

RESUMÉ

NAME: Dara Wallie Childs

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EDUCATION:

Ph.D. Engineering Mechanics, University of Texas at Austin, August 1968.

M.S. Civil Engineering, Oklahoma State University, August 1962.

B.S. Civil Engineering, Oklahoma State University, May 1961.



PROFESSIONAL EXPERIENCE:

6/80 Mechanical Engineering Department, Texas A&M University, College Station, Texas.
I have conducted research and taught graduate and undergraduate courses in dynamics, vibrations, and engineering analysis. I have served as principal or co-principal investigator on numerous contracts for governmental and private entities.

From January 1984 until June 1986 I was the interim TEES Mechanical Engineering Division Head (interim department head for research). During this time period, the department recruited and hired four faculty members.

Since September 1984, I have been the director for the Turbomachinery Laboratory (TL). The TL manages two annual symposia: the Turbomachinery Symposium (approximately 3000 attendees) and the International Pump Symposium (approximately 3000 attendees). In February 2011, the TL organized and presented the 1st Middle East Turbomachinery Symposium in Doha Qatar

In 1982, I co-founded the Turbomachinery Research Consortium (TRC), which is an industrially-sponsored research group with around 22 members. The TRC activities are managed through the TL. There are approximately 10 participating faculty members.

During June of 1986, I was a visiting professor at the Technical University of Eindhoven, the Netherlands.

During January - July 1991, I was a visiting professor at ETH, Swiss Federal Institute of Technology in Zurich, Switzerland.

During June-December 1999, I was a visiting professor at The University of New South Wales in Sydney, Australia.

During the fall semester 2009, I was a visiting professor at Texas A&M University in Qatar.

9/71-6/80 Mechanical Engineering Department, The University of Louisville, Louisville, Kentucky.

During the 1975-76 academic year, I was a visiting faculty member at the Technische Hogeschool Twente, Enschede, The Netherlands.

During the summer of 1979, I was a guest professor at the Danish Technical University; Lyngby, Denmark.

8/68-8/71 Assistant Professor, Department of Mechanical Engineering, Colorado State University, Fort Collins, Colorado.

1/68-6/68 Graduate Teaching Assistant, University of Texas at Austin.

8/62-8/65 Rocketdyne Division of North American Rockwell, Canoga Park, California.

Summer Positions: NASA-ASEE summer faculty fellow during the summers of 1970 and 1973.

PROFESSIONAL AFFILIATIONS AND ACTIVITIES:

- Registered Professional Engineer, The State of Texas, # 49383
- Member-ASME, Chi Epsilon, Phi Kappa Phi, Pi Tau Sigma
- Technical proposal reviewer for NSF, ARO, and the State of Virginia
- Technical paper reviewer for many journals including the *ASME Journals of Tribology, Vibrations and Acoustics*, and *Gas Turbines*
- *IFTOMM* (International Federation Theory of Machines and Mechanisms) Technical Committee on Rotordynamics, September 1986 - 2010, organizing committee for 1990, 1994, 1998, 2002, 2006, and 2010 *International Conferences on Rotordynamics*
- Peer-review committee for NASA Contract NAS3-25644, "Numerical/Analytical/ Experimental Study of Fluid Dynamic Forces in Seals," 1990 - 1995.
- Member EPRI Advisory Committee for Boiler Feed Pump Research Project, 1985 - 1991.
- Co-organizer of the "Workshop on Rotordynamic Instability Problems in High Performance Turbomachinery," held at TAMU, 12-14 May 1980, 10-12 May 1982, 28-30 May 1984, 2-4 June 1986, 16-18 May 1988, 10-12 May 1993, and 6-8 May 1996.
- Organizing committee, 4th International Conference on Magnetic Bearings, Zurich, Switzerland, 23-26 August 1994, 7th International Conference on Magnetic Bearings, Zurich, Switzerland, 23-25 August 2000.
- Organizing Committee, VDMA Compressor Users International Forum, 2004, Karlsruhe Germany.

HONORS AND AWARDS:

ASME IGTI, Structures and Dynamics Committee, 2009 Best Paper Award, Wilkes, J, Dyck, B.J., Childs, D., and Phillips, S., "The Numerical and Experimental Characteristics of Multi-Mode Dry-Friction Whip and Whirl," ASME Paper 2009-GT-59459

Britton award for outstanding undergraduate teaching in the TAMU Mechanical Engineering Department, 1996

Regents Professor, Texas A&M University, May 2004

TAMU Former Students' award for outstanding research contributions, May 1993.

Leland T. Jordan Chair of Mechanical Engineering (Jan. 1992 - present).

Henry R. Worthington medal from ASME for outstanding contributions in Pumping Machinery, Jan. 1992.

Tenneco Professor of Mechanical Engineering (1987 - 1991).

ASME Design Engineering Division best paper award in Mechanical Vibration and Noise at the 1989 Design Engineering Technical Conferences: Williams, J. and Childs, D., "Influence of Impeller Shroud Forces on Turbopump Rotordynamics," awarded at the 1991 ASME Vibration Conference, Sept. 1991, Miami, FL.

ASME Fellow, Dec. 1990.

H. H. Jeffcott Award, best rotordynamics paper at the 1987 Vibration Conference, "Fluid-Structure Interaction Forces at Pump-Impeller-Shroud Surfaces for Rotordynamic Calculations."

Haliburton Research Professor for the College of Engineering 1986.

Texas Engineering Experiment Station (TEES) research fellow 1984, 1985, 1986 (Senior TEES Fellow 1986).

ASME best technical paper in Tribology, 1985, "Theory Versus Experiment for the Rotordynamic Coefficients of Annular Gas Seals: Part 1-Test Facility and Apparatus.

