Christopher Reed Dillon

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Education

PhD, University of Utah Salt Lake City, UT August 2014

- Bioengineering: Biomechanics Track
- Dissertation: Identifying parameters from the bioheat transfer equation using magnetic resonance-guided focused ultrasound (MRgFUS)
- 4.00/4.00 Cumulative GPA

BS, Brigham Young University Provo, UT April 2009

- Mechanical Engineering
- 3.85/4.00 Cumulative GPA

Research Experience

Assistant Professor Provo, UT November 2021-Present

Brigham Young University

- Establishing research in MRgFUS for characterizing temperature-dependent fat tissue properties
- Beginning collaboration with Sandia National Laboratories in reduced order modelling of heat transfer problems
- Investigating the role of water content and stress in dancers with Achilles tendinopathy

R&D S&E, Senior Computer Scientist Albuquerque, NM January 2018-October 2021

Sandia National Laboratories, Managers: Roy Hogan, Shawn Burns, Leslie Phinney

- Support system- and component-level safety and reliability evaluations through computational simulations of fire environments.
- Develop modeling capability for combined mechanical-thermal accident environments.
- Implement and evaluate two-phase porous media model of aeroshell pyrolysis in abnormal thermal environments.

Postdoctoral Research Associate Salt Lake City, UT August 2014-December 2017

University of Utah, Advisers: Allison Payne and Dennis Parker

- Developed unique ex vivo perfused tissue model for studying the effects of uterine fibroid tissue properties on MRgFUS thermal therapy outcomes.
- Developed novel technique for quantifying blood flow effects on MRgFUS therapies.
- Developed technique for simultaneous determination of thermal diffusivity and Pennes perfusion using MRgFUS.
- Characterized MR, acoustic, and thermal properties of uterine fibroids pertinent to MRgFUS.

Graduate Research Assistant Salt Lake City, UT August 2009-August 2014

University of Utah, Advisers: Douglas Christensen and Robert Roemer

- Created four MATLAB graphical user interfaces (GUI) for thermal therapy cancer treatments.
- Improved estimations of MRgFUS SAR by up to 90% when compared with traditional method.
- Developed technique with improved precision in MRgFUS thermal diffusivity estimation.
- Established MR sampling characteristics for accurate SAR and thermal diffusivity estimation.
- Wrote user manuals for measuring tissue specific heat capacity via digital scanning calorimeter and for quantifying ultrasound transducer power output via radiation force balance.

Research Assistant Provo, UT May 2008-April 2009

Brigham Young University, Adviser: Matthew Jones

- Derived and coded in Maple 3D transient analytical heat transfer solutions to friction stir welding.
- Validated analytical solution with experimental thermocouple temperature measurements.

Grants

Focused Ultrasound Surgery Foundation Research Awards Program 2019-2020

- Pre-clinical Grant: $94,365
- Title: Convective skin-cooling device for use with existing MRgFUS systems to prevent skin burns

- Role: Author

National Institutes of Health, NICHD 2015-2017

- F32 Kirschstein-NRSA Postdoctoral Fellowship
- Title: The role of T2 and blood flow properties in MRgFUS treatments of uterine fibroids
- Role: Principal Investigator

University of Utah, Vice President for Research 2015-2016

- Funding Incentive Seed Grant
- Title: The role of T2 and blood flow properties in magnetic resonance-guided focused ultrasound treatments of uterine fibroids
- Role: Co-Investigator

Awards

- Sandia National Laboratories Employee Recognition Award 2021

- F32 Kirschstein-NRSA Postdoctoral Fellowship, National Institutes of Health 2015-2017
- Outstanding Trainee Presentation Award, 28th Annual UCAIR Symposium 2017
- Higher Education Teaching Specialist, University of Utah 2017

- Young Investigator Award, Focused Ultrasound Foundation 2014
- New Investigator Travel Award, Society for Thermal Medicine 2014
- Mechanical Engineering Department Scholarship, Brigham Young University 2008
- Robert C. Byrd Honors Scholarship, Utah State Office of Education 2001-2007
- Gordon B. Hinckley Presidential Scholarship, Brigham Young University 2001-2007
- National Merit Scholarship, Brigham Young University 2001-2007

Bibliography

Journal Publications

1. R Merrill, H Odéen, **C Dillon**, R Bitton, P Ