

Noah Denver Manning

College of Engineering
University of Missouri – Columbia
Columbia, Missouri 65211
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Professional Experience:

- Department Chairman**, 2008 – present. Electrical and Computer Engineering Department, University of Missouri – Columbia
- Associate Dean for Administration**, 2007 – 2008. School of Engineering and Applied Science, Princeton University
- Associate Dean for Research**, 2004 – 2007. College of Engineering, University of Missouri – Columbia
- Director of Graduate Studies**, 2003 – 2005. Mechanical and Aerospace Engineering Department, University of Missouri – Columbia
- Program Manager**, 1999 – 2000. Hydraulic Component Research Group, Caterpillar, Inc., Technical Center, Peoria, IL
- Full, Associate, and Assistant Professor**, 1997 – present. Mechanical and Aerospace Engineering Department, University of Missouri – Columbia
- Senior Research Engineer**, 1994 – 1997. Hydrostatic Transmission Research, Sauer-Sundstrand (now Sauer-Danfoss), Inc., Ames IA
- Design Engineer**, 1990 – 1994. Pump and Motor Product Group, Caterpillar, Inc., Joliet IL

Education:

- Ph.D. Mechanical Engineering**. 1996. Iowa State University, Ames IA
- M.S. Theoretical and Applied Mechanics**. 1993. University of Illinois, Urbana-Champaign IL
- M.A. Religion**. 2006. Reformed Theological Seminary, Charlotte NC
- B.S. Mechanical Engineering**. 1990. Michigan State University, E. Lansing MI
- B.A. Interdisciplinary Humanities**. 1990. Michigan State University, E. Lansing MI

Patents:

1. Du, H., and N. D. Manning. 2002. Apparatus and method for controlling a discharge pressure of a variable displacement hydraulic pump. [US Patent Number: 6,468,046](#).
2. Manning, N. D. 2002. Method and apparatus for controlling straight line travel of a tracked machine. [US Patent Number: 6,445,990](#).
3. Du, H., and N. D. Manning. 2002. Method and apparatus for controlling pump discharge pressure of a variable displacement hydraulic pump. [US Patent Number: 6,375,433](#).

4. Du, H., and N. D. Manring. 2002. Apparatus and method for controlling a discharge pressure of a variable displacement hydraulic pump. [US Patent Number: 6,374,722](#).
5. Manring, N. D., and L. Yu. 2001. Method and system for electrohydraulic valve control. [US Patent Number: 6,286,412](#).
6. Manring, N.D. and J. Ivantysyn. 2001. Extended slipper for hydrostatic pump and motor rotating cylinders. [US Patent Number: 6,220,144](#).
7. Manring, N. D. 1996. Displacement control for a variable-displacement axial-piston pump. [US Patent Number: 5,564,905](#).
8. Manring, N. D. 1996. Pump displacement control for a variable displacement pump. [US Patent Number: 5,562,424](#).
9. Manring, N. D. 1996. Stabilizing device for variable displacement axial piston pumps. [US Patent Number: 5,568,762](#).
10. Childress, D. B., and N. D. Manring. 1996. Pump displacement control for a variable displacement pump. [US Patent Number: 5,567,123](#).

Memberships, Registrations, Awards and Honors:

Professional Engineer. State of Missouri License No. PE-2006019684. 2006 – present. Missouri Board for Architects, Professional Engineers, etc. 3605 Missouri Boulevard, Jefferson City, MO 65102-0184.

Glen A. Barton Professor of Fluid Power. 2006 – present. College of Engineering. University of Missouri – Columbia.

James C. Dowell Professorship. 2003 – 2006. College of Engineering. University of Missouri – Columbia.

Teaching Excellence Award. 2003. Mechanical and Aerospace Engineering. University of Missouri – Columbia. Nominated and awarded by the graduating student body of Fall Semester, 2003.

ASME Distinguished Service Award. 2003. Fluid Power Systems and Technology Division. ASME International Mechanical Engineering Congress and Exposition. Washington, DC.

Best Paper Award, \$500 honorarium. 2002. The theoretical flow ripple of an external gear pump. ASME International Mechanical Engineering Congress and Exposition. New Orleans, LA.

Junior Research Faculty Award, \$1,000 prize. 2001. The College of Engineering. University of Missouri – Columbia. Nominated and awarded by the administration and faculty.

