1990)
- Member, Editorial Board, Computational Mechanics Communication - an international Journal (1989-1990)

- Chairman, 1991 Canadian Congress of Applied Mechanics (1988-1990)
- Member, Central Committee, Canadian Congress of Applied Mechanics (1989-1990)
- Member, Advisory Board for Industrial Technology Center, Manitoba Research Council (1986-1990)
- Member, Advisory Board for Red River Community College (1986-1990)
- Member, Research and Development Committee of Association of Professional Engineers of Manitoba (1987-1990)
- Chairman, Mechanical Engineering Grant Selection Committee, Natural Sciences and Engineering Research Council (NSERC), (1988-1989); Member (1986-1988) (NSERC = Natural Sciences and Engineering Research Council, is the equivalent of the NSF in U.S.A.)

### **COMMUNITY SERVICES:**

- Director, Shin-Shin Educational Foundation, Cupertino, California (2006-2008)
- Director, Yuan-jie Dance of America, San Jose, California (June 2000-2004)
- Judge, annual Manitoba Science Symposium, Winnipeg, Manitoba, Canada (1971-1990); Chief Judge, High School Engineering & Technology Division (1975-1990)
- Founding Director, Chinatown Non-Profit Housing Corporation, Winnipeg, Manitoba, Canada: responsible for the construction and management of a \$7.6 million housing complex project (1982-86)
- Founding Director, Manitoba Academy of Chinese Studies, Winnipeg, Manitoba, Canada(1974-75); President (1980); Director (1981-82)
- Founding Director, Suzuki Talent Education Institute of Manitoba, Winnipeg, Manitoba, Canada (1973-74)

### **MEMBERSHIP OF PROFESSIONAL SOCIETIES:**

- Fellow, The American Society of Mechanical Engineers (member since 1962)
- Member, The Institute of Electrical and Electronic Engineers (expired 2004)
- Member, American Society for Engineering Education (1962 - 2000)
- Member, Sigma Xi, The Scientific Research Society (expired 1996)

### **PUBLICATION RECORD:**

- Total number of books published (6 authored, 2 edited): 8
- Total number of papers published in peer-reviewed systems: 118
- Total number of papers published in archive journals: 60
- Total number of papers published in books or symposia: 35
- (with full review)
- Total number of papers published in conference proceedings: 23
- (with abstract reviewed)

## **LIST OF PUBLICATIONS**

### **I BOOKS** (authored six, edited two):

1. "MEMS and Microsystems - Design, manufacture and nanoscale engineering," 2<sup>nd</sup> Edition, John-Wiley & Sons, Inc., Hoboken, NJ, 2008 (ISBN 978-0-470-08301-7)



2. "MEMS Packaging," Edited by Tai-Ran Hsu, Institute of Electrical Engineers, London, United Kingdom, 2004 (ISBN 0-86341-335-8)
3. "MEMS & Microsystems - Design and manufacture," McGraw-Hill Higher Education, Boston, MA, 2002 (ISBN 0-07-239391-2 USA) (ISBN 0-07-113051-9 International) Translation in traditional Chinese, Princeton International, Taiwan (ISBN 957-493-776-3), Translation in contemporary Chinese, China Machine Press, Beijing (ISBN 0-07-120476-8)
4. "Computer-Aided Design - an integrated approach," co-authored with D.K. Sinha, West Publishing Company, St. Paul, Minnesota, 1992 (ISBN 0-314-80781-0)
5. "*Advanced Machine Design by Microcomputers*," co-authored with D.K. Sinha, Kern International, Duxbury, MA, 1989 (ISBN 1-55948-000-9)
6. "Finite Element Analysis by Microcomputers," co-authored with D.K. Sinha, Kern International, Rockland, MA, 1988 (ISBN 0-940254-91-3)
7. "The Finite Element Methods in Thermomechanics," Allen & Unwin (Publisher), England, 1986 (ISBN 0-04-620013-4).
8. "Advances in Electronic Packaging 1995," Proceedings of the International Intersociety Electronic Packaging Conference - INTERpack '95, Volume 1: P. 1-577; Volume 2: P. 588-1317, edited by: Tai-Ran Hsu, A. Bar-Cohen and W. Nakayama, ASME, New York, March, 1995 (ISBN 0-7918-1303-7)

## II. Papers Published in Archive Journals (60):

1. Okamoto, N.C., Hsu, T-R. and Bash, C., "A Thermal Management of Electronics Course and Laboratory for Undergraduates," *Advances in Engineering Education*, Vol. 1, No. 3, 2009.
2. Hsu, T.R. "Packaging Design of Microsystems and Meso-Scale Devices," *IEEE Transactions on CPMT-B: Advanced Packaging*, Vol. 23, No.4, November 2000, pp. 596-601.
3. Hsu, T.R. "Development of an Undergraduate Curriculum in Mechatronics Systems Engineering," *Journal of Engineering Education*, April 1999, pp. 173-179.
4. Hsu, T.R. "Mechatronics-An Overview," *IEEE Transactions on Components, Packaging, and Manufacturing Technology-Part C*, Vol. 20, No. 1, 1997 (Guest edited by T.R. Hsu), pp. 4-7.
5. Sun, N.S. and Hsu, T.R., "Thermomechanical Coupling Effects on Fractured Solids," *International Journal of Fracture*, Vol. 78, 1996, pp. 67-87.
6. Liniecki, A., Hsu, T.R. and Li, W., "Fatigue Strength of Adhesive Bonded Aluminum Joints," *Journal of Testing and Evaluation*, ASTM, Vol. 23, No.6, November, 1995, pp.453-469.
7. Ayari, M.L., Sun, B.K. and Hsu, T.R., "A Continuum Damage Mechanics Model for Cyclic Creep Fracture," *Engineering Fracture Mechanics*, Vol. 47, No.2, 1994, pp. 215-222.
8. Ayari, M.L., Hsu, T.R. and Sun, B.K., "A Numerical Analysis of Cyclic Creep Fracture," *International Journal of Solids Structures*, Vol. 31, No. 7, 1993, pp. 971-984.
9. Hsu, T.R., "Computational Thermofracture Mechanics and Life Prediction," *Nuclear Engineering and Design*, Vol. 133, 1992, pp. 447-456.
10. Hsu, T.R., Sun, N.S., Chen, G.G. and Gong Z.L., "Finite Element Formulation for Two-Dimensional Inverse Heat Conduction Analysis," *Journal of Heat Transfer*, ASME Transactions, Vol. 114, 1992, pp. 553-557.
11. Chen, G.G. and Hsu, T.R., "The Role of Plastic Strains in Creep Crack Growth," *Engineering Fracture Mechanics*, Vol. 39, No.3, 1991, pp. 493-508.

