CURRICULUM VITAE

Jagannatha R. Rao

Department of Mechanical Engineering
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EDUCATION

University of Michigan, Ann Arbor. Department of Mechanical Engineering.

Ph.D. in Mechanical Engineering. *December 1989.*

Dissertation: *Higher Level Modeling Formulations in Optimal Design.*

Graduate studies in system design, optimization methods, structures and optimal control.

Indian Institute of Technology-Madras, India. Department of Mechanical Engineering.

B. Tech. (Bachelor of Technology) in Mechanical Engineering. *May 1985.*

PROFESSIONAL EXPERIENCE

University of Houston. Department of Mechanical Engineering.

Associate Professor *September 1996 – present.*

Assistant Professor *September 1990 – Aug 1996.*

Currently teaching graduate courses in optimization methods and applications, and undergraduate courses in mechanical system design including kinematics, dynamics and mechanisms. Research focus is on multi-level modeling and optimization of mechanical systems, applications of duality principles and nonsmooth optimization, game-theoretic modeling in concurrent design and parametric nonlinear programming.

NASA, Langley. ICASE - Institute for Computer Applications in Science and Engineering.

Visiting Scientist. *June 1995.*

Performed research in algorithms for multilevel optimization. Two new applications were developed, one from structural design and another from a game-theoretic model in a multidisciplinary setting.

Sandvik Rock Tools, Inc, Houston.

Consultant *January – June 1991.*

Developed models for optimization of percussion hammer-drills used in mining industries. This consulting work directly lead to a three year research contract with Sandvik.

University of Michigan, Ann Arbor. Department of Mechanical Engineering.

Visiting Assistant Professor *September 1989 – June 1990.*

Taught a graduate course in Design Optimization. Conducted research in multilevel decomposition methods in design. Applications included automotive powertrain systems.

University of Michigan, Ann Arbor. Department of Mechanical Engineering.

Graduate Research Assistant *September 1985 – August 1989.*

Investigated theoretical and computational problems in optimal design of mechanical and structural systems. Research experience in nonlinear programming algorithms and knowledge-based production systems (specifically, OPS5). Developed a production system for performing global boundedness analysis of optimal design models.

General Motors Research Laboratories. Power Systems Research Department.

Graduate Student Trainee *June – August 1988.*

Formulated and solved different optimization models for the design of powertrains in unconventional hybrid vehicles.

University of Michigan, Ann Arbor. Department of Aerospace Engineering.

Teaching Assistant for AERO 565 *January – May 1988.*

Incorporated numerical optimization procedures in this graduate course on structural optimization and supervised computational work in student term projects.

INVITED PRESENTATIONS

1. "Formulations for Designs Subjected to Uncertainties in Design Variables and Operating Parameters," (with and presented by doctoral student K. Badhrinath), Invited for the interactive plenary session of AIAA SDM Conference (3-6 April 2000, Atlanta, GA).
2. "Multilevel Models in Optimization," presented at Waseda University, Tokyo, July 31, 1997.
3. "New Dual and Multilevel Models in Structural Optimization," presented as part of an invited minisymposium on Multidisciplinary Optimization at the *SIAM Annual Meeting,* held at Charlotte, NC, from October 23-26, 1995.
4. "New Dual and Multilevel Models in Structural Optimization," presented at the *Euromech Colloquium 345* being held on the theme: 'The Future of Structural Optimization' at Liverpool England during April 1-3, 1996.
5. "A Two-Level Approach to Computing Worst Case Optimum Designs," presented as part of an invited minisymposium on Algorithms for Multilevel Programming at the *Fifth SIAM Conference on Optimization* held at Victoria, British Columbia from May 20-22, 1996.

JOURNAL PUBLICATIONS

1. J. R. Jagannatha Rao and Panos Y. Papalambros, 1991, "PRIMA : A Production - Based Implicit Elimination System for Monotonicity Analysis of Optimal Design Models," *Trans. of ASME, J. of Mechanical Design* Vol 4, No. 4, pp. 408-415.
2. R. Muralidhar, J. R. Jagannatha Rao, K. Badhrinath, and A. Kalagatla, 1996, "Multilevel Formulations in the Limit Analysis and Design of Structures With Bilateral Contact Constraints," *Intl. J. of Num. Meth. in Eng.,* Vol. 39, 2031-2053.
3. A. Kalagatla, J. R. Jagannatha Rao and S. Borkar, 1996, "Models for Two-Player Games in Design: An Application to Automotive Suspensions," *Mechanics of Structures and Machines,* Vol. 24, No. 4, 453-473.