Member: American Society of Mechanical Engineers. 1997 – present. ASME. Three Park Avenue, New York.

Journal Publications (graduate students are underlined):

1. Peterson, J. T., N. D. Manring, and C. A. Kluever. (in review). Directional control of dual path hydrostatic transmission for a track-type vehicle. *Optimal Control Applications and Methods (John Wiley)*.

2. Manring N. D., V. S. Mehta, F. J. Raab, and K. J. Graf. 2007. The shaft torque of a tandem axial-piston pump. *ASME Journal of Dynamic Systems, Measurement, and Control*. Technical Brief. 129:367-71.
3. Manring, N. D. 2005. Measuring pump efficiency: uncertainty considerations. *ASME Journal of Energy Resources Technology*. 127:280-84.
4. Crabtree, A. B., N. D. Manring, and R. E. Johnson. 2005. Pressure measurements for translating hydrostatic thrust bearings. *International Journal of Fluid Power*. Volume 6, Number 3, pp. 19-24.
5. Johnson, R. E., and N. D. Manring. 2005. Translating radial thrust bearings. *Journal of Fluid Mechanics*. 530:197-212.
6. Manring, N.D., C.L. Wray, and Z. Dong. 2004. Experimental studies on the performance of slipper bearings within axial-piston pumps. *ASME Journal of Tribology*. 126:511-18.
7. Manring, N. D., and Z. Dong. 2004. The impact of using a secondary swash-plate angle within an axial piston pump. *ASME Journal of Dynamic Systems, Measurement, and Control*. 126:65-74.
8. Manring, N.D. 2003. Sensitivity analysis of the conical-shaped equivalent model of a bolted joint. *ASME Journal of Mechanical Design*. Technical Brief. 125:642-46.
9. Manring, N. D., and S. B. Kasaragadda. 2003. The theoretical flow ripple of an external gear pump. *ASME Journal of Dynamic Systems, Measurement, and Control*. 125:396-404.
10. Manring, N. D. 2003. Valve-plate design for an axial piston pump operating at low displacements. *ASME Journal of Mechanical Design*. Technical Brief. 125:200-05.
11. Zhang, X., Nair, S. S., and N. D. Manring. 2002. Robust nonlinear control of a novel indexing valve plate pump: Simulation Studies. *ASME Journal of Dynamic Systems, Measurement, and Control*. 124:613-16.
12. Cho, J., X. Zhang, N.D. Manring, and S. Nair. 2002. Dynamic modeling and parametric studies of an indexing valve plate pump. *International Journal of Fluid Power*, Volume 3, Number 3, pp. 37-48.
13. Manring, N. D., R. E. Johnson, and H. Cherukuri. 2002. The impact of linear deformations on stationary hydrostatic thrust bearings. *ASME Journal of Tribology*, Technical Brief. 124:874-77.
14. Manring, N. D. 2002. Designing a control and containment device for cradle-mounted, axial-actuated swash plates. *ASME Journal of Mechanical Design*. 124:456-64.
15. Manring, N. D., and Y. Zhang. 2001. The improved volumetric-efficiency of an axial-piston pump utilizing a trapped-volume design. *ASME Journal of Dynamic Systems, Measurement, and Control*. 123:479-87.
16. Zhang, X., Cho, J., Nair, S. S., and N. D. Manring. 2001. New swash plate damping model for hydraulic axial-piston pump. *ASME Journal of Dynamic Systems, Measurement, and Control*. 123:463-70.
17. Manring, N. D., and F. A. Damtew. 2001. The control torque on the swash plate of an axial-piston pump utilizing piston-bore springs. *ASME Journal of Dynamic Systems, Measurement, and Control*. 123:471-78.
18. Manring, N. D. 2001. Designing a control and containment device for cradle-mounted, transverse-actuated swash plates. *ASME Journal of Mechanical Design*. 123:447-55.