REVIEWED JOURNAL PUBLICATIONS:

Tschoepe, D. and D. Childs, "Measurements Versus Predictions for the Static and Dynamic Characteristics of a Four-Pad, Rocker-Pivot, Tilting-Pad Journal Bearing," *ASME J. for Gas Turbines and Power*, 136 (1), May 2014, 136, pp. 052501-1-11

Mehta, N. and Childs, D.W., "Measured Comparison of Leakage and Rotordynamic Characteristics for a Slanted-Tooth and a Straight-Tooth Labyrinth Seals," *ASME J. for Gas Turbines and Power*, 136 (1), January 2014, pp. 012501-1-10

Vannarsdal, M. and Childs, D.W., "Static and Rotordynamic Characteristics for a New Hole-Pattern Annular Gas Seal Design Incorporating Larger Diameter Holes," *ASME J. Eng. Gas Turbines and*

Power **136** (2), 022507 (Nov 04, 2013) doi:10.1115/1.4025536

Avendano, R. and Childs, D.W., "One Explanation for $2n$ Response due to Misalignment in Rotors Connected by Flexible Couplings," *ASME J. for Gas Turbines and Power*, **135** (6), June, 2013, 062501

Muhammed, A.R.A., and Childs, D., "Rotor Dynamics of a 2-phase Flow Twin Screw Pump," *ASME J. for Gas Turbines and Power*, **135** (6), June, 2013, 062502

Wilkes, J. and Childs, D.W., "Improving Tilting Pad Journal Bearing Predictions-Part I: Model Development and Impact of Rotor Excited Versus Bearing Excited Impedance Coefficients," 012502, *ASME J. for Gas Turbines and Power*, January 2013 **135** (1)

Wilkes, J. and Childs, D.W., "Improving Tilting-Pad Journal Bearing Predictions-Part II: Comparison of Measured and Predicted Rotor-Pad Transfer Functions for a Rocker-Pivot Tilting-Pad Journal Bearing," 012503, *ASME J. for Gas Turbines and Power*, January 2013 **135** (1)

Brown, P. and Childs, D., "Measurement versus Predictions of Rotordynamic Coefficients of a Hole-Pattern Gas Seal with Negative Preswirl," *ASME J. for Gas Turbines and Power*, **134** (12), pp. 122503-1-11, December 2012

Wilkes, J. and Childs, D.W., "Tilting Pad Journal Bearings - A Discussion on Stability Calculation, Frequency Dependence, and Pad and Pivot Flexibility," *ASME J. for Gas Turbines and Power*, **134** (12), pp. 122508-1-17, December 2012

Childs, D. and Kumar, D., "Dry-Friction Whip and Whirl Predictions for a Rotor-Stator Model with Rubbing Contact at two Locations," *ASME J. for Gas Turbines and Power*, **134** (7), 072502, July 2012

Childs, D. and Saha, R., "A New, Iterative, Synchronous-Response Algorithm for Analyzing the Morton Effect," *ASME J. for Gas Turbines and Power*, **134** (7), 072501, July 2012

Kulhanek, C. and Childs, D., "Measured Static and Rotordynamic Coefficient Results for a Rocker-Pivot pad TP bearing with 50 and 60% Offsets," *ASME J. for Gas Turbines and Power*, **134**, 052505, May 2012

Childs, D., Kheireddin, B., Phillips, S., and Asiravataham, T., "Friction Factor Behavior From Flat-Plate Tests of Smooth and Hole-Pattern Roughened Surfaces With Supply Pressures up to 84 bars," *ASME J. for Gas Turbines and Power*, **133**, 092504, September 2011

Childs, D. and Carter, C., "Rotordynamic characteristics of a 5 pad, rocker-pivot, tilting pad bearing in a load-on-pad configuration; comparisons to Predictions and load-between-pad results," *ASME J. for Gas Turbines and Power*, **133**, 082503, August, 2011

Thorat, M. and Childs, D., "Predicted rotordynamic behavior of a labyrinth seal as rotor surface speed approaches Mach 1," *ASME J. For Gas Turbines*, **132**, 112504 (2010)

Gupta, M. and Childs, D., "Rotordynamic Stability Predictions for Centrifugal Compressors Using a Bulk-Flow Model to Predict Impeller Shroud Force and Moment Coefficients," *ASME J. Eng. Gas Turbines Power*, **132**, 091402 (2010)

- Wilkes, J, Dyck, B.J., Childs, D., and Phillips, S., “The Numerical and Experimental Characteristics of Multi-Mode Dry-Friction Whip and Whirl,” *ASME J. For Gas Turbines and Power*, May 2010, **132**(5), pp 052503 1-9
- Harris, J. and Childs, D., “Static Performance Characteristics and Rotordynamic Coefficients for a Four-Pad Ball-in-socket Tilting Pad Journal Bearing,” *ASME J. For Gas Turbines and Power*, November 2009, **131**(6), pp 062502 1-11
- Carter, C. and Childs, D., “Measurements versus Predictions for the Rotordynamic Characteristics of a 5-Pad, Rocker-Pivot, Tilting-Pad Bearing in Load Between Pad Configuration,” *ASME J. For Gas Turbines*, January 2009, **131**(1), pp. 012507 1-9
- Al Jughaiman, B., and Childs, D., “Static And Dynamic Characteristics For Pressure-Dam Bearing,” *ASME J. For Gas Turbines*, September 2008, **130** (5), pp. 052501 1-7
- Shin, Y.-S. and Childs, D., “ The Impact of Real Gas Properties on the Static and Dynamic Properties of Annular Seals in High-Pressure Injection Compressors,” *ASME J. For Gas Turbines*, July 2008, **130** (4), pp. 042504 1-5
- Zuttavern, Z., and Childs, D., “Identification of Rotordynamic Forces in a Flexible Rotor System Using Magnetic Bearings,” *ASME J. for Gas Turbines*, March 2008, **130** (2), pp. 022504 1-5.
- Gupta, M., Soulas, T., and Childs, D., “New Steps to Improve Rotordynamic Stability Predictions of Centrifugal Compressors,” *ASME J. for Gas Turbines*, March 2008, **130** (2), pp. 022505 1-5.
- Childs, D., Shin, Y.-S., and Seifert, B., “A Design to Improve the Effective Damping Characteristics of Hole-Pattern-Stator Annular Gas Seals,” *ASME J. for Gas Turbines*, January 2008, **130** (1), pp. 12505 1-7
- Childs, D. and Bhattacharya, A., “Prediction of Dry-Friction Whirl and Whip between a Rotor and a Stator,” *ASME J. of Vibrations and Acoustics*, June 2007, **129**, 355-362
- Childs, D., Graviss, M., and Rodriguez, L., “The Influence of Groove Size on the Static and Rotordynamic Characteristics of Short, Laminar-Flow Annular Seals,” *ASME J. for Tribology*, April 2007, **129**, pp. 398-406
- Sprowl, B. and Childs, D., “A Study of the Effects of Inlet Preswirl on the Dynamic Coefficients of a Straight-Bore Honeycomb Gas Damper Seal,” *ASME J. for Gas Turbines*, January 2007, **129** (1), pp 220-229.
- Al-Ghasem, A. and Childs, D., “Rotordynamic Coefficients; Measurements versus predictions for a High Speed Flexure-Pivot Tilting-Pad Bearing (Load-Between-Pad Configuration),” *ASME J. For Engineering for Gas Turbines and Power*, October 2006, **128** (4), pp. 896-906.
- Smalley, A., Camatti, M., Childs, D., Hollingsworth, J., Vannini, G., Carter, J., “Dynamic Characteristics of the Diverging Taper Honeycomb-Stator Seal,” *ASME J. of Turbomachinery*, October 2006, **128**, (4), pp. 717-724
- Childs, D., Rodriguez, L., Cullotta, V., Al-Ghasem, A., and Graviss, M., “Rotordynamic-Coefficients,

and Static (Equilibrium Loci and Leakage) Characteristics for Short, Laminar-Flow Annular Seals,” *ASME J. of Tribology*, April 2006, **128**, pp. 378-387

