

Kevin Levi Troyer, PhD
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SUMMARY

Dr. Kevin Troyer received his BS (2008), MS (2010), and PhD (2012) from the Department of Mechanical Engineering at Colorado State University (CSU). Before joining the faculty at CSU, Dr. Troyer worked as a research fellow at the U.S. Food and Drug Administration, a mechanical engineer at Honeywell Federal Manufacturing and Technologies, and a member of the research and development staff at Sandia National Laboratories. His research interests include biomechanics, computational solid mechanics, and viscoelastic phenomena.

INDUSTRY EXPERIENCE

03/2015 – 08/2017 **Senior Research and Development Mechanical Engineer**
Sandia National Laboratories
1515 Eubank Blvd. NE, Albuquerque, NM 87123

Lead internally-funded research in the areas of: (1) reduced-order modeling of structures with nonlinear and time-dependent materials, and (2) verification and validation large computational models of mechanical components. Supported design engineering customers via development of dynamic (high energy shock) and quasi-static computational models.

11/2016 – 08/2017 **Faculty Affiliate**
Department of Mechanical Engineering, Colorado State University
1374 Campus Delivery, Fort Collins, CO 80523-1374

Serve as doctoral committee member for student studying spinal cord viscoelasticity.

03/2013 – 02/2015 **Mechanical Engineer II**
Honeywell Federal Manufacturing and Technologies
14520 Botts Rd., Kansas City, MO 64147

Delivered on-time results for customer-oriented structural (quasi-static and dynamic), thermal, and coupled finite element investigations of manufacturing processes. Continuously researched and developed techniques to advance the department's capability to simulate complex material behavior, including elastic and plastic nonlinearity, viscoelasticity, and fracture.

09/2012 – 02/2013 **Oak Ridge Institute for Science and Education (ORISE) Fellow**
U.S. Food and Drug Administration
10903 New Hampshire Ave., Silver Spring, MD 20993

Interrogated the efficacy of patient-reported knee and hip arthroplasty outcome metrics. Collaborated with multiple agencies to organize and host a public workshop to understand the current state-of-the-art for orthopaedic arthroplasty patient outcome metrics.

ACADEMIC/TEACHING EXPERIENCE

06/2008 – 05/2012 **Graduate Research Assistant**
Orthopaedic Bioengineering Research Laboratory, Colorado State University
1062 Campus Delivery, Fort Collins, CO 80523

Performed research in the fields of experimental biomechanics and computational mechanics. Developed and designed physical experiments and analyzed large data sets. Developed optimization techniques to fit experimental data. Actively pursued personal and professional research funding via university and federal agency grants and scholarships.

01/2009 – 12/2009 **Graduate Teaching Assistant**
Department of Mechanical Engineering, Colorado State University
1062 Campus Delivery, Fort Collins, CO 80523

Assisted with teaching two undergraduate courses in mechanical design (MECH202) and computer-aided design (MECH201). Assisted with course organization, development of teaching materials and assignments, held regular office hours, and graded assignments and exams.

08/2006 – 05/2008 **Tutor**
Department of Mathematics, Colorado State University
1062 Campus Delivery, Fort Collins, CO 80523

Tutored undergraduate students in precalculus mathematics. Proctored students during examination.

EDUCATION

08/2012 **Doctor of Philosophy (Ph.D.)**
Department of Mechanical Engineering, Colorado State University, Fort Collins, CO
Dissertation: Viscoelastic Characterization and Modeling of Musculoskeletal Soft Tissues

05/2010 **Master of Science (M.S.)**
Department of Mechanical Engineering, Colorado State University, Fort Collins, CO
Thesis: Comprehensive Viscoelastic Characterization of Human Lower Cervical Spine Ligaments

05/2008 **Bachelor of Science (B.S.)**
Department of Mechanical Engineering, Colorado State University, Fort Collins, CO
Minor: Mathematics

AWARDS/HONORS/PROFESSIONAL CERTIFICATION

- Nominated, Employee Recognition Award, Sandia National Laboratories, April 2016
- Six Sigma Greenbelt and Design for Six Sigma certification, 2014
- Margery Monfort Wilson Scholarship, 2010-2011
- Shrake/Culler Scholarship, 2010-2011
- Colorado Graduate Grant, 2008-2011
- Pi Tau Sigma, National Mechanical Engineering Honor Society, 2008
- Engineer in Training (E.I.T.) certification, 2008