19. Manring, N. D. 2000. Designing the shaft diameter for an axial-piston swash-plate type hydrostatic pump. *ASME Journal of Mechanical Design*. 122:553-59.
20. Manring, N. D. 2000. The discharge flow ripple of an axial-piston swash-plate type hydrostatic pump. *ASME Journal of Dynamic Systems, Measurement, and Control*. 122:263-68.
21. Manring, N. D. 2000. Tipping the cylinder block of an axial-piston swash-plate type hydrostatic machine. *ASME Journal of Dynamic Systems, Measurement, and Control*. 122:216-21.
22. Manring, N. D. 1999. The control and containment forces on the swash plate of an axial-piston pump. *ASME Journal of Dynamic Systems, Measurement, and Control*. 121:599-605.
23. Manring, N. D. 1999. The relative motion between the ball guide and the slipper retainer within an axial-piston swash-plate type hydrostatic pump. *ASME Journal of Dynamic Systems, Measurement, and Control*. 121:518-23.
24. Manring, N. D. 1999. Friction forces within the cylinder bores of swash-plate type axial-piston pumps and motors. *ASME Journal of Dynamic Systems, Measurement, and Control*. 121:531-37.
25. Manring, N. D. 1998. The torque on the input shaft of an axial-piston swash-plate type hydrostatic pump. *ASME Journal of Dynamic Systems, Measurement, and Control*. 120:57-62.
26. Manring, N. D., and G. R. Luecke. 1998. Modeling and designing a hydrostatic transmission with a fixed-displacement motor. *ASME Journal of Dynamic Systems, Measurement, and Control*. 120:45-9.
27. Manring, N. D., and R. E. Johnson. 1997. Optimal orifice geometry for a hydraulic pressure-reducing valve. *ASME Journal of Dynamic Systems, Measurement, and Control*. 119:467-73.
28. Manring, N. D. 1997. The effective fluid bulk-modulus within a hydrostatic transmission. *ASME Journal of Dynamic Systems, Measurement, and Control*. 119:462-66.
29. Manring, N. D., and R. E. Johnson. 1996. Modeling and designing a variable displacement open-loop pump. *ASME Journal of Dynamic Systems, Measurement, and Control*. 118:267-71.

Magazine Articles:

1. Fairchild B. and A. Burchett. 2003. Your hydrostat's Achilles' heel (interview with Noah Manring). *Farm Journal, The Magazine of American Agriculture*. Farm Journal Media, 1818 Market St., Philadelphia, PA. Mid-March issue.
2. Sawchuk, W. 2003. A new life for heavy construction equipment (interview with Noah Manring). *Construction Association of Michigan (CAM) Magazine*. 43636 Woodward Ave., Bloomfield Hills, MI 48302. March issue.
3. Manring, N.D. 2000. La velocità critica dei pattini in una pompa a stantuffi assiali. (Translated: Critical operating speeds for slippers within an axial-piston pump.) *Oleodinamica e Pneumatica*. Tecniche Nuove S.P.A., Via Ciro Menotti, 14, 20129, Milano, Italy. December issue.

Meeting Proceedings & Presentations (graduate students are underlined):

1. Manring, N.D. 2008. A reduced order model for a poppet-type relief valve. Fluid Power and Motion Control Conference. University of Bath. Bath, England.
2. Mehta, V. S., N. D. Manring. 2005. Torque ripple attenuation of an axial piston pump by continuous swash plate adjustment. ASME International Mechanical Engineering Congress and Exposition. Orlando, FL.
3. Manring, N.D. 2004. Modeling spool valve flow forces. ASME International Mechanical Engineering Congress and Exposition. Anaheim, CA.
4. Peterson, J. T., N. D. Manring, and C. A. Kluever. 2004. Directional control of dual path hydrostatic transmission for a track-type vehicle. ASME International Mechanical Engineering Congress and Exposition. Anaheim, CA.
5. Manring, N.D., C.L. Wray, and Z. Dong. 2003. The load carrying capacity of hydrostatic thrust bearings. ASME International Mechanical Engineering Congress and Exposition. Washington, DC. (presentation only)
6. Manring, N.D. 2003. Sensitivity analysis of the conical-shaped equivalent model of a bolted joint. ASME International Mechanical Engineering Congress and Exposition. Washington, DC.
7. Johnson, R. E., and N. D. Manring, 2003. Sensitivity studies for the shallow-pocket geometry of a hydrostatic thrust bearing. ASME International Mechanical Engineering Congress and Exposition. Washington, DC.
8. Feng J., H. P. Cherukuri, R. E. Johnson, and N. D. Manring. 2003. Influence of geometry and deformation on the performance of profiled hydrostatic thrust bearings. ASME International Mechanical Engineering Congress and Exposition. Washington, DC.
9. Manring, N. D. and S. B. Kasaragadda. 2002. The theoretical flow ripple of an external gear pump. ASME International Mechanical Engineering Congress and Exposition. New Orleans, LA. **Best Paper Award, FPSTD, \$500 honorarium.**
10. Manring, N.D. 2002. The control and containment forces on the swash plate of an axial piston pump utilizing a secondary swash-plate angle. American Control Conference. Anchorage, AK.
11. Johnson, R. E., H. Cherukuri, and N. D. Manring. 2002. Analysis of profiled thrust bearings. Poster Session. 2002 NSF Design, Service and Manufacturing Grantees and Research Conference. San Juan, Puerto Rico.
12. Shi, X., and N. D. Manring. 2001. A torque efficiency model for an axial-piston swash-plate type hydrostatic pump. Power Transmission and Motion Control Workshop (PTMC 2001). Bath, England.
13. Du, H., and N. D. Manring. 2001. A stable single-actuator control design for hydraulic variable displacement pumps. Poster Session. American Control Conference. Arlington, VA., pp. 4484-4489.
14. Zhang, X., S.S. Nair and N.D. Manring. 2001. Nonlinear control of a novel indexing valve plate pump. Poster Session. American Control Conference. Arlington, VA.
15. Manring, N. D. 2001. Predicting the required slipper hold-down force within an axial-piston swash-plate type hydrostatic pump. ASME International Mechanical Engineering Congress and Exposition. New York, NY.