Rodriguez, L. and Childs, D., “Frequency Dependency of Measured and Predicted Rotordynamic Coefficients for Load-on-Pad Flexible-Pivot Tilting-Pad Bearings,” *ASME J. of Tribology*, April 2006, **128** (2), pp. 388-395

Picardo, A. and Childs, D., “Rotordynamic coefficients for a Teeth-on-Stator Labyrinth Seals at 70 bar Supply Pressures—Measurements Versus Theory and Comparisons to a Honeycomb Seal,” *ASME J. of Gas Turbines*, October 2005, **127** , pp. 843-855

Villasmil, L., Chen, H-C., and Childs, D. “Understanding Friction-Factor Behavior in Liquid annular Seals with Deliberately Roughened Surfaces, “October 2005, *AIAA Journal*, **43**, Number 10, pp. 2137-2146

Villasmil, L., Childs, D., and Chen, H.C. , “Understanding Friction Factor Behavior in Liquid Annular Seals with Deliberately Roughened Surfaces, Roughness Geometric Characteristics Defining Flow Resistance,” *ASME J. of Tribology*, January 2005, **127**, pp. 213-222.

Childs, D. and Wade, J., “Rotordynamic-Coefficient and Leakage Characteristics for Hole-Pattern-Stator Annular Gas Seals — Measurements versus Predictions,” *ASME J. of Tribology*, p. 326-333, **126** (2), April 2004.

“The Multiple Contributions of Jorgen Lund’s Ph.D. Dissertation, ‘Self-Excited, Stationary Whirl Orbits of a Journal in Sleeve Bearings,’ RPI, 1966, Engineering Mechanics,’ *ASME J. of Vibration and Acoustics*, pp 445-447, October 2003.

Weatherwax, M., and Childs, D. “The Influence of Eccentricity on the Leakage and Rotordynamic Coefficients of a High Pressure, Honeycomb, Annular Gas Seal...Measurements Versus Predictions,” *ASME J. of Tribology*, **125**, pp. 422-429, April 2003.

“Twice-Running-Speed Response Due to Elliptical-Bearing Clearances,” *ASME J. on Vibrations and Acoustics*, **125**, pp. 64-68, Jan 2003

Dawson, M., Childs, D., Holt, C., and Phillips, S.,”Theory versus Experiments for the Dynamic Impedances of Annular Gas Seals: Part 1-Test Facility and Apparatus,” *ASME J. of Gas Turbines and Power*, **124**, pp. 958-963, October 2002

Dawson, M., Childs, D., Holt, C., and Phillips, S.,”Theory versus Experiments for the Dynamic Impedances of Annular Gas Seals: Part 2 –Smooth and Honeycomb Seals,” *ASME J. of Gas Turbines and Power*, **124**, pp. 963-970, October 2002.

D’Souza, R. and Childs, D., “A Comparison of Rotordynamic-Coefficient Predictions of Annular Honeycomb Gas Seals Using Different Friction-Factor Models, “ *ASME J. of Tribology*, July 2002, **124**, pp. 524-529.

Laurant, F. and Childs, D.,”Measurements of Rotordynamic Coefficients of Hybrid Bearings with :(a) A Plugged Orifice, and (b) A Worn Land Surface, *ASME J. of Gas Turbines and Power*, April 2002, **124**, pp. 363-368.

Holt, C. and Childs, D., "Theory Versus Experiment Results for the Dynamic Impedances of Two Hole-Pattern Annular Gas Seals, *ASME J. of Tribology*, January 2002, **24**, pp 137-143.

"A Note on Kellenberger's Model for Spiral Vibrations," *ASME, J. of Vibrations and Acoustics*, July 2001, pp. 405-408.

Nielsen, K., Childs, D., and Mylerup, C. "Experimental and Theoretical Comparison of two Swirl-Brake Designs, *ASME, J. of Turbomachinery*, April 2001, **123**, No.2, pp. 353-356.

Laurant, F., and Childs, D., "Rotordynamic Evaluation of A Near-Tangential-Injection Hybrid Bearing," *ASME, J. of Tribology*, October 1999, **121**, pp. 886-891.

Soto, E., and Childs, D., "Experimental Rotordynamic Coefficient Results for: (a) A Labyrinth Seal With and Without Shunt Injection and (b) A Honeycomb Seal," *ASME, J. of Engineering for Gas Turbines and Power*, January 1999, **121**(1), pp. 153-159.

Childs, D. and Fayolle, P., "Test Results for Liquid "Damper" Seals Using a Round-Hole Roughness Pattern for the Stators," *ASME, J. of Tribology*, January 1999, **121**(1), pp. 42-49.

Fayolle, P. and Childs, D., "Rotordynamic Evaluation of Roughened-Land Hybrid Bearing," *ASME, J. of Tribology*, January 1999, **121**(1), pp. 133-138.

Mosher, P., and Childs, D., "Theory Versus Experiment for the Effects of Pressure Ratio on the Performance of an Orifice-Compensated Hybrid Bearing," *ASME, J. of Vibrations and Acoustics*, October 1998, **120** (4), pp. 930-936.

Yu, Z., and Childs, D., "A Comparison of Experimental Rotordynamic Coefficients and Leakage Characteristics Between Hole-Pattern Gas Damper Seals and a Honeycomb Seal," *ASME, J. of Engineering for Gas Turbines and Power*, **120** (4), pp. 778-783, October 1998.

Lindsey, T., and Childs, D., "The Effects of Converging and Diverging Axial Taper on the Rotordynamic Coefficients of Liquid Annular Pressure Seals: Theory versus Experiment," *ASME, J. of Vibrations and Acoustics*, **122**, April 2000, pp. 126-131.

Kleynhans, G., and Childs, D., "The Acoustic Influence of Cell Depth on the Rotordynamic Characteristics of Smooth-Rotor/Honeycomb-Stator Annular Gas Seals," *ASME, J. of Engineering for Gas Turbines and Power*, October 1997, **119** (4), pp. 949-957.

Marquette, O., Childs, D., and San Andrés, L., "Eccentricity Effects on the Rotordynamic Coefficients of Plain Annular Seals: Theory Versus Experiment," *ASME, J. of Tribology*, July 1997, **119** (3), pp. 443-448.

San Andrés, L., and Childs, D., "Angled Injection — Hydrostatic Bearings Analysis and Comparison to Test Results," *ASME, J. of Tribology*, January 1997, **119** (1), pp. 179-187.

Gansle, A., and Childs, D., "Experimental Leakage and Rotordynamic Results for Helically Grooved Annular Gas Seals," *ASME, J. of Engineering for Gas Turbines and Power*, April 1996, **118**, pp. 389-393.

- Marquette, O., and Childs, D., "An Extended Three-Control-Volume Theory for Circumferentially-Grooved Liquid Seals," *ASME , J. of Tribology*, April 1996, **118** (2), pp. 276-285.
- Ha, T.-W., A Rotordynamic Analysis of an Annular Honeycomb Seal Using a Two-Control Volume Model, *KSME J.*, 1996, **10** (3), pp.332-340.
- Yang, Z., San Andrés, L., and Childs, D., "Thermohydrodynamic Analysis of Process-Liquid Hydrostatic J. Bearings in Turbulent Regime, Part I: The Model and Perturbation Analysis," *ASME , J. of Applied Mechanics*, September 1995, **62**, pp. 674-678.
- Yang, Z., San Andrés, L., and Childs, D., "Thermohydrodynamic Analysis of Process-Liquid Hydrostatic Journal Bearings in Turbulent Regime, Part II: Numerical Solution and Results," *ASME , J. of Applied Mechanics*, September 1995, **62**, pp. 679-684.
- San Andrés, L., Childs, D., and Yang, Z., "Turbulent-Flow Hydrostatic Bearings: Analysis and Experimental Results," *International J. of Mechanical Sciences*, August 1995, **37** (8), pp. 815-829.
- Franchek, N., Childs, D., and San Andrés, L., "Theoretical and Experimental Comparisons for Rotordynamic Coefficients of a High-Speed, High-Pressure, Orifice-Compensated Hybrid Bearing," *ASME , J. of Tribology*, April 1995, **117**, pp. 285-290.
- Alexander, C., Childs, D., and Yang, Z., "Theory Versus Experiment for the Rotordynamic Characteristics of a Smooth Annular Gas Seal at Eccentric Positions," *ASME , J. of Tribology*, January 1995, **117**, pp. 148-152.
- Childs, D., and Hale, K., "A Test Apparatus and Facility to Identify the Rotordynamic Coefficients of High-Speed Hydrostatic Bearings," *ASME , J. of Tribology*, April 1994, **116**, pp. 337-344.
- Ha, T-W. and Childs, D., "Annular Honeycomb-Stator Turbulent Gas Seal Analysis Using A New Friction-Factor Model Based on Flat Plate Tests," *ASME , J. of Tribology*, April 1994, **116**, pp. 352-360.
- Franchek, N., and Childs, D., "Experimental Test Result for Four High-Speed, High Pressure, Orifice-Compensated Hybrid Bearing," *ASME , J. of Tribology*, January 1994, **116**, pp. 147-153.
- Yang, Z., San Andrés, L., and Childs, D., "Dynamic Force Performance of Gas Seals at Off-Center Conditions," *STLE Tribology* , 1994, **37**, No. 1, pp. 33-44.
- Rouvas, C. and Childs, D., "A Parameter Identification Method for the Rotordynamic Coefficients of a High Reynolds Number Hydrostatic Bearing," *ASME , J. of Vibration and Acoustics*, July 1993, **115**, pp. 264-270.
- Conner, K. and Childs, D., "Rotordynamic Coefficient Test Results For a 4-Stage Brush Seal," *AIAA J. of Propulsion and Power*, June 1993, pp. 462-465.
- Yang, Z., San Andrés, L., and Childs, D., "Thermal Effects in Cryogenic Liquid Annular Seals-- Part I: Theory and Approximate Solution," *ASME , J. of Tribology*, April 1993, **115**, pp. 267-276.
- Yang, Z., San Andrés, L., and Childs, D., "Thermal Effects in Cryogenic Liquid Annular Seals-- Part II:

Numerical Solution and Results,” *ASME , J. of Tribology*, April 1993, **115**, pp. 277-284.

Kurtin K., Childs D., San Andrés L., Hale K., “Experimental Versus Theoretical Characteristics of a High-Speed Hybrid (Combination Hydrostatic and Hydrodynamic) Bearing,” *ASME , J. of Tribology*, January 1993, **115**, pp. 160-169.

Ha, T-W., Childs, D., “Friction-Factor Data for Flat-Plate Tests of Smooth and Honeycomb Surfaces,” *ASME , J. of Tribology*, October 1992, **114**, pp. 722-730.

Ha, T-W., Morrison, G., Childs, D., “Friction-Factor Characteristics for Narrow-Channels with Honeycomb Surfaces,” *ASME , J. of Tribology*, October 1992, **114**, pp. 714-721.

Childs, D., “Pressure Oscillation in the Leakage Annulus Between a Shrouded Impeller and Its Housing Due to Impeller-Discharge-Pressure Disturbances,” *ASME J. of Fluids Engineering*, March 1992, **114**, pp. 61-67.

Yang, Z., San Andrés, L., and Childs D., “Importance of Heat Transfer From Fluid Film to Stator in Turbulent Flow Annular Seals,” *Wear*, 1992.

Williams, J. and Childs, D., “Influence of Impeller Shroud Forces on Pump Rotordynamics,” *ASME , J. of Vibration and Acoustics*, October 1991, **113**, pp. 509-515.

Childs, D., Baskharone, E. and Ramsey, C., “Test Results for Rotordynamic Coefficients of the SSME HPOTP Turbine Interstage Seal With Two Swirl Brakes,” *ASME , J. of Tribology*, July 1991, **113**, pp.577-583.

“Centrifugal-Acceleration Modes for Incompressible Fluid in the Leakage Annulus Between a Shrouded Pump Impeller and Its Housing,” *ASME J. of Vibration and Acoustics*, April 1991, **113**, pp. 209-218.

“Fluid-Structure Interaction Forces at Pump-Impeller-Shroud Surfaces for Axial Vibration Analysis,” *ASME J. of Vibration and Acoustics*, January 1991, **113**, pp. 113-115.

Childs, D. and Ramsey, C., “Seal-Rotordynamic-Coefficient Test Results for A Model SSME ATD-HPFTP Turbine Interstage Seal With and Without A Swirl Brake,” *ASME , J. of Tribology*, January 1991, **113**, pp. 113-203.

Kilgore, J. and Childs, D., “Rotordynamic Coefficients and Leakage Flow of Circumferentially-Grooved Liquid-Seals,” *ASME J. of Fluids Engineering*, September 1990, **112**, pp.250-256.

Childs, D., Nolan, S., and Kilgore, J., “Test Results for Turbulent Annular Seals, Using Smooth Rotors and Helically Grooved Stators,” *ASME , J. of Tribology*, April 1990, **112**, No. 2, pp. 254-258.

Childs, D., Nolan, S., and Kilgore, J., “Additional Test Results for Round-Hole-Pattern Damper Seals: Leakage, Friction Factors, and Rotordynamic Force Coefficients,” *ASME , J. of Tribology*, April 1990, **112**, No. 2, pp. 365-371.

Elrod, D., Childs, D., and Nelson, C., “An Annular Gas Seal Analysis Using Empirical Entrance and Exit Region Friction Factors,” *ASME , J. of Tribology*, April 1990, **112**, No. 2, pp. 196-204.

“Fluid-Structure Interaction Forces at Pump-Impeller-Shroud Surfaces for Rotordynamic Calculations,” *ASME J. of Vibration, Acoustics, Stress, and Reliability in Design*, July 1989, **111**, pp. 216-225.

Elrod, D., Nelson, C., and Childs, D., “An Entrance Region Friction Factor Model Applied to Annular Seals Analysis: Theory vs. Experiment for Smooth and Honeycomb Seals,” *ASME , J. of Tribology*, April 1989, **111**, pp. 337-343.

Childs, D., Elrod, D., and Hale, K., “Annular Honeycomb Seals: Test Results for Leakage and Rotordynamic Coefficients; Comparisons to Labyrinth and Smooth Configurations,” *ASME , J. of Tribology*, April 1989, **111**, pp. 293-301.

Hawkins, L., Childs, D., and Hale, K., “Experimental Results for Labyrinth Gas Seals With Honeycomb Stators: Comparisons to Smooth Stator Seals and Theoretical Predictions,” *ASME , J. of Tribology*, January 1988, **111** (1), pp. 161-168.

Childs, D. and Scharrer, J., “Theory Versus Experiment for the Rotordynamic Coefficients of Labyrinth Gas Seals: Part II - A Comparison to Experiment,” *ASME J. of Vibration, Acoustics, Stress, and Reliability in Design*, July 1988, **110**, (3), pp. 281-287.

Kim, C-H, and Childs, D., “Analysis for Rotordynamic Coefficients of Helically-Grooved Turbulent Annular Seals,” *ASME , J. of Tribology*, January 1987, **109**, pp. 136-143.

Childs, D. and Garcia, F., “Test Results for Sawtooth-Pattern Damper Seals: Leakage and Rotordynamic Coefficients,” *ASME , J. of Tribology*, January 1987, **109**, pp. 124-128.

Childs, D. and Scharrer, J., “Experimental Rotordynamic Coefficients and Results for Teeth-On-Rotor and Teeth-On-Stator Labyrinth Gas Seals,” *ASME , J. of Engineering for Gas Turbine and Power*, October 1986, **108**, pp. 599-604.

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Childs, D., Nelson, C. C., Nicks, C., Scharrer, J., Elrod, D., and Hale, K., “Theory Versus Experiment for the Rotordynamic Coefficients of Annular Gas Seals: Part 1-Test Facility and Apparatus”, *ASME , J. of Tribology*, July 1986, **108**, pp. 426-432.

Nelson, C., Childs, D., Nicks, C., Elrod, D., and Hale, K., “Theory Versus Experiment for the Rotordynamic Coefficients of Annular Gas Seals: Part 2-Constant-Clearance and Convergent-Tapered Geometry,” *ASME , J. of Tribology*, July 1986, **108**, pp. 433-438.

Childs, D., and Scharrer, J., “An Iwatsubo-Based Solution for Labyrinth Seals - Comparison to Experimental Results,” *ASME , J. of Engineering for Gas Turbine and Power*, April 1986, **108**, pp. 325-331.

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- "Two Jeffcott-Based Simulation Models for Flexible Rotating Equipment," *ASME J. of Engineering for Industry*, August 1975, pp. 1000-1014.
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“Fuel-Optimal Direction-Cosine Attitude Control for Spin- Stabilized Axisymmetric Spacecraft,” *AIAA J. of Spacecraft and Rockets*, December 1970, **7** (12), pp. 1481-1482.

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PAPERS IN REVIEWED CONFERENCE PROCEEDINGS

“Rotordynamics of Turbomachinery... Looking Back...Looking Forward,” Proceedings, *IFTToMM* 6th International Conference on Rotordynamics, September 2002, Sydney, Australia, pp. 25-27

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"Rotordynamic Moment Coefficients for Finite-Length Turbulent Seals," Proceedings *IFTtoMM* Conference on Rotordynamic Problems in Power Plants, 28 September - 1 October 1982.

"Convergent-Tapered Annular Seals: Analysis for Rotordynamic Coefficients," Proceedings ASME Symposium of Fluid/Structure Interactions in Turbomachinery, 16-20 November 1981, Washington, D.C.

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PATENTS

System and Method for Measuring Dynamic Loads in Magnetic Bearings, U.S. Patent Number 6,518,770, 11 February 2003.

Annular Seals for non-contact sealing of fluids in turbomachinery, U.S. Patent Number 8,074,998, 13 December 2011

SHORT CONTRIBUTIONS AND CONFERENCE PAPERS

Childs, D. McLean, J., Zhang, M., and Arthur, S., "Rotordynamic Performance of a Negative-Swirl Brake for a Tooth-on-Stator Labyrinth Seal," paper GT2014-25577, Turbo Expo 2014: Turbine Technical Conference and Exposition, Dusseldorf Germany

Khatri, R. and Childs, D.W., "An Experimental Study Of The Load-Orientation Sensitivity Of Three-Lobe Bearing," paper GT2014-25482, Turbo Expo 2014: Turbine Technical Conference and Exposition, Dusseldorf Germany

Khatri, R. and Childs, D.W., "An Experimental Investigation Of The Dynamic Performance Of A Vertical-Application Three-Lobe Bearing," paper GT2014-25483, Turbo Expo 2014: Turbine Technical Conference and Exposition,

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Childs, D., S. Arthur, and N. Mehta (2013), "The Impact of Hole Depth on the Rotordynamic and Leakage Characteristics of Hole-Pattern-Stator Gas Annular Seals, Paper # GT2013-94333, Proceedings of ASME Turbo Expo, 3-7 June, San Antonio, TX, USA