4. K. Badhrinath and J. R. Jagannatha Rao, 1996,"Illustration of Bilevel Formulations in Concurrent Design Modeling," *Int. J. of Concurrent Engineering* (invited for a special issue on Concurrent Engineering in Design Automation), Vol. 4, No. 4, 389-399.
5. J. R. Jagannatha Rao, K. Badhrinath, R. Pakala and F. Mistree, 1997,"A Study of Optimal Design Under Conflict Using Models of Multi-Player Games," *Engineering Optimization,* Vol. 28, pp. 63-94.
6. R. Pakala and J. R. Jagannatha Rao, 1997, "A Study of Concurrent Decision-Making Protocols in the Design of a Metal Cutting Tool Using Monotonicity Arguments," *Engineering Optimization,* Vol. 28, 63-94.
7. R. Muralidhar and J. R. Jagannatha Rao, 1997, "New Models for Optimal Truss Topology in Limit Design Based on Unified Elastic/plastic Analysis," *Comp. Meth. Appl. Mech. Eng.,* Vol 140, 109-138.
8. J. R. Jagannatha Rao, R. Bradlaw and Ramakrishna Kowta, "A Unified Characterization of Nonunique Response in Elastic/Perfectly-Plastic and Elastic/Locking Structures Using Constraint Qualifications," *Journal of Optimization Theory and Applications,* (accepted).

JOURNAL PUBLICATIONS CURRENTLY IN PROGRESS.

1. Ramakrishna Kowta, and J. R. Rao "A Study of Duality Based Models for the Optimal Topology Design of Compliant Mechanisms," *J. of Optimization Theory and Applications.*
2. J. R. Rao, Ramakrishna Kowta, and K. Badhrinath, "A Duality Based Approach for the Topology Design of Vibration Support Structures," *Intl. J. of Numerical Methods in Engineering.*
3. Jim Masciarelli, and J. R. Rao, "A Study of NAND and SAND Formulations in the Multidisciplinary Design of a Launch Vehicle Upper Stage Vehicle," *AIAA Journal.*
4. J. R. Rao and R. Hebert, "A Study of Variable and Constraint Relaxation in Design Optimization," *Mechanics Based Design of Structures and Machines..*
5. J. R. Rao, " Discovery of Adaption Controls in Optimum Robust Design Using Model Relaxation," *ASME J. of Design.*
6. J. R. Rao and R. Bradlaw, "A Study of Parametric Singularities Due to Variable Obstacles and Supports in Structural Design," *Computer Methods in Applied Mechanics and Engineering.*

REFEREED PUBLICATIONS IN BOUND VOLUMES

1. Ed. Mercado and J. R. Rao, "The Pneumatic Scour Detection System," *Proceedings of the NDE Conference on Civil Eng sponsored by the American Society of Nondestructuve Testing*, St. Louis, MO, USA. Aug. 14-18, 2006, pp. 138-146.
2. J. R. Rao and Ramkrishna Kowta, "Duality and Multilevel Models in the Optimal Design of Adaptive Structures and Mechanisms," *Paper No. 26783, Proc. of the 1st AIAA Multidisciplinary Design Optimization Specialist Conference (April 18-21, 2005, Austin, Texas),* AIAA Online Proceedings, 2005.
3. J. R. Jagannatha Rao and Farrokh Mistree, 1995, "Recent Applications of Bilevel Models in Multidisciplinary Optimization," *Proc. WCSMO - 1:First World Congress of Structural and Multidisciplinary Optimization (May 28-June 2, 1995, Goslar, Germany),* Pergamon, NY, pp. 17-24.

4. K. Badhrinath and J. R. Jagannatha Rao, 1995, "Illustration of Bilevel Formulations in Concurrent Design Modeling," *Advances in Design Automation,* Vol. 82, No. 1, ASME Publ., pp. 189-195.
5. K. Badhrinath and J. R. Jagannatha Rao, 1994, "Bilevel Models for Optimum Designs Which are Insensitive to Perturbations in Variables and Parameters," *Advances in Design Automation,* Vol. 69, No. 2, ASME Publ., pp. 15-23.
6. J. R. Jagannatha Rao and B. Chidambaram, 1993, "Parametric Deformations and Model Optimality in Concurrent Design," *Advances in Design Automation,* Vol.65, No. 2, ASME Publ., pp. 477-485.
7. R. Hebert and J. R. Jagannatha Rao., 1992, "An Investigation into Hierarchical Modeling in Optimal Design," *Advances in Design Automation*, Vol. 44, No. 1, ASME Publ., pp. 193-202.
8. H. M. Karandikar, J. R. Jagannatha Rao and F. Mistree, 1991, "Sequential versus Concurrent Formulations for the Synthesis of Engineering Designs," *Advances in Design Automation,* Vol. 32, No. 2, ASME Publ., pp. 361-369.
9. J. R. Jagannatha Rao and Panos Y. Papalambros, 1990, "Remarks on Conditions for the validity of Parametric Decomposition in Optimal Design[5]," *Advances in Design Automation,* Vol. 23, No. 2, pp. 51-61.
10. J. R. Jagannatha Rao and Panos Y. Papalambros, 1989, "Extremal Behavior of One Parameter Family of Optimal Design Models," *Advances in Design Automation,* Vol. 19, No. 2, ASME Publ., pp. 91-100.
11. J. R. Jagannatha Rao and Panos Y. Papalambros, 1989, "A Nonlinear Programming Continuation Strategy for One Parameter Design Optimization Problems," *Advances in Design Automation,* Vol. 19, No. 2, ASME Publ., pp. 77-89.
12. J. R. Jagannatha Rao and P. Papalambros, 1987, "Implementation of Semi-Heuristic Reasoning for Boundedness Analysis of Design Optimization Models[5]," *Advances in Design Automation,* Vol. 10, No. 1, ASME Publ., pp. 59-66.