PEER-REVIEWED PUBLICATIONS

1. Ramo, N.R., Puttlitz, C.M., Troyer, K.L., 2017. "The development and validation of a numerical integration method for computationally tractable non-linear viscoelastic modeling." *Journal of Biomechanical Engineering*. (in review)
2. Ramo, N.R., Shetye, S.S., Streijger, F., Lee, J.H., Troyer, K.L., Kwon, B.K., Crompton, P.A., Puttlitz, C.M., 2017. "Comparison of in-vivo and ex-vivo viscoelastic behavior of the spinal cord." *Acta Biomaterialia*. (in review)
3. McGilvray, K.C., Unal, E., Troyer, K.L., Santoni, B.G., Palmer, R.H., Easley, J.T., Demir, H.V., Puttlitz, C.M., 2015. "Implantable microelectromechanical sensors for diagnostic monitoring and post-surgical prediction of bone fracture healing." *Journal of Orthopaedic Research* 33, 1439-1446. (Editor's Pick)
4. Shetye, S., Troyer, K., Streijger, F., Lee, J., Kwon, B., Crompton, P., Puttlitz, C., 2014. "Nonlinear viscoelastic characterization of the porcine spinal cord." *Acta Biomaterialia* 10, 792-797.
5. Troyer, K.L., Shetye, S.S., Puttlitz, C.M., 2012. "Experimental characterization and finite element implementation of soft tissue nonlinear viscoelasticity." *Journal of Biomechanical Engineering* 134, 114501.
6. Troyer, K.L., Puttlitz, C.M., 2012. "Nonlinear viscoelasticity plays an essential role in the functional behavior of spinal ligaments." *Journal of Biomechanics* 45, 684-691.
7. Troyer, K.L., Estep, D.J., Puttlitz, C.M., 2012. "Viscoelastic effects during loading play an integral role in soft tissue mechanics." *Acta Biomaterialia* 8, 234-243.
8. Troyer, K.L., Puttlitz, C.M., 2011. "Human cervical spine ligaments exhibit fully nonlinear viscoelastic behavior." *Acta Biomaterialia* 7, 700-709.
9. Cabano, N.R., Troyer, K.L., Palmer, R.H., Puttlitz, C.M., Santoni, B.G., 2011. "Mechanical comparison of two suture constructs for extra-capsular stifle stabilization." *Veterinary Surgery* 40, 334-339.

INVITED PRESENTATIONS

1. Troyer, K.L., "Life on the Outside." Young Alumni Speaker Series, Colorado State University, April 12, 2017.
2. Troyer, K.L., "Viscoelasticity in Biomechanics and Aerospace Engineering." University of New Mexico, December 7, 2016.

CONFERENCE PROCEEDINGS

1. Ramo, N., Shetye, S., Streijger, F., Lee, J., Troyer, K., Kwon, B., Crompton, P., Puttlitz, C., "In-vivo versus ex-vivo spinal cord viscoelastic behavior", 8th World Congress of Biomechanics, Dublin, Ireland, July 8-12, 2018. (in review)