12. Chen, G.G. and Hsu, T.R., "Effects of Cyclic Plasticity on Creep Crack Growth," *Engineering Fracture Mechanics*, Vol. 39, No.3, 1991, pp. 509-524.
13. Gong, Z.L. and Hsu, T.R., "Constitutive Models for Engineering Materials Subjected to Cyclic Creep," *Journal of Engineering Materials and Technology*, ASME Transactions, Vol. 113, No.4, 1991, pp. 419-424.
14. Gong, Z.L. and Hsu, T.R., "Deformation of Aluminum Alloy under Cyclic Creep Loadings," *Journal of Testing and Evaluation*, ASTM, 1991, pp. 14-23.
15. Sun, L.X. and Hsu, T.R., "Thermal Buckling of Laminate Composite Plates with Transverse Shear Deformation," *Computer & Structures*, Vol. 36, No.5, 1990, pp. 883-339.
16. Sun, L.X. and Hsu, T.R., "Thermal Stress Analysis of Laminate Composite Solids of Axisymmetric Geometry," *AIAA Journal*, Vol. 28, No.8, 1990, pp.1527-1529.
17. Sun, N.S., Hsu, T.R., Gong, Z.L. and Chen, G.G., "An Experimental Study of Thermofracture Behavior of Leaking Pipes," *Experimental Techniques*, Sept., 1989, pp. 16-20.
18. Hsu, T.R., Gong, Z.L., Sun, N.S. and Chen, G.G., "A Technique for the Measurement of Mechanical Damping Characteristics of Oil Sands," *AOSTRA Journal of Research*, Vol. 4, 1988, pp. 95-101.
19. Chen, G.G. and Hsu, T.R., "A Mixed Explicit-Implicit (EI) Algorithm for Creep Stress Analysis," *International Journal for Numerical Methods in Engineering*, Vol. 26, 1988, pp. 511-524.
20. Banas, A., Hsu, T.R. and Sun, N.S., "Coupled Thermoelastic-Plastic Stress Analysis of Solids by Finite Element Method," *Journal of Thermal Stresses*, Vol. 10, No.4, 1987, pp. 319-344.
21. Abdel-Hadi, E. and Hsu, T.R., "Computer Modeling of Fixed Bed Underground Coal Gasification Using the Permeation Method," *Journal of Energy Resources Technology*, ASME Transactions, Vol. 109, March, 1987, pp. 11-20.
22. Hsu, T.R., Pizey, G. and Yu, J.R., "Analysis of In-situ Fracture of Oil Sand Formations by Explosives," *In-situ*, Vol. 11, No. 1, 1987, pp. 63-79.
23. Chen, G.G., Hsu, T.R. and Gong, Z.L., "On the Analysis of Thermofracture Behavior of Thin Wall Pipes," *International Journal of Pressure Vessels and Piping*, Vol. 24, 1986, pp. 269-281.
24. Bassim, M.N., Bayoumi, M.R., Hsu, T.R. and Mathews, J.R., "Investigation of Dynamic  $J_k$  for Alloy Steel Weldments Using the Split Hopkinson Bar," *Journal of Materials Testing and Evaluation*, ASTM, Vol. 14, No.5, Sept., 1986, pp. 229-235.
25. Yu, J.R. and Hsu, T.R., "On the Solution of Diffusion-Convection Equations by the Space-Time Finite Element Method," *International Journal for Numerical Methods in Engineering*, Vol. 23, 1986, pp. 737-750.
26. Yu, J.R. and Hsu, T.R., "Analysis of Heat Conduction in Solids by Space-Time Finite Element Method," *International Journal for Numerical Methods in Engineering*, Vol. 21, 1985, pp. 2001-2012.
27. Hsu, T.R., Bassim, M.N., Pizey, G. and Ashour, H.A., "Computer Modeling of In-situ Fracture of Coal Seams for Underground Coal Gasification," *International Journal of Energy Systems*, Vol. 5, No.1, 1985, pp. 26-33.
28. Hsu, T.R., Chen, G.G. and Gong, Z.L., "A Technique for the Measurement of Dynamic Mechanical Properties of Oil Sands," *The Journal of Canadian Petroleum Technology*, Vol. 24, No.3, May-June, 1985.
29. Liu, Y.J. and Hsu, T.R., "A General Treatment of Creep Crack Growth," *Engineering Fracture Mechanics*, Vol. 21, No.3, 1985, pp. 437-452.
30. Hsu, T.R. and Zhai, Z.H., "A Finite Element Algorithm for Creep Crack Growth," *Engineering Fracture Mechanics*, Vol. 20, No.3, 1984, pp. 521-533.

