

CURRICULUM VITAE **Stephen M. Klisch, Ph.D.**

Associate Professor
Mechanical Engineering Department
California Polytechnic State University
San Luis Obispo, CA 93407
sklisch@calpoly.edu
<http://www.calpoly.edu/~sklisch/biogroup/index.htm>

EDUCATION

- University of California, Berkeley, Ph.D., Mechanical Engineering (1999)
- University of Virginia, M.S., Mechanical Engineering (1994)
- University of Virginia, B.S., Aerospace Engineering (1991)

POSITIONS AND HONORS

Professional Experience

- Associate Professor, Mechanical Engineering Department, California Polytechnic State University, San Luis Obispo (2004-present)
- Visiting Professor, Department of Bioengineering, Politecnico di Milano, Milan, Italy (2007-2008)
- Assistant Professor, Mechanical Engineering Department, California Polytechnic State University, San Luis Obispo (2001-2004)
- Postdoctoral Fellow, Departments of Mechanical Engineering and Bioengineering, University of California, San Diego (1999-2001)
- Graduate Research Assistant, Department of Orthopaedic Surgery, University of California, San Francisco (1994-1999)

Professional Memberships

- American Society of Mechanical Engineers (1999-present)
- Biomedical Engineering Society (2008-present)

Honors and Awards

- Honorable Mention, M.S. Research Poster Competition, ASME Summer Bioengineering Conference (Principal Investigator) (2007)
- 1st Place, B.S. Research Poster Competition, ASME Summer Bioengineering Conference (Principal Investigator) (2006)
- Northrop Grumman Research and Development Award, Cal Poly CENG (2005)
- Faculty Appreciation Award, Cal Poly Engineering Student Council (2003)
- Nominated, Most Supportive Professor Award, Cal Poly Society of Women Engineers (2002)
- Finalist, New Investigator Recognition Awards competition, 47th Annual meeting of the Orthopaedic Research Society (2001)
- National Research Service Award, National Institutes of Health (2000-2001)
- Postdoctoral Fellowship, U.C. President's Office (1999-2000)
- Graduated *summa cum laude*, University of Virginia (1991)

Professional Service

Session chair:

- ASME Summer Bioengineering Conference (2003, 2006-2007)
- U.S. National Congress of Theoretical and Applied Mechanics (2006)
- ASME International Mechanical Engineering Conference and Exposition (2004)
- Annual Meeting of the Biomedical Engineering Society (2002)
- Finite Thermoelasticity Symposium, ASME Winter Meeting (1999)

Reviewer:

- *Acta Biomaterialia* (2006)
- *Annals of Biomedical Engineering* (2002-2003)
- *ASME Summer Bioengineering Conference* (2006-2007)
- *Biomechanics and Modeling in Mechanobiology* (2003-2008)
- *International Journal of Engineering Science* (2002-2003)
- *Journal of Biomechanical Engineering* (2002-2008)
- *Journal of Biomechanics* (2004-2006)
- *Journal of Biomedical Materials Research Part A* (2007)
- *Journal of Elasticity* (2001-2003, 2005)
- *Mechanics of Biological Tissue*, Eds. Holzapfel and Ogden (2005)
- *Mechanical of Materials* (2006)
- *Medical and Biological Engineering and Computing* (2006)
- *Proceedings of the Royal Society of London* (2000)
- *Shock and Vibration Journal* (1999)

Grant Proposal Reviewer:

- Dutch Arthritis Association (March, 2008)
- National Science Foundation (May, 2007)
- National Science Foundation (April, 2007)
- National Science Foundation (December, 2006)

PEER-REVIEWED PUBLICATIONS

Journal Articles

1. Ficklin TP, Davol A, Klisch SM. Simulating the growth of articular cartilage explants in a permeation bioreactor to aid in experimental protocol design. *Journal of Biomechanical Engineering*, in press, 2008.
2. Asanbaeva A, Tam J, Schumacher BL, Klisch SM, Masuda K, Sah RL. Articular cartilage tensile integrity: modulation by matrix depletion is maturation-dependent. *Archives of Biochemistry and Biophysics*, 474:175-182, 2008.
3. Klisch SM, Asanbaeva A, Oungoulian SR, Masuda K, Thonar EJ, Davol A, Sah RL. A cartilage growth mixture model with collagen remodeling: validation protocols. *Journal of Biomechanical Engineering*, 130:031006, 2008.
4. Williams GM, Klisch SM, Sah RL. Bioengineering cartilage growth, maturation, and form. *Pediatric Research*, 63:527-534 2008.