16. Manring, N. D., and Y. Zhang. 2000. The improved volumetric-efficiency of an axial-piston pump utilizing a trapped-volume design. ASME International Mechanical Engineering Congress and Exposition. Orlando, FL.
17. Du, H., and N. D. Manring. 2000. An adaptive pressure servo control design for variable displacement pumps. ASME International Mechanical Engineering Congress and Exposition. Orlando, FL.
18. Zhang, X., S. S. Nair, and N. D. Manring. 2000. Feed forward plus feedback control of an indexing valve plate pump. ASME International Mechanical Engineering Congress and Exposition. Orlando, FL.
19. Zhang X., J. Cho, S. S. Nair, and N. D. Manring. 2000. Reduced order modeling of the dynamics of an indexing valve plate pump. American Control Conference. Chicago, IL.
20. Zhang X., J. Cho, S. S. Nair, and N. D. Manring. 2000. Damping on the swash plate of an axial piston pump. American Control Conference. Chicago, IL.
21. Cho, J., X. Zhang, Nair, S. S., and N. D. Manring. 1999. Dynamic modeling and parametric studies of an indexing valve plate pump. ASME International Mechanical Engineering Congress and Exposition. Nashville, TN.
22. Manring, N. D. 1998. Slipper tipping within an axial-piston swash-plate type hydrostatic pump. ASME International Mechanical Engineering Congress and Exposition. Anaheim CA, FPST 169-175.
23. Manring, N. D., and R.E. Johnson. 1994. Swivel torque within a variable displacement pump. SAE International Off-Highway & Powerplant Congress and Exp. Milwaukee WI. Presentation only.
24. Johnson, R. E., and N. D. Manring. 1994. Modeling a variable displacement pump. ASME Fluid Machinery Forum, Tahoe NV, FED 195, 1-10.
25. Manring, N. D., and R.E. Johnson. 1994. Swivel torque within a variable displacement pump. National Fluid Power Association. 46th National Conference on Fluid Power. Anaheim, CA., 13-24.

Books, Booklets, and Thesis:

1. Manring, N.D. 2006. The element of dance in worship. MA Thesis. Reformed Theological Seminary, Charlotte NC 28226.
2. Manring, N. D. 2005. [Hydraulic Control Systems](#). John Wiley & Sons. New York. ISBN 0471693111.
3. Manring, N. D. 1999. The analysis, design, and control of axial-piston swash-plate type hydrostatic machines. Two hundred and eighty page book written for giving seminars to industry.
4. Manring, N. D. 1997. Controlling axial-piston swash-plate type hydrostatic pumps. Sixty-nine page booklet written for giving seminars to industry.
5. Manring, N. D. 1996. Torque on the cylinder block of an axial-piston swash-plate type hydrostatic pump. Ph.D. Dissertation. Iowa State University, Ames, IA 50011.
6. Manring, N. D. 1993. Modeling a variable displacement pump. MS Thesis. University of Illinois at Urbana-Champaign, Urbana IL 61801.