Childs, D., and S. Arthur (2013), "Static Destabilizing Behavior for Gas Annular Seals at High Eccentricity Ratios," Paper # GT2013-94201, Proceedings of ASME Turbo Expo, 3-7 June, San Antonio, TX, USA

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Tschoepe, D. and D. Childs (2013), "Measurements Versus Predictions for the Static and Dynamic Characteristics of a Four-Pad, Rocker-Pivot, Tilting-Pad Journal Bearing," Paper# GT2013-94302, Proceedings of ASME Turbo Expo, 3-7 June, San Antonio, TX, USA

Wilkes, J. and Childs, D.W., "Journal Versus Bearing Perturbed Impedance Coefficients for the Tilting-Pad Journal Bearing," Paper number GT2012-69804, Proceedings of ASME Turbo Expo 2012, 11-15 June 2012, Copenhagen, Denmark, accepted for publication, *ASME J. for Gas Turbines and Power*

Wilkes, J. and Childs, D.W., "Measured and Predicted Rotor-Pad Transfer Functions for a Rocker-Pivot Tilting-Pad Journal Bearing," Paper number GT2012-69808, Proceedings of ASME Turbo Expo 2012, 11-15 June 2012, Copenhagen, Denmark, accepted for publication, *ASME J. for Gas Turbines and Power*

Agnew, J. and Childs, D.W., "Rotordynamic Characteristics of a Flexure Pivot Pad Bearing with an Active and Locked integral Squeeze Film Damper," Paper number GT2012-69564, Proceedings of ASME Turbo Expo 2012, 11-15 June 2012, Copenhagen, Denmark

Childs, D. and Asirvatham, T., "Flat-Plate Friction-Factor Test results for a Rough Surface with Large (12.15 mm) Round Holes Facing a Smooth Surface," Paper # GT2011-42513, IGTI 2011 conference proceedings, Vancouver, CN, FL, June 2011

Bhattacharya, A. and Childs, D., "Dry-Friction Whirl and Whip between a Rotor and a Stator: Effect of rotor-stator coupling due to seals and rotor rigid-body dynamics," GT2009-59979 IGTI 2009 conference proceedings, Orlando, FL, June 2009

Hensley, J., and D. Childs, "Measurements versus Predictions for Rotordynamic Characteristics of a Flexure Pivot Pad Tilting Pad Bearing in an LBP Condition at Higher Unit Loads," Proceedings of ASME Turbo Expo 2008, Paper GT2008-50066, June 9-13, 2008, Berlin, Germany

Childs, D., Schaible, A., and Al-Jughaiman, B., "Static and Dynamic Performance of Pressure Dam Bearings with dam steps that are (i) Square and (ii) Filleted, " Proceedings of ASME Turbo Expo 2008, Paper GT2008-50136, June 9-13, 2008, Berlin, Germany

Van der Velde, D. And Childs, D., "Measurements Versus Predictions for Rotordynamic and Leakage Characteristics of a Convergent-Tapered, Honeycomb-Stator/Smooth-Rotor Annular Gas Seal, " Proceedings of ASME Turbo Expo 2008, Paper GT2008-50068, June 9-13, 2008, Berlin, Germany

“Retrofitting with Brush Seals,” Letter to the editor, Turbomachinery International, Discussion of a paper in the Sep.-Oct edition of *Turbomachinery International*, p.28, Nov/Dec 2007

Childs, D., Shin, Y.-S., and Wade, J., “A Design to Increase the Static Stiffness of Hole-Pattern-Stator Annular Gas Seals, Paper # GT2006-90778, ASME Turbo Expo 2006: Power for Land, Sea and Air, May 8-11, 2006, Barcelona, Spain.

Zutavern, Z. and Childs, D., “Fiber Optic Strain Gauge Calibration and Dynamic Flexibility Transfer Function Identification in Magnetic Bearings, “ Paper # 2005-68484, Proceedings of ASME Turbo Expo 2005 Power for Land, Sea and Air June 6-9, 2005, Nevada, USA

Zutavern, Z. and Childs, D., “Fiber Optic Strain Gauge Calibration and Dynamic Flexibility Transfer Function Identification in Magnetic Bearings,” Proceedings 6th Magnetic Bearing Conference, Lexington, Ky., July 2004.

Childs, D. and Siddiqui, N., “Rotordynamics Involving Axial Rubbing Against a Disk,” ASME paper DETC2001/VIB-21383 presented at the 18th Biennial Conference on Mechanical Vibration and Sound, 9-12 September 2001, Pittsburgh, PA.

Raymer, S. and Childs, D., “Transient Force Measurements in Magnetic Bearings using Fiber-Optic Strain Gauges,” ASME paper # 2001-GT-0027, 4-7 June 2001 ASME IGTI conference, New Orleans, LA.

“Stability Insights from Hybrid-Bearings Research at the Texas A&M University Turbomachinery Laboratory,” Paper 3016, Proceedings, 1st International Symposium on Stability Control of Rotating Machinery, 20-24 August 2001, South Lake Tahoe, Nevada

“Developing A New Differential-Equation-Based Dynamics/Vibration Course,” ASEE Gulf-Southwest Section 2001 Annual Conference “Changing the Engineering Profession” March 28 – 30, 2001, Texas A&M University, College Station, TX.

Marquette, O., Childs, D., and Phillips, S., “Theory Versus Experiment for Leakage and Rotordynamic Coefficients of Circumferentially-Grooved Liquid Annular Seals with L/D of 0.45,” presented at the 1997 ASME Fluids Engineering Division Summer Meeting, June 22-26, British Columbia.

Elrod, D., Pelletti, J., and Childs, D., “Theory Versus Experiment for the Rotordynamic Coefficients of an Interlocking Labyrinth Gas Seal,” Paper No. 95-GT-932, 1995 ASME International Gas Turbine and Aeroengine Congress and Exposition, Houston, Texas, 5-8 June 1995.

“Annular Seals as Tools to Control Rotordynamic Response of Future Gas Turbine Engines,” at the 30th Joint Propulsion Conference, Indianapolis, Indiana, 27-29 June, 1994 (Co-Authored with Dr. John Vance).

“Theory vs. Experiment for the Rotordynamic Characteristics of a Smooth Gas Annular Seal at Eccentric Positions,” at the Advanced Earth-to-Orbit Propulsion Technology Conference, Huntsville, Alabama, 17-19 May 1994.

“Development of High Speed Hydrostatic Bearings for Liquid-Rocket-Engine Applications at Texas A&M University,” at the 32nd Aerospace Sciences Meeting and Exhibit, Session 1320LP-1, Reno,

Nevada, 10-13 January 1994.