31. Cleghorn, W.L., Fathi, A., Hsu, T.R., Popplewell, N., Sinha, D.K., Thorton-Trump, A.B. and Young, D.R., "Computer-Aided Analysis and Graphics by Microcomputer- Manitoba Experience," *Microcomputer Applications*, Vol. 3, No.3, 1984, pp. 60-65.
32. Hsu, T.R. and Lewak, R., "On the Sensitivity of the Fringe Interpretation Technique in Laser Holographic Interferometry Measurements," *Experimental Mechanics*, Vol. 24, No. 1, 1984, pp. 40-43.
33. Klepaczko, J.R., Hsu, T.R. and Bassim, M.N., "Elastic and Pseudo-Viscous Properties of Coal under Quasi-Static and Impact Loadings," *Canadian Geotechnical Journal*, Vol. 21, No.2, 1984, pp. 203-212.
34. Klepaczko, J.R., Bassim, M.N. and Hsu, T.R., "Fracture Toughness of Coal Under Quasi-Static and Impact Loading," *Engineering Fracture Mechanics*, Vol. 19, 1984, pp. 305-316
35. Sinha, D.K. and Hsu, T.R., "On the Optimum Load Step Size Selection Scheme for Nonlinear Finite Element Stress Analysis," *Computers & Structures*, Vol. 17, 1983, pp. 149-155.
36. Liu, Y.J. and Hsu, T.R., "On Multi-Dimensional Creep Deformation of Ice by Finite Element Analysis," *Journal of Energy and Resources*, *ASME Transactions*, Vol. 104, Sept., 1982, pp. 193-198.
37. Kim, Y.J. and Hsu, T.R. "A Numerical Analysis on Stable Crack Growth Under Increasing Load," *International Journal of Fracture*, Vol. 20, 1982, pp. 17-32.
38. Hsu, T.R., McAllister, W.J. and Scarth, D.A., "Reinforcement of Perforated Metal Sheets by Thermal Shock with Laser Beams," *Experimental Mechanics*, Vol. 22, No.8, 1982, pp. 302-309.
39. Hsu, T.R. and Pizey, G., "On the Prediction of Fusion Rate of Ice by Finite Element Analysis," *Journal of Heat Transfer*, *ASME Transactions*, Vol. 103, Nov., 1981, pp. 727-732.
40. Cheng, S.Y., Hsu, T.R. and Too, J.M., "An Integrated Load Increment Method for Finite Element Elastoplastic Stress Analysis," *International Journal for Numerical Methods in Engineering*, Vol. 15, No.6, 1980, pp. 833-842.
41. Hsu, T.R., "On Behavior of Fuel Elements subject to Combined Cyclic Thermomechanical Loads," *Nuclear Engineering and Design*, Vol., 56, 1980, pp. 279-287.
42. Cheng, S.Y. and Hsu, T.R., "On Elastoplastic Stress-Strain Relationship for Multi-Axial Stress States," *International Journal for Numerical Methods in Engineering*, Vol. 12, 1978, pp. 1617-1622.
43. Trasi, S. and Hsu, T.R., "Improvement of Sheet Metal Strength by Localized Multiple Thermal Shocks," *Journal of Testing and Evaluation*, *ASTM*, Vol. 6, No.4, July, 1978, pp. 280-283.
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14. "Solutions of Nonlinear Transient Heat Conduction Problems by 3-Level Time Difference Scheme," Tech. Rep. No. 79-9-66, Nov., 1979.
15. "Applications of Lasers in Manufacturing Industry", Tech. Rep. No. 79-7-64, Apr., 1979.
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17. "Summary of Results on the Analysis of Thin Wall Tube Sag due to Gravity Load", Tech. Rep. No. 79-4-61, Mar., 1979.
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  40. "Annual Report", Part III: Listing of TEPSA computer program, Tech. Rep. No. 74-4-18, May, 1974.
  41. "Annual Report", Part III: Listing of TEPSA computer program, Tech. Rep., No. 74-3-17, May, 1974.
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  44. "Engineering Design of Brittle Structures", Tech. Rep. No. PRE-4-4, Sept., 1969.
  45. "Stress Analysis on Thin Shells with Variable Wall Thickness", Tech. Rep. No. PRE-3-3, Sept., 1968.
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## APPENDIX 1

### Summary of Research Grants and Contracts Received by T.R. Hsu Prior to Joining San Jose State University in August 1990

Projects	Sponsor*	Period	Amount
1) Measurement of solid deformation by laser holographic interferometry technique 2) Development of thermomechanical analytical models using finite element method 3) Computer-aided design and graphics using microcomputers 4) Creep mechanics and creep fracture of solids 5) On thermofracture mechanics of solids	NSERC (operating & equipment grants)	November 1971 to March 1992	\$661,536.00
6) On mobility of oil slick in ice/water compounds due to changing thermal environments	NSERC (Strategic grant)	November 1978 to October 1981	\$119,000.00
7) In-situ fracture and thermal conditioning of Canadian coals	NSERC (Strategic grant)	November 1980 to October 1983	\$241,499.00
8) Computer modeling of in-situ fracture of oil sand formations	NSERC (Strategic grant)	November 1983 to October 1985	\$395,743.75
9) Computer modeling and verification of nuclear reactor fuel behavior	AECL (contracts)	October 1972 to February 1979	\$514,090.81
10) Measurements of thermal distortion of wave guides and satellite transponders	CRC (contracts)	January 1978 to March 1980	\$57,444.00
11) Setting up laser holographic laboratory	U of M (grant)	November 1971 to March 1972	\$5,500.00
		May 1976 to April 1976	
12) Strength enhancement of sheet metals by thermal shock process	DRB (contract)	April 1974 to March 1976	\$15,600.00
13) Computer modeling of in-situ fracture of oil sand formations	AOSTRA (contract)	July 1983 to June 1986	\$196,300.00
		July 1986 to September 1988	\$134,718.00
14) Cutting sheet metals by laser beams	MTM (contract)	March 1983	\$7,637.28
15) Measurement of thermal distortion of composite structures	Bendix (contract)	January 1982 to July 1982	\$5,140.44
16) Training of personnel for operating laser holographic interferometry experiments	Boeing Canada (contract)	January 1983	\$1,857.22
17) Providing finite element design services	ITC/MRC	January 1988	\$14,900.00
<b>Total</b>			<b>\$2,370,966.50</b>