Invited Lectures:

1. National Sciences and Engineering Research Council of Canada, 2005. International Workshop on Nano Precision & High Performance Actuation Systems, Hamilton Ontario, Canada. Keynote Speaker: "Hydrostatic Actuation Systems & Components".
2. University of Saskatchewan, 2004. Dynamic analysis of hydraulic control valves. Mechanical Engineering Department, Special Lectures. Also an invited committee member for Yuvin Chinniah's Ph.D. defense: Using Kalman Filters to Measure Fluid Bulk Modulus and Viscous Damping Coefficients.
3. Vanderbilt University, 2003. NSF Sponsored Research: Controlling an axial piston pump utilizing a secondary swash-plate angle. Mechanical Engineering Department, Graduate Student Seminars.

Post-Doctoral Employees:

1. Dong, Z. 2002-2003. NSF Award 0099740. University of Missouri – Columbia, Columbia, MO 65211.
2. Du, H. 1999-2000. Research support for Caterpillar pump and motor research programs. University of Missouri – Columbia, Columbia, MO 65211.

Advised Doctoral Students:

1. Zhang, S. Current. Measuring transient flow forces in spool valves. Ph.D. Dissertation. University of Missouri – Columbia, MO 65211.
2. Mehta, V. 2006. Torque and noise reduction for axial piston pumps. Ph.D. Dissertation. University of Missouri – Columbia, Columbia, MO 65211.
3. Luo, Y. 2006. System modeling and control design of a two-stage metering poppet-valve system. Ph.D. Dissertation. University of Missouri – Columbia, Columbia, MO 65211.
4. Crabtree, A. Withdrew. Experimental studies of hydrostatic bearing lubrication. Ph.D. Dissertation. University of Missouri – Columbia, Columbia, MO 65211.
5. Cho, J. 2000. Analysis and control of a swash-plate type hydrostatic axial-piston machine using an indexing valve-plate. Ph.D. Dissertation. University of Missouri – Columbia, Columbia, MO 65211.

Advised Master Students:

1. Dierking, J. Current. Frequency response of a variable displacement pump. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
2. Noronha, N. 2005. A reconsideration of pressure transient flow-forces acting on hydraulic spool valves. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
3. Venkateswaran, P. 2004. Modeling the instability of a pressure compensated flow-control valve. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
4. Pfeiffer, F. 2004. Modeling the instability of two-way poppet valve. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.

5. Dirck, M. 2003. Modeling and designing a hybrid power regenerating transmission for automotive applications. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
6. Peterson, J. 2003. Designing a directional tracking control for dual path transmissions. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
7. Mummert, M. A. 2003. An analysis of the fluid forces acting on hydraulic spool-type valves. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
8. Kasaragadda, S. B. 2003. The theoretical flow ripple of an external gear pump. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
9. Bhamkar, M. R. 2003. Performance analysis of the deformed slipper bearing. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
10. Crabtree, A. B. 2003. Modeling and development of a mass flow sensors for mobile agricultural spreader systems. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
11. Wray, C. L. 2002. Measuring the static deformation of a slipper within an axial-piston pump. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
12. Zhang, Y. 2001. The efficiency of an axial piston pump utilizing a trapped volume design. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
13. Shi, X. 2000. Efficiency mapping for axial piston pumps using modeling techniques and the method of least squares. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.
14. Damtew, F. A. 1998. The design of piston bore springs for over-whelming inertial effects within axial-piston swash-plate type hydrostatic machines. M.S. Thesis. University of Missouri – Columbia, Columbia, MO 65211.