Childs, D. and Kleynhans, G., "Theory Versus Experiment for Short ($L/D=1/6$) Honeycomb and Smooth Annular Pressure Seals," proceedings *14th ASME Vibration and Noise Conference*, September 19-22, 1993, Albuquerque, NM.

Childs, D., Elrod, D., and Hale, K., "Rotordynamic Coefficient and Leakage Test Results for Interlock and Tooth-on-Stator Labyrinth Seals," Paper 88-GT-87, ASME IGTI Conference, Amsterdam, The Netherlands, 6-9 June 1988.

Childs, D., and Moyer, D., "Sample Rotordynamic Calculations Using Cal-Tech (Impeller) Rotordynamic Coefficients," *Proceedings 2nd International Pump Symposium*, Addendum and Discussion of the paper, "Forces on Centrifugal pump Impellers," by Jery et al., pp 29-32, 1985.

Childs, D., and Moyer, D., Vibration Characteristics Of the HPOTP (High Pressure Oxygen Turbopump) of the SSME (Space Shuttle Main Engine), Advanced High Pressure O_2/H_2 Technology, NASA Conference Publication 2372, Proceedings of a conference held at MSFC, Huntsville, AL, 27-29 June 1984, pp 452-481

INVITED PAPERS, ARTICLES, AND LECTURES:

"Tilting-Pad Bearings: Measured Frequency Characteristics of Their Rotordynamic Coefficients," Invited conference key note speech, the 8th IFToMM International Conference on Rotordynamics September 12-15, 2010, KIST, Seoul Korea

"Making a Difference in Commercial Turbomachinery --- Rotordynamic Success Stories from the Turbomachinery Laboratory at Texas A&M University," Rotating Equipment and Gas Turbine Asset Management 2006, 26-28 July 2006, Marriott Hotel, Singapore, IBC Asia

"Recent Advances in the Rotordynamic Behavior of Annular Gas Seals," Keynote speech at the 4th EDF/LMS Poitiers Workshop: Advanced Topics and Technical Solutions in Dynamic Sealing, Poitiers, France, 6 October 2005

"Fluid Structure Interaction Forces in Pump Rotordynamics," Invited Keynote address, Fluids Engineering Division Summer Meeting, Houston, Texas, 20 June 2005

"Solution for a 25-year-old Tilt Pad Problem," *Turbomachinery International*, September/October 2004, p. 6

"Gas Annular Seals and Their Influence on Rotordynamics of Turbomachinery," Keynote Welcoming Address, IMechE, Ninth International Conference on Vibrations in Rotating Machinery, Swansea, Wales, UK, 7 September 2004.

"Dealing with Unpredicted Instabilities in Turbomachines," Guest Column, *Turbomachinery International*, July/August 2004.

"The Turbomachinery Symposia — What Difference Have They Made?," Guest Column, *Turbomachinery International*, November-December, 2003, p.35.

"Pumping Education: The Old is New Again (and Again)," Guest Column, *Pumps and Systems*, February

2002, pp. 6-7.

Keynote Speaker, “Rotordynamic Modeling — Looking Backwards and Looking Forward,” presented at The 52nd Meeting of the Society for Machinery Failure Prevention Technology Conference, March 30 - April 3, 1998, Virginia Beach, Virginia.

Presented the keynote lecture, “Rotordynamic of Turbomachinery Modeling Issues — Looking Back...Looking Forward,” 1997 6th Latin American Turbomachinery Symposium, 19, February, Mexico City, Mexico.

Ehrich, F. and Childs, D., (1984), “Self-Excited Vibration in High-Performance Turbomachinery,” *Mechanical Engineering*, ASME, May 1984, pp. 66-79

SHORT COURSES

Presented lectures for short course on Machinery Vibrations and Rotordynamics sponsored initially by VAVCO (John Vance) in College Station and then Bearings Plus (Fouad Zeidan) in Houston almost every year from ~1990-2011

Presented short courses on Rotordynamics of Turbomachinery in Doha, Qatar through Texas A&M university in Qatar in 2008 and 2010.

Presented Short Course on Rotordynamics with Dr. Fouad Zeidan in Bahrain, 7-11 November 1998, for STSC. Approximately 20 students attended.

Presented Short Course on Rotordynamics with Dr. Fouad Zeidan in Rio De Janeiro, Brazil for Petrobras. Approximately 25 students attended. 1994

Presented Short Course on Rotordynamics with Mr. Larry Hawkins at Saudi Aramco in Saudi Arabia, 12-26 August, 1993. Approximately 30 students attended. It had not been previously presented.

Presented Short Course on Rotordynamics at the University of Alabama in Huntsville, 26-30 July, 1993. Approximately 25 students attended the short course. It had not been previously presented.

Presented six lectures for the short course, Fluid Structure Interactions in Turbomachinery, CSIM, Udine, Italy, June 1993.

Presented Short Course on Rotordynamics at II Conferencia Latinamericana de Turbomaquinas, Cuernavaca, Morelos, MEXICO 15-18 February, 1993 and moderated a session. Approximately 45 students attended the short course. It had not been previously presented.

“Identification and Avoidance of Instabilities in High-Pressure Turbomachinery,” Lecture as part of a Course on Centrifugal Compressors, The Von Karman Institute, Brussels, Belgium, 21 January 1987.

BOOKS AND PROCEEDINGS:

Turbomachinery Rotordynamics with Case studies (2013), Minter Spring Publishing, ISBN# 978-0-615-85272-0, D. Childs

Dynamics in Engineering Practice (2010), CRC Press, Taylor and Francis Group, ISBN # 978-1-4398-3125-0

Turbomachinery Rotordynamics: Phenomena, Modeling, and Analysis (1993), John Wiley & Sons, Inc., D. Childs

Handbook of Rotordynamics, F. Ehrlich, McGraw Hill, 1991; co-authored 1st chapter.

Rotordynamic Instability Problems in High-Performance Turbomachinery-1996, NASA CP3344, Proceedings of a Workshop held at Texas A&M University, College Station, Texas, 6-8 May 1996.

Rotordynamic Instability Problems in High-Performance Turbomachinery-1993, NASA CP3239, Proceedings of a Workshop held at Texas A&M University, College Station, Texas, 10-12 May 1993; co-editors with Robert C. Hendricks and John Vance, published January 1994.

Rotordynamic Instability Problems in High-Performance Turbomachinery-1990, NASA CP3122, Proceedings of a Workshop held at Texas A&M University, College Station, Texas, 21-23 May 1990; co-editors with Robert C. Hendricks and John Vance, published October 1991.