NOTE: The above list does not include the two NSERC\* Chair Professors that I established for the department in 1987 and 1988 during my tenure as the Head of the ME Department at the University of Manitoba. The two Chair Professor positions were in "Advanced manufacturing for small and medium sized industries" and "Ergonomics in advanced manufacturing", Each Chair worth \$1.2 million with 20% cash contributions from industry for the first Chair, and 50% industrial contributions for the second Chair.

\*NSERC - Natural Sciences and Engineering Research Council, Government of Canada  
AECL - Atomic Energy of Canada Ltd., Pinawa, Manitoba, Canada  
CRC - Communication Research center, Ottawa, Ontario, Canada  
UofM - University of Manitoba, Winnipeg, Manitoba, Canada  
DRB - Defense Research Board, Ottawa, Ontario, Canada  
AOSTRA - Albert Oil Sands Technology and Research Authority, Edmonton, Canada  
MTM - Micro Tools and Machines Ltd., Winnipeg, Manitoba, Canada  
Bendix - Bendix Advanced Technology Center, Maryland, U.S.A.  
Boeing - Boeing Canada, Winnipeg, Manitoba, Canada  
ITC/MR - Industrial Technology Center, Manitoba Research Council, Winnipeg, Canada

## APPENDIX 2

### Major Research Grants and Contracts Awards Received after Joining San Jose State University in 1990

Projects	Funding Sources	Period	Amount (\$)
Wind Power Generation on High Rise Buildings in Urban Centers Co-PIs: Craig Clements & Eugene Cordero (Meteorology Dept., SJSU)	California Energy Commission	Sep/10 to Dec/11	50000
A Mobile Atmospheric Profiling System for Multi-Campus Research & Education (CSU-MAPS). PI: Craig Clements (Meteorology Dept., SJSU) Co-PIs: T.R. Hsu and A. Bridger	National Science Foundation MRI-R <sup>2</sup> (Major Research Instrumentation Program)	Jul/09 to Dec/12	446894
Hybrid Powered Zero Emission (ZEM) Vehicle Design and Development (a student project)	College of Engineering, SJSU	Jul/07 to Jun/08	41000
		Jul/06 to Jun/07	36229
Laboratory Experiments in MEMS PI: John Lee, CO-PIs: T.R. Hsu, G. Stacy and D. Parent	National Science Foundation Washington, DC	Aug/04 to Jul/06	115564
Laboratory and Curriculum Development in Thermal Management of Electronics PI: Nicole Okamoto, CO-PI: T.R. Hsu	National Science Foundation Washington, DC	Jul/03 to Jun/06	105757
On Miniature Microphone Design	Industrial Technology Research Institute, San Jose, CA		45000
On Moisture-Induced Fracture of Integrated Circuits with Plastic Encapsulations	US Airforce/National Semiconductor Corp., Santa Clara, CA	Jun/95 to Jul/96	63000
Undergraduate Curriculum Development on Mechatronics Systems Engineering	National Science Foundation Washington, DC	Feb/95 to Jan/98	494279
	Hewlett-Packard Company		70978
	David Brown Fellowship in mechatronics		50000
Trans-Pacific Workshops on Mechatronic Technology	National Science Foundation Washington, DC	Jan/95 to Dec/96	50000
Planning Trip on Trans-Pacific Workshops on Mechatronic Technology	National Science Foundation Washington, DC	Jan-94	8200
Fatigue Strength of Adhesives for Wind Turbine blades	FloWind Corporation Pleasanton, CA	Jan/92 to Dec/93	27000

**Total: \$1,603,901**