Advised Undergraduate Students (Honors Thesis):

1. Bax, B. 2004. Computer programming for a pneumatic control system with a manufacturing application. MAE 350, Undergraduate Honors Thesis. University of Missouri – Columbia, Columbia, MO 65211.
2. Marshall, M. B. 2004. Transient spool valve flow forces. MAE 350, Undergraduate Honors Thesis. University of Missouri – Columbia, Columbia, MO 65211.
3. White, D. 2003. Debugging of computer program for analyzing the trapped volume regions of a gear pump. University of Missouri – Columbia, Columbia, MO 65211.
4. Kuhn, A. E. 2003. Analysis of the bolted joint using a conically shaped equivalent model. MAE 350, Undergraduate Honors Thesis. University of Missouri – Columbia, Columbia, MO 65211.
5. Soucie, A. M. 2002. Finite element analysis: Applications in industry. MAE 300, Special Problems. University of Missouri – Columbia, Columbia, MO 65211.
6. Sutton, E. 2002. Design and analysis of an experimental setup for hydrostatic thrust bearings. MAE 300, Special Problems. University of Missouri – Columbia, Columbia, MO 65211.

Taught Graduate Courses and Senior Electives:

1. MAE 418. **Advanced Dynamics.** Graduate course. University of Missouri – Columbia, Columbia MO 65211.
2. MAE 410. **Graduate Seminar.** Graduate course. University of Missouri – Columbia, Columbia MO 65211.
3. MAE 327 / 4710 / 7710. **Hydraulic Control Systems.** Senior / Graduate course. University of Missouri – Columbia, Columbia MO 65211.
4. MAE 306. **Analysis of Mechanisms.** Senior / Graduate course. University of Missouri – Columbia, Columbia MO 65211.

Taught Undergraduate Courses:

1. ECE 1000. **Introduction to Electrical and Computer Engineering.** Undergraduate course. University of Missouri – Columbia, Columbia MO 65211.
2. MAE 3900. **Mechanical Design I.** Undergraduate course. University of Missouri – Columbia, Columbia MO 65211.
3. MAE 285. **System Dynamics.** Undergraduate course. University of Missouri – Columbia, Columbia MO 65211.
4. MAE 256. **Design of Machine Elements.** Undergraduate course. University of Missouri – Columbia, Columbia MO 65211.
5. MAE 185. **Dynamics.** Undergraduate course. University of Missouri – Columbia, Columbia MO 65211.
6. PHY 201. **Engineering Physics.** Undergraduate course. Joliet Junior College, Joliet IL 60434.
7. MTH 170. **Calculus.** Undergraduate course. Joliet Junior College, Joliet IL 60434.
8. MTH 160. **Applied Calculus.** Undergraduate course. Iowa State University, Ames IA 50011.
9. CEE 102. **Engineering for the Modern World.** Undergraduate course. Princeton University, Princeton, NJ 08544.

Grants, Contracts, & Gifts (Federal Government):

1. Manring, N.D., R.C. Fales. 2006-2007. Portable Power Research Institute Vane Motor Model Development, **US Army, \$66,249.** Federal plus up with Vanderbilt University. University of Missouri – Columbia, Columbia MO 65211.
Investigator Status: Principal Investigator
Shared Credit: 50% = \$33,125
Period of Grant: 08/07/06 – 11/24/07
Other: None
2. Smith, D., and N. D. Manring. 2006-2011. Graduate Assistance in Areas of National Need (GAANN), **US Department of Education, \$627,030.** University of Missouri – Columbia, Columbia MO 65211.
Investigator Status: co-Principal Investigator

Shared Credit: 20% = \$125,400
Period of Grant: 09/01/06 – 09/01/11
Other: Institutional matching

3. Smith, D., N. D. Manring, F. Feng, Y. Lin, H. Ma. 2003-2006. Graduate Assistance in Areas of National Need (GAANN), **US Department of Education, \$500,000**. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: co-Principal Investigator
Shared Credit: 20% = \$100,000
Period of Grant: 09/01/03 – 09/01/06
Other: UMC Graduate School matched 1 Fellow

4. Manring, N. D. 2001-2003. [National Science Foundation, CMS – Unsolicited, \\$125,557](#). The rigid-body dynamic analysis of the control and containment requirements for the swash plate of an axial-piston pump. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator
Shared Credit: 100% = \$125,557
Period of Grant: 08/01/01 – 07/31/03
Other: Parker matching \$30,000 (see below)

5. Manring, N. D., R.E. Johnson, and H.P. Cherukuri. 2001 - 2003. [National Science Foundation, DMII – GOALI, \\$310,649](#). Analysis, design and testing of profiled radial-thrust bearings. University of Missouri – Columbia, Columbia MO 65211, University of North Carolina – Charlotte, Charlotte NC 28223-0001.