OTHER REFEREED PUBLICATIONS

1. J. R. Jagannatha Rao and K. Badhrinath, 1996, "Solution of Multilevel Structural Design Problems Using a Nonsmooth Algorithm," *Sixth AIAA/USAF/NASA/ISSMO Symposium on Multidisciplinary Analysis and Optimization,* Bellevue, WA, Spetember 1996, pp. 47-55.
2. J. R. Jagannatha Rao and P. Y. Papalambros, 1994, "Computation of Kuhn-Tucker Triples in Optimum Design Problems in the Presence of Parametric Singularities," *Fifth AIAA Symposium on Multidisciplinary Analysis and Optimization,* Panama City, Florida, September 1994, pp. 1418-1424.
3. R. Bradlaw and J. R. Jagannatha Rao, 1994, "A Feature-Based Design study in Constrained Optimization Using the Simulated Annealing Algorithm," *Fifth AIAA Symposium on Multidisciplinary Analysis and Optimization,* Panama City, Florida, September 1994, pp. 941-948.

CONFERENCE PRESENTATIONS

1. Ed. Mercado and J. R. Rao, "The Pneumatic Scour Detection System," *The NDE Conference on Civil Eng sponsored by the American Society of Nondestructuve Testing*, St. Louis, MO, USA. Aug. 14-18, 2006.

2. J. Rao and R. Kowta, "Duality and Multilevel Models in the Optimal Design of Adaptive Structures and Mechanisms," *The 1st AIAA Multidisciplinary Design Optimization Specialist Conference*, April 18-21, 2005, Austin, Texas.
3. R. Muralidhar and J. R. Jagannatha Rao, "Topology Optimization in Limit Design of Elastic-Plastic Truss Structures," *First World Congress of Structural and Multidisciplinary Optimization,* Goslar, Germany, May 1995.
4. J. R. Jagannatha Rao and P. Y. Papalambros, "The Role of Parametric Singularities in the Analysis and Design of Structures," *First World Congress of Structural and Multidisciplinary Optimization,* Goslar, Germany, May 1995.
5. J. R. Jagannatha Rao, "Parametric Deformations in Game Theory Models and their Application to Concurrent Design of Mechanical Systems," Fifteenth Symposium on Mathematical Programming with Data Perturbations, Washington, D. C., May 1993.
6. J. R. Jagannatha Rao, "Concurrent Design Using Parametric Model Deformations," NSF Grantees Conference, Charlotte, N.C., January 1993.
7. J. R. Jagannatha Rao and Panos Y. Papalambros, 1989, " Application of Large Parametric Deformation in Optimal Design Models," 14th IFIP Conference on System Modeling and Optimization, Liepzig, July 1989.
8. Papalambros P. , and J. R. Jagannatha Rao, 1988, " A Case for Input Output Modeling Formulations in Optimal Design," Second NASA/Air Force symposium on recent Advances in Multidisciplinary Analysis and Optimization, Hampton, Va. 1988.
9. J. R. Jagannatha Rao and Panos Y. Papalambros, 1990, "Parametric Formulations in Optimal Design," Third Air Force/NASA symposium on Recent Advances in Multidisciplinary Analysis and Optimization, San Francisco.
10. J. R. Jagannatha Rao and Papalambros, P. Y., 1990, "Computation of Parametric Solution Sets in Optimal Design," TIMS/ORSA Joint National Meeting, Las Vegas, May, 1990.

SUPERVISION OF GRADUATE STUDENTS – Ph. D. Program

1. Krishnakumar Badhrinath (1996). Thesis: "Applications of Multilevel Modeling, Duality Principles and Nonsmooth Optimization in Concurrent Design of Mechanical Systems." Krishnakumar is with Boeing Aircraft Co.
2. Ram Kowta (2005). Thesis: "New Mathematical Models for the Design of Passive and Active Devices and Structures."