2. Kuether, R., Troyer, K., “Two-tier model order reduction of viscoelastically damped structures”, International Modal Analysis Conference, Orlando, FL, February 12-15, 2018. (in press)
3. Ortiz, J., Anwar, I., Davis, G., Troyer, K., Johnson, W., Heyliger, P., “The influence of edge boundary conditions and cracks in ferroelectrically excited vibrational modes”, International Modal Analysis Conference, Orlando, FL, February 12-15, 2018. (in press)
4. Ramo, N., Troyer, K., Puttlitz, C., “An efficient numerical integration method for non-linear viscoelastic modeling”, Summer Biomechanics, Bioengineering, and Biotransport Conference, Tucson, AZ, June 21-24, 2017.
5. Ramo, N., Troyer, K., Puttlitz, C., “Viscoelastic behavior of isolated cervical spinal cord and pia matter tissues”, Summer Biomechanics, Bioengineering, and Biotransport Conference, Tucson, AZ, June 21-24, 2017.
6. Jamison, R., Elisberg, B., Troyer, K., Stavig, M., Ewsuk, K., “Assessing sealing glass equivalency based on viscoelastic behavior”, 12th Pacific Rim Conference on Ceramic and Glass Technology, Waikoloa, HI, May 21-26, 2017.
7. Kuether, R., Troyer, K., “Substructuring of viscoelastic subcomponents with interface reduction”, International Modal Analysis Conference, Garden Grove, CA, January 30-February 2, 2017.
8. Vemuganti, S., Ozdagli, A., Liu, B., Bajric, A., Moreu, F., Brake, M., Troyer, K., “Impact rating system for vehicle-railway bridge collision”, International Modal Analysis Conference, Garden Grove, CA, January 30-February 2, 2017.
9. Kuether, R., Troyer, K., “Craig-Bampton substructuring of linear viscoelastic finite element models.” International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, Charlotte, North Carolina, August 21-24, 2016.
10. Kuether, R., Troyer, K., Brake, M., “Time domain model reduction of linear viscoelastic finite element models.” International Conference on Noise and Vibration Engineering, Leuven, Belgium, September 19-21, 2016.
11. Troyer, K., Mirza, F., Stone, H., Ghambaryan, A., Sedrakyan, A., Loyo-Berrios, N., Bayona, M., Marinac-Dabic, D., “Patient-reported outcome instruments and the minimum important difference in total knee arthroplasty.” 77th Annual Meeting of the Western Orthopaedic Association, Lake Tahoe, CA, July 31-August 3, 2013.
12. Stone, H., Mirza, F., Ghambaryan, A., Troyer, K., Sedrakyan, A., Loyo-Berrios, N., Bayona, M., Marinac-Dabic, D., “Patient-reported outcome instruments and the minimum important difference in total hip arthroplasty.” 77th Annual Meeting of the Western Orthopaedic Association, Lake Tahoe, CA, July 31-August 3, 2013.
13. S. Shetye, K. Troyer, F. Streijger, J. Lee, B. Kwon, P. Cripton, C. Puttlitz., “In vitro nonlinear viscoelastic characterization of the porcine spinal cord.” ASME Summer Bioengineering Conference, Sunriver, OR, June 26-29, 2013.

14. Troyer, K.L., Puttlitz, C.M., “Nonlinear viscoelasticity is requisite to simultaneously describe static and dynamic ligament mechanics.” 58th Annual Meeting of the Orthopaedic Research Society, San Francisco, CA, February 4-7, 2012.
15. McGilvray, K., Demir, H., Unal, E., Troyer, K.L., Melik, R., Puttlitz, C., “In vivo fracture healing assessment using a novel bio-microelectromechanical system.” 58th Annual Meeting of the Orthopaedic Research Society, San Francisco, CA, February 4-7, 2012.
16. Troyer, K.L., Puttlitz, C.M., “Comparison of a novel nonlinear viscoelastic finite ramp time correction method to a Heaviside step assumption.” ASME Summer Bioengineering Conference, Farmington, PA, June 22-25, 2011.
17. Troyer, K.L., Puttlitz, C.M., “Development and validation of an iterative computational algorithm to characterize the viscoelastic behavior of biological tissue.” 19th Annual Symposium on Computational Methods in Orthopaedic Biomechanics, Long Beach, CA, January 12, 2011.
18. Troyer, K.L., Puttlitz, C.M., “Quasi-linear viscoelastic theory is insufficient to comprehensively describe the time-dependent behavior of human cervical spine ligaments.” ASME Summer Bioengineering Conference, Naples, FL, June 16-19, 2010.
19. Troyer, K.L., Puttlitz, C.M., “Nonlinear viscoelastic behavior of human cervical spine ligaments.” 56th Annual Meeting of the Orthopaedic Research Society, New Orleans, LA, March 6-9, 2010.
20. Cabano, N.R., Santoni, B.G., Palmer, R.H., Troyer, K.L., Puttlitz, C.M., “Mechanical comparison of two suture materials for extra-capsular stifle stabilization.” Veterinary Orthopaedic Society Conference, Steamboat Springs, CO, February 28-March 7, 2009.
21. Tichota, R., Puttlitz, C., Lyons, A., Troyer, K.L., Shetye, S., Womack, W., Arslanoglu, R., Santoni, B., “A biomechanical study of a limited motion device for lumbar posterior stabilization in an ovine model.” 55th Annual Meeting of the Orthopaedic Research Society, Las Vegas, NV, February 22-25, 2009.

BOOK CHAPTERS

1. Puttlitz, C.M., Shetye, S.S., Troyer, K.L., “Viscoelasticity of Load Bearing Soft Tissues: Constitutive Formulation, Numerical Integration, and Computational Implementation.” In Zhang, G. (Ed.), *Computational Bioengineering*. Boca Raton, FL: CRC Press. 2015.

PATENTS

1. Branson, D., Troyer, K., Honeywell FM&T, LLC. “Self-Aligning Swaging Punch and Method for Swaging.” U.S. Patent 20,170,080,476. Issued March 2017.