Investigator Status: Principal Investigator
Shared Credit: 100% = \$310,649
Period of Grant: 04/01/01 – 12/31/03
Other: \$240,000 subcontracted to UNC, Caterpillar matching \$148,547 (see below)

Grants, Contracts, & Gifts (Industry and Private Donors):

1. Manring, N.D., and R.C. Fales. 2008. **Caterpillar, Inc., \$36,637**. Frequency response testing for Caterpillar pumps. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator
Shared Credit: 50% = \$18,318
Period of Grant: one-time gift 06/01/08 – 09/01/08
Other: none

2. Manring, N.D. 2008. **Caterpillar, Inc., \$30,000**. Increasing the frequency response of axial piston, displacement controlled pumps. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator
Shared Credit: 100% = \$30,000
Period of Grant: one-time gift 03/01/07 – 06/01/07
Other: none

3. Manring, N.D. 2005. **Caterpillar, Inc., \$50,000**. Lubrication studies for axial piston machinery. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator
Shared Credit: 100% = \$50,000

Period of Grant: one-time gift 01/01/05 – 12/31/05

Other: none

4. Manring, N.D. 2005. **Glen Barton, \$550,000.** A private donation from Glen Barton to establish the Endowed Chair in Fluid Power. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator

Shared Credit: 50% Shared with office of development = \$275,000

Period of Grant: one-time gift 08/01/05

Other: none

5. Manring, N.D. 2004. **National Fluid Power Association, \$30,000.** Unrestricted gift for support for writing a textbook called, “Hydraulic Control Systems”. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator

Shared Credit: 100% = \$30,000

Period of Grant: one-time gift 12/01/04

Other: none

6. Manring, N.D. 2004. **Caterpillar, Inc., \$200,000.** Graduate research assistantship support. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator

Shared Credit: 100% = \$200,000

Period of Grant: one-time gift 01/01/04 – 12/31/04

Other: none

7. Manring, N.D. 2003. **National Fluid Power Association, \$50,000.** Unrestricted gift for support of hydraulics research. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator

Shared Credit: 100% = \$50,000

Period of Grant: one-time gift 12/01/03

Other: none

8. Manring, N.D. 2003. **FESTO Corporation, \$250,000.** A donation for supporting the Fluid Power Laboratories at the University of Missouri. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator

Shared Credit: 100% = \$250,000

Period of Grant: one-time gift 12/01/03

Other: none

9. Manring, N.D. 2003. **Randy and Sandra Rolf, \$500,000.** A private donation from Randy and Sandra Rolf for starting the Rolf Fluid Power Laboratories. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator

Shared Credit: 50% Shared with office of development = \$250,000

Period of Grant: one-time gift 10/01/03

Other: used for purchasing research equipment

10. Manring, N.D. 2003. **Caterpillar, Inc., \$8,000.** A donation from the Caterpillar Foundation for supporting capstone design projects within the Mechanical and Aerospace Engineering Department. University of Missouri – Columbia, Columbia MO 65211.
Investigator Status: Principal Investigator
Shared Credit: 50% Shared with office of development = \$4,000
Period of Grant: 09/01/03 – 05/31/04
Other: used for supporting 4 design projects in MAE 296
11. Manring, N.D. 2002. **National Fluid Power Association, \$4,040.** Analysis of the fluid pressure in the trapped pocket of an external gear pump. University of Missouri – Columbia, Columbia MO 65211.
Investigator Status: Principal Investigator
Shared Credit: 100% = \$4,040
Period of Grant: 09/01/02 – 05/31/03
Other: 1 undergraduate student supported
12. Manring, N.D. 2002. **Caterpillar, Inc., \$15,000.** A donation from the Caterpillar Foundation for supporting capstone design projects within the Mechanical and Aerospace Engineering Department and faculty development expenses. University of Missouri – Columbia, Columbia MO 65211.
Investigator Status: Principal Investigator
Shared Credit: 50% Shared with office of development = \$7.5k
Period of Grant: 09/01/02 – 05/31/03
Other: used for supporting 4 design projects in MAE 296 and faculty development
13. Manring, N.D. 2002. **Parker Hannifin Corporation, \$30,000.** Principal membership in the fluid power research consortium. University of Missouri – Columbia, Columbia MO 65211.
Investigator Status: Principal Investigator
Shared Credit: 100% = \$30,000
Period of Grant: 01/01/02 – 12/31/02
Other: none
14. Manring, N.D. 2001. **Caterpillar, Inc., \$30,000.** Unrestricted gift for support of hydraulics research. University of Missouri – Columbia, Columbia MO 65211.
Investigator Status: Principal Investigator
Shared Credit: 100% = \$30,000
Period of Grant: one-time gift 01/01/01
Other: none
15. Manring, N. D. 2000 - 2003. **Caterpillar, Inc., \$148,547.** Experiments for determining the effect of deformation on the hydrostatic performance of slippers within axial-piston pumps. University of Missouri – Columbia, Columbia MO 65211.
Investigator Status: Principal Investigator
Shared Credit: 100% = \$148,547
Period of Grant: 09/01/02 – 12/31/03
Other: none
16. Manring, N. D. 2000. **Caterpillar, Inc., \$33,036.** Optimization of swash-plate containment geometry for an axial-piston swash-plate type hydrostatic pump. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator
Shared Credit: 100% = \$33,036
Period of Grant: 08/01/00 – 12/31/00
Other: none