Rotordynamic Instability Problems in High-Performance Turbomachinery-1988, NASA CP3026, Proceedings of a Workshop held at Texas A&M University, College Station, Texas, 16-18 May 1988; co-editors with Robert C. Hendricks and John Vance, published March 1989.

Rotordynamic Instability Problems in High-Performance Turbomachinery-1986, NASA CP2443, Proceedings of a Workshop held at Texas A&M University, College Station, Texas, 2-4 June 1986; co-editors with Robert C. Hendricks and John Vance, published June 1987.

Rotordynamic Instability Problems in High-Performance Turbomachinery-1984, NASA CP2338, Proceedings of a Workshop held at Texas A&M University, College Station, Texas, 28-30 May 1984; co-editors with Robert C. Hendricks and John Vance.

Rotordynamic Instability Problems in High-Performance Turbomachinery-1982, NASA CP2133, Proceedings of a Workshop held at Texas A&M University, College Station, Texas, 10-14 May 1982; co-editors with Robert C. Hendricks and John Vance.

Rotordynamic Instability Problems in High-Performance Turbomachinery-1980, NASA CP2250, Proceedings of a Workshop held at Texas A&M University, College Station, Texas, 12-14 May 1980; co-editors with Robert C. Hendricks and John Vance.

RECENT FUNDED RESEARCH PROJECTS:

Measuring Static and Rotordynamics Characteristics for an Enhanced-Stability, Fixed-Arc, 3-Lobe Bearings with a Predicted Whirl-Frequency Ratio of 0.17, TRC \$39k, 6/2010-

Measuring Static and Rotordynamics Characteristics for:

- (1) 4-Pad Rocker-back Tilting-Pad bearing in LBP Configuration, and
- (2) A "Stability-Optimized-Clearance" fixed-arc bearing with a predicted infinite OSI, TRC \$39k, 6/2010

Developing a new Module for XLTRC to Perform analysis for the Morton Effect, TRC \$20k, 6/2009-12/2010

Measuring Transfer Functions Between Rotor Motion and Pad Motion for a Rocker-back Tilting-Pad bearing in LBP Configuration, TRC \$100k, 6/2008-9/2010

Further Analysis of the Impact of Coupling Misalignment on Rotordynamics, TRC \$72.3k, 6/2008-6/2010

Developing a new Module for XLTRC to Perform analysis for the Morton Effect, TRC \$39k, 6/2009-7/2010

Measurements versus Predictions for the Rotordynamic Characteristics of a Rocker-Pivot Tilting-Pad Bearing at 50% offset, TRC, \$80k, 6/2008-12/2010

Measuring Static and Rotordynamics Characteristics for a Rocker-back Tilting-Pad bearing in LBP Configuration at two Additional Preloads, TRC \$40000, 6/2008-6/2009

A JIP agreement was signed between ExxonMobil, Rolls Royce, MAN-TURBO, Siemens), ODS-Lords, Cameron, GE, Chevron, and Elliott with each company providing \$20k/year for two years. May 2009-Dec 2011

Measuring Static and Rotordynamics Characteristics for a Spherical-Seat Tilting-Pad bearing in Load-Between-Pad Configuration, TRC, \$48k, 5/2006-8/2007,

CLIN 004 - Tool/Method Development of the AFRL Upper Stage Technology Program (USET)
Sponsor: Northrop Grumman, 1 February 2005-30 September 2008, Total award \$455,597, current funding \$287,097.

Elimination of "Steam Whirl" from Large Steam Turbines, Sponsor: Autonomous University of Morelos State (AUMS) of Mexico, 01-SEP-05 to 28-FEB-06, \$20,00.

"USET Proposal development," Co-PI with Dr. San Andr es, Northrop Grumman, January-July 2004, \$50,000.

"Measuring Rotordynamic Coefficients for a Convergent Tapered Annular Gas Seal with a Smooth Rotor and Hole-Pattern Roughness Stator, TRC, 5/30/2005-5/30/2006, \$22,000

"Testing Brush Seals," Sponsor: Dresser-Rand (Turbo Products Division), \$79K, 1/7/2004 to 4/31/2006

"Using Fiber Optic Strain Gauges to measure Dynamic Forces in Magnetic Bearings, 5/30/2001--5/30/2006, TRC, \$104,000.

"Measuring Tilting Pad Bearing Rotordynamic Coefficients," TRC, 5/30/2001-5/30/2006, TRC, \$107,000

"Measuring Rotordynamic Coefficients and Static Characteristics for Pressure-Dam Bearings," TRC, \$22,000, 5/30/2005-5/30/2006

"Hydrodynamic Bearing Test Program," Dresser Rand, 7/1/04-5/31/05, \$70,000.

"Tilting-Pad-Bearing Test Consortium," (Dresser Rand, Siemens DeLaval, Kingsbury Bearings, Orion Bearings), 2002-6/2004, \$100,000.

“Test of Two Damper Seal Geometries,”GE-Pignone,2002-2003, \$97,884.

“Coupling Pump Rotordynamics with Water-hammer Dynamics,” 5/30/2000-5/30/2001, TRC, \$20,000

“Oil Bushing Seals for Compressors,” TRC , 05/30/00-12/31/03, \$48,500.

“An R&D Program to Develop Validated Computer Prediction Codes for Honeycomb Stator and Hole-Pattern Stator Annular Gas Seals,” eight-company consortium, 2001-2002, \$85,000

“Optimum Design for Hole-Pattern Annular Seals,” Texas Higher Education Coordinating Board, January 1, 2000 - December 31, 2001; \$53,100.00.

“Testing Labyrinth Steam-Force Seals,” General Electric Company, April 1, 2000 - March 31, 2001; \$99,484.00.

“Testing Two Damper Seal Geometries,” Dresser-Rand Company, January 14, 2000 - January 13, 2001 in the amount of \$58,952.00.

“Testing of High Pressure Oil Seals for Compressors,” Kobe Steel, Ltd., October 1, 1997 - December 31, 1999 in the amount of \$53,974.00.

“Grant-in-Aid,” Societe Europeenne de Propulsion (SEP), February 1, 1997 - August 31, 1999 in the amount of \$25,000.00.

An R&D Program to Develop Validated Computer Prediction Codes for Honeycomb Stator and Hole-Pattern Stator Annular Gas Seals,” Seventeen Member Companies, December 1, 1996 - May 31, 2000 in the amount of \$510,000.00.

“Validation Testing of Fluid-Film Bearings and Annular Load-Carrying Seals for Liquid-Hydrogen Turbopumps,” Department of Air Force, July 7, 1994 - February 12, 1997 in the amount of \$270,697.00.