SUPERVISION OF GRADUATE STUDENTS – M. S. Thesis Program

1. Balagurunathan Chidambaram (August 1990 - August 1992). Thesis: "Stackelberg Games in Optimal Design."
2. Shantanu Swadi (August 1991 - December 1993). Thesis: "Model Approximations and Line Search Strategies in the Simultaneous Analysis and Design of Mechanical Systems."
3. B. Krishnakumar (August 1992 - December 1993). Thesis: "An Investigation into Singularities Due to Parametric Deformation in General Bi-Level Models of Concurrent Design."
4. Rama Rao Pakala (August 1992 - May 1994). Thesis: "A Study on Application of Stackelberg Game Strategies in Concurrent Design Models."

5. Sanjeev Borkar (August 1992 - May 1994). Thesis: "Development of Pareto and Stackelberg Games to Model Concurrency in Engineering Design."
6. George Matta (August 1992 - December 1994). Co-Chaired with Yi-Chao Chen. Thesis: "Parametric and Extremal Behavior in Optimum Design: An Application to Novel Hydraulically Operated Percussion-type Impact Devices."
7. Anil Kalagatla (August 1992 - December 1994). Thesis: "New Applications of Nonsmooth Optimization in Bilevel and Structural Design."
8. Robert Bradlaw (August 1992 - January 1994). Thesis: "A Study of Parametric Singularities in Feature-Based Design."
9. Ravuri Muralidhar (August 1993 - August 1995). Thesis: "Duality and Nonsmoothness in Structural Topology Design and Multilevel Optimization." Murali is with Seibel Inc. in San Jose, CA.
10. James P. Masciarelli III., (August 1995 - August 1997). Thesis: "Reduced Hessian Sequential Quadratic Programming Methods for Multidiscipline Design Optimization." James was a NASA fellow during part of this thesis work and is with NASA-JSC.
11. Timothy Moose., (August 1996 - December 1999). Thesis: "Design of Smart Structures: Optimal Parameter Selection in Finite-Dimensional Linear Quadratic Control Problems."
12. Ram Kowta (August 1998 - August 2001). Thesis: "Models and Algorithms for Optimal Synthesis of Smart Structures and Compliant Devices."
13. Rao Venkata Harivamsi, (August 2001 - November 2003) Thesis: "Optimization by Cooperative Game Theory Using Internet as a Communication Tool."
14. Harshal Mungikar, (Dec. 2009 –) Thesis: "Models for Robust Design in Multifunctional Systems (tentative)".
15. S. Bhanu Kiran, (Dec. 2009 –) Thesis: "Tuned Robustness in Design of Compliant Mechanical Systems (tentative)."

In addition, the following students have completed their MSME (non-thesis) design project work under my supervision: Chris Johnson of NASA-JSC (Summer 2002), Dan Markel of Schlumberger (Fall 1992), Divyesh Dalal of Stone and Webster (Spring 1993), Rodrigo Feliu (Summer 2009).

COURSES TAUGHT

1. MECE 1331 – Computing for Mechanical Engineers (both in-class and now an online version in Spring 2010). Introduction to problem solving, structured programming as applied to engineering problems using MATLAB and EXCEL.

2. MECE 3360 – Experimental Methods. Introductory junior level course in engineering experimentation.

3. MECE3338 - Dynamics and Control of Mechanical Systems. This is a junior level core course in our design sequence. The emphasis in this course is on kinematics, dynamics and mechanism design. A unique aspect of this course, as taught at UH, is the semester long design group project which leads either to prototype construction or to detailed computer simulations of new mechanism designs.

4. MECE4332 - Finite Element Based Mechanical Design. Senior level core course in our design sequence.

5. MECE 5373 - Computer-Based Resolution of Open Problems. This is a novel senior level elective course where the emphasis is on teaching optimal decision-making in a very wide range of practical problems using a case-study approach.

6. MECE5397 - Strength-Based Design. This is a senior level elective course where the objective is to introduce optimization methods as applied to structural systems.

7. MECE5397 - Simulation-Based Design. This is a new senior level elective begin offered during Spring 1996 where the focus is on building simulation and design models for practical mechanical systems using available state-of-the art modeling software (Mathematica and Working Model).

8. MECE6379 - Computer Methods in Mechanical Design. This is a completely new version of an existing course. The entire focus is on applied optimization, i.e., modeling and optimization of an engineering system. The emphasis is equally on a semester long design project (list of past projects attached) and on the theoretical and algorithmic aspects of nonlinear programming.

9. MECE7397 - Advanced Design Optimization. This is a new course and is in the process of getting its own regular course number. The focus in this course is on design applications of duality principles and nonsmooth optimization. This course is perhaps unique in a mechanical engineering curriculum due to its rather detailed treatment of topics from mathematical optimization theory.