5. Asanbaeva A, Masuda K, Thonar EJ, Klisch SM, Sah RL. Cartilage growth and remodeling: modulation of balance between proteoglycan and collagen network in vitro with beta-aminopropionitrile. *Osteoarthritis and Cartilage*, 16:1-11, 2008.
6. Davol A, Bingham MS, Sah RL, Klisch SM. A nonlinear finite element model of cartilage growth. *Biomechanics and Modeling in Mechanobiology*, 7:295-307, 2008.
7. Asanbaeva A, Masuda K, Thonar EJ, Klisch SM, Sah RL. Regulation of immature cartilage growth by IGF-1, TGF- β 1, BMP-7, and PDGF-AB: role of metabolic balance between fixed charge and collagen network. *Biomechanics and Modeling in Mechanobiology*, 7:263-276, 2008.
8. Ficklin T, Thomas G, Barthel JC, Thonar EJ, Masuda K, Asanbaeva A, Chen AC, Sah RL, Davol A, Klisch SM. Articular cartilage mechanical and biochemical property relations before and after in vitro growth. *Journal of Biomechanics*, 40:3607-3614, 2007.
9. Klisch SM. Bimodular polyconvex fiber-reinforced strain energy functions for articular cartilage. *Journal of Biomechanical Engineering*, 129: 250-258, 2007.
10. Asanbaeva A, Masuda K, Thonar EJ, Klisch SM, Sah RL. Mechanisms of cartilage growth: modulation of balance between proteoglycan and collagen in vitro using chondroitinase ABC. *Arthritis and Rheumatism*, 56(1): 188-198, 2007.
11. Klisch SM. A bimodular theory for finite deformations: comparison of orthotropic second-order and exponential stress constitutive equations for articular cartilage. *Biomechanics and Modeling in Mechanobiology*, 5:90-101, 2006.
12. Klisch SM, Sah RL, Hoger A. A cartilage growth mixture model for infinitesimal strains: solutions of boundary-value problems related to in vitro growth experiments. *Biomechanics and Modeling in Mechanobiology* 3: 209-223, 2005.
13. Klisch SM, Chen SS, Hoger A, Sah RL. A growth mixture theory for cartilage with application to growth-related experiments on cartilage explants. *Journal of Biomechanical Engineering* 125: 169-179, 2003.
14. Klisch SM, Hoger A. Volumetric growth of thermoelastic materials and mixtures. *Mathematics and Mechanics of Solids* 8:377-402, 2003.
15. Klisch SM. A mixture of elastic materials with different constituent temperatures and internal constraints. *International Journal of Engineering Science* 40(7): 805-828, 2001.
16. Klisch SM, Van Dyke TJ, Hoger A. A theory of volumetric growth for compressible elastic biological materials. *Mathematics and Mechanics of Solids* 6:551-575, 2001.
17. Klisch SM, Lotz JC. A special theory of biphasic mixtures and experimental results for human annulus fibrosus tested in confined compression. *Journal of Biomechanical Engineering* 122: 180-188, 2000.
18. Klisch SM. Internally constrained mixtures of elastic continua. *Mathematics and Mechanics of Solids* 4: 481-498, 1999.
19. Klisch SM, Lotz JC. Application of a fiber-reinforced continuum theory to multiple deformations of the annulus fibrosus. *Journal of Biomechanics* 32: 1027-1036, 1999.
20. Whyne C, Hu SS, Klisch SM, Lotz JC. Effect of the pedicle and posterior arch on vertebral body strength predictions in finite element modeling. *Spine* 23(8): 899-907, 1998.
21. Glazer PA, Colliou O, Klisch SM, Bradford DS, Bueff HU, Lotz JC. Biomechanical analysis of multi-level fixation methods in the lumbar spine. *Spine* 22(2): 171-182, 1997.
22. Hall G, Crandall J, Klisch S, Klopp G, Pilkey W. Measurement of dynamic rotary motion using magnetohydrodynamic angular rate sensors. *Shock and Vibration Digest* 28(5): 12-17, 1996.