17. Manring, N. D. 1999 - 2000. **Caterpillar, Inc., \$143,603.** Research support for Caterpillar pump and motor research programs. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator
Shared Credit: 100% = \$143,603
Period of Grant: 07/01/99 – 12/31/00
Other: none

18. Manring, N. D. 1998. **Caterpillar, Inc., \$213,579.** Controlling a variable displacement pump utilizing two methods: 1) a pressurized head pocket, and 2) a variable indexing port plate. University of Missouri – Columbia, Columbia MO 65211.

Investigator Status: Principal Investigator
Shared Credit: 100% = \$213,579
Period of Grant: 01/01/98 – 12/31/99
Other: none

Consulting:

Andlinger & Company, Inc., Sanderson Engine Development, Frisby Aerospace, Caterpillar Inc., AmerenUE Calloway Power Plant, Moog Inc., FMC Wyoming Corporation, Dennison Hydraulics, Eenceratec (Cummins), Sauer Sundstrand, Parker Hannifin Corporation, Eaton Corporation, Ross Controls, State of Indiana

Services and Affiliations:

Scientific Advisory Board Member, Center for Compact and Efficient Fluid Power. 2006 - present. A [National Science Foundation Engineering Research Center](#). University of Minnesota, Department of Mechanical Engineering, 111 Church Street SE, Minneapolis, Minnesota 55455.

Board Member, National Conference on Fluid Power (NCFP). 2004 – present. National Fluid Power Association. 3333 N. Mayfair Road, Milwaukee, WI 53222-3219

Book Reviewer, McGraw-Hill, \$400 honorarium. 2004. Mechanical Engineering Design, 7th ed. By Joseph E. Shigley, Charles R. Mischke, Richard G. Budynas.

Book Reviewer, McGraw-Hill, \$1,000 honorarium. 2003. Fundamentals of Machine Elements, 2nd ed. (chapter 1-10). By Bernard J. Hamrock, Bo Jacobson, and Steven R. Schmid

Associate Editor, *International Journal of Fluid Power*. 2002 - present. Journal Office: Prof. Monika Ivantysynova, Technical University of Hamburg-Harburg, Institute for Aircraft Systems Engineering, Nesspiel 5, 21129 Hamburg, Germany.

Book Reviewer, McGraw-Hill, \$800 honorarium. 2001. Mechanical Engineering Design, 6th ed. By Joseph E. Shigley and Charles R. Mischke

Proposal Reviewer, National Science Foundation (NSF), \$500 honorarium, 2001 DMII – Major Research Instrumentation Grants, 2001, INT – Africa, Near East, & SO Asia, 2003

Program Representative, ASME International Mechanical Engineering Congress and Exposition, 2001, 2002, 2003, Fluid Power Systems and Technology Division

Editor, ASME Fluid Power Systems and Technology Division Newsletter, Spring 2001, 2002, 2003, 2004

Associate Editor, ASME *Journal of Dynamic Systems, Measurement, and Control*. 2000 - 2006.
Journal Office: Prof. Galip Ulsoy, Mechanical Engineering and Applied Mechanics,
University of Michigan College of Engineering, Ann Arbor MI 48109-2125.

References: Available upon request.