Conference Abstracts

1. Stender ME, Dills KJ, Nelson LM, Williams GM, Stewart KM, Flores CR, Chen AC, Sah RL, Klisch SM. Differential regulation of articular cartilage compressive properties by IGF-I and TGF- β 1 during in vitro growth. *Transactions of the 2008 BMES Annual Fall Meeting*, 2008.
2. Oungoulian SR, Klisch SM. A cartilage growth mixture model validation for grown articular cartilage tested in compression, *Transactions of the 2008 BMES Annual Fall Meeting*, 2008.
3. Klisch SM, Thomas GC, Hendrickson K. Analytical and experimental study of articular cartilage growth in vitro. *2007 NSF Grantee Conference on International Research and Education in Engineering*, 2007.
4. Thomas GC, Ficklin TP, Barthel JC, Asanbaeva A, Thonar EJ, Masuda K, Chen AC, Sah RL, Davol A, Klisch SM. Investigation of cartilage biomechanical properties: dependence on strain, direction, and biochemical composition. *Transactions of the ASME Summer Bioengineering Conference*, 2007.
5. Oungoulian SR, Chen SS, Davol A, Sah RL, Klisch SM. Extended two compartmental swelling stress model and isotropic Cauchy stress equation for articular cartilage proteoglycans. *Transactions of the ASME Summer Bioengineering Conference*, 2007.
6. Klisch SM, Asanbaeva A, Oungoulian SR, Thonar EJ, Masuda K, Davol A, Sah RL. A cartilage growth mixture model with collagen remodeling: validation protocols. *Transactions of the ASME Summer Bioengineering Conference*, 2007.
7. Asanbaeva A, Schumacher BL, Klisch SM, Masuda K, Sah RL. Articular cartilage tensile integrity: modulation by matrix depletion is maturation-dependent. *Transactions of the Annual Meeting of the Orthopaedic Research Society*, 2007.
8. Ficklin TP, Thomas GC, Asanbaeva A, Chen AC, Sah RL, Davol A, Klisch SM. Development of an experimental protocol to measure anisotropic material properties of bovine articular cartilage. *Transactions of the ASME Summer Bioengineering Conference*, 2006.
9. Klisch SM, Sah RL, Davol A. Bimodular-orthotropic-polyconvex strain energy functions for the collagen-proteoglycan solid matrix of articular cartilage. *Transactions of the ASME Summer Bioengineering Conference*, 2006.
10. Klisch SM, Asanbaeva A, Sah RL, Davol A. Theoretical and experimental study of articular cartilage growth. *U.S. National Congress of Theoretical and Applied Mechanics*, 2006.
11. Klisch SM, Sah RL, Davol A. A bimodular theory for finite deformations: comparison of orthotropic second-order and exponential stress constitutive equations for articular cartilage. *International Conference on the Mechanics of Biological Tissue*, 2005.
12. Davol A, Sah RL, Klisch SM. A cartilage growth finite element model for simulation of in vitro unconfined compression tests. *International Conference on the Mechanics of Biological Tissue*, 2005.
13. Bingham MS, Davol A, Sah RL, Klisch SM. A nonlinear finite element model of cartilage growth under in vitro dynamic compression. *Transactions of the ASME Summer Bioengineering Conference*, 2005.
14. Asanbaeva A, Masuda K, Thonar EJ, Klisch SM, Sah RL. Regulation of immature cartilage growth by IGF-1, TGF- β 1, BMP-7, and PDGF-AB: role of metabolic balance between fixed charge and collagen network. *Transactions of the Annual Meeting of the Orthopaedic Research Society*, 2005.
15. Klisch SM, Asanbaeva A, Davol A, Sah RL. Cartilage growth mixture model: finite strain theory, constitutive equations, and boundary-value problem solutions. *Proceedings of the International Plasticity Meeting*, 2005.

16. Klisch SM, Holtrichter SE, Sah RL, Davol A. A bimodular second order orthotropic stress constitutive equation for cartilage. *Transactions of the ASME IMECE: Advances in Bioengineering*, 2004.
17. Asanbaeva A, Masuda K, Thonar EJ, Klisch SM, Sah RL. Biophysical basis of cartilage growth: matrix remodeling. *National Meeting of the American Society for Matrix Biology*, 2004.
18. Klisch SM. A bimodular second order constitutive theory for fiber-reinforced soft biological tissues. *Proceedings of the IUTAM Mechanics of Biological Tissue Symposium*, 2004.
19. Asanbaeva A, McGowan KB, Masuda K, Klisch SM, Thonar EJ, Sah RL. Mechanisms of cartilage growth: alteration of function and composition in vitro by deposition of collagen and proteoglycan matrix components. *Transactions of the International Cartilage Repair Society Symposium*, 2004.
20. Asanbaeva A, McGowan KB, Masuda K, Klisch SM, Thonar EJ, Sah RL. Mechanisms of cartilage growth: alteration of function and composition in vitro by deposition of collagen and proteoglycan matrix components. *Transactions of the Annual Meeting of the Orthopaedic Research Society*, 2004.
21. Klisch SM, Sah RL, Hoger A. A Cartilage Growth Mixture Model for Infinitesimal Strains: Equilibrium Solutions. *Transactions of the ASME Summer Bioengineering Conference*, 2003.
22. Klisch SM, Chen SS, Hoger A, Sah RL. A growth and remodeling mixture model and the biomechanics of developing bovine articular cartilage. *Proceedings of the Biomedical Engineering Society Annual Meeting*, 2002.
23. Klisch SM, Chen SS, Masuda K, Thonar EJ, Hoger A, Sah RL. Application of a growth and remodeling mixture theory to developing articular cartilage. *Transactions of the Annual Meeting of the Orthopaedic Research Society*, 2001.
24. Klisch SM, Sah RL, Hoger A. A growth mixture theory for cartilage. *Mechanics in Biology*, Eds. J Casey and G Bao. ASME AMD-Vol. 242, 2000.
25. Klisch SM, Hoger A. Development of a growth mixture theory for cartilage. *Proceedings of the International Congress of Theoretical and Applied Mechanics*, 2000.
26. Klisch SM, Sah RL, Hoger A. A mixture theory for the growth of cartilaginous tissues: the solid matrix. *Proceedings of the UC Bioengineering Symposium*, UC Davis, 2000.
27. Klisch SM. A mixture of elastic materials with internal constraints. *Finite Thermoelasticity*, Eds. J Casey and A Abeyaratne. ASME AMD-Vol. 236, 1999.
28. Klisch SM, Lotz JC. Material constants for human annulus fibrosus depend on water content and reference configuration. *Transactions of the ASME: Advances in Bioengineering*, 1999.
29. Wagner DR, Klisch SM, Lotz JC. A constitutive formulation which simultaneously predicts the response of the annulus fibrosus to seven distinct deformations. *Proceedings of the Summer Bioengineering Conference*, ASME, 1999.
30. Klisch SM, Lotz JC. Application of a special theory of biphasic mixtures to annulus fibrosus. *Transactions of the ASME: Advances in Bioengineering*, 1998.
31. Klisch SM, Lotz JC. Application of fiber-reinforced continuum theory to multiple deformations of the annulus fibrosus. *Transactions of the ASME: Advances in Bioengineering*, 1998.
32. Klisch SM, Lotz JC. A fiber-reinforced continuum theory and constitutive equation for the annulus fibrosus. *Transactions of the 1998 Annual Meeting of the Orthopaedic Research Society*, 1998.
33. Klisch SM, Lotz JC. Deriving constitutive equations for a simple incompressible mixture of an elastic solid and an inviscid fluid. *Proceedings of the Summer Bioengineering Conference*, ASME, 1997.
34. Klisch SM, Duncan NA, Keaveny TM, Lotz JC. The relative effects of disc water content and bone modulus on vertebral body stresses. *International Society for the Study of the Lumbar Spine*, 1996.

35. Glazer PA, Colliou O, Klisch SM, Bradford DS, Bueff HU, Lotz JC. Biomechanical analysis of multi-level interbody fixation devices in the lumbar spine. *International Society for the Study of the Lumbar Spine*, 1996.
36. Whyne C, Hu S, Klisch S, Lotz JC. Effect of the pedicle on vertebral body strength predictions in finite element modeling. *International Society for the Study of the Lumbar Spine*, 1996.
37. Hall G, Crandall J, Klopp G, Klisch S, and Pilkey, WD. Joint kinematics with angular rate sensors. *Proceedings of the 69th Shock and Vibration Symposium*, 1996.
38. Crandall JR, Klisch SM, Klopp GS, Sieveka E, Pilkey WD, Martin P. Research program to investigate lower extremity injuries. *SAE International Congress and Exposition*, SAE Technical Paper #940711, 1994.
39. Crandall JR, Klopp GS, Klisch S, Kennett KB, Morgan RM, Eppinger RH. Instrumentation package for the lower extremities. *Proceedings of the International Workshop on Human Subjects for Biomechanical Research*, 1994.
40. Digges K, Malliaris A, Ommaya A, Klisch S. The mechanics and biomechanics of rollover casualties. *Injury Prevention Through Biomechanics Symposium*, Center for Disease Control, 1992.
41. Digges K, Klisch S. Analysis of the factors which influence rollover crash severity. *Proceedings of the International Conference on Experimental Safety Vehicles*, 1991.

Book Chapters

1. Klisch SM. Continuum Models of growth with special emphasis on articular cartilage. In: *Mechanics of Biological Tissue*. Eds. Holzapfel GA, Ogden RW, Springer, Berlin-Heidelberg-New York, 2006.
2. Chen AC, Klisch SM, Bae WC, Temple MM, McGowan KB, Gratz KR, Schumacher BL, Sah RL. Mechanical characterization of native and tissue-engineered cartilage. In: *Methods in Molecular Medicine: Osteoarthritis: Methods and Protocols*. Eds. Sabatini M, DeCeuninck F, Pastoureau P. Humana Press, Totowa, NJ, 2004.
3. Klisch SM, DiMicco MA, Hoger A, Sah RL. Bioengineering the growth of articular cartilage. In: *Functional tissue engineering*. Eds. Guilak F, Butler D, Mooney D, Goldstein S. Springer-Verlag, New York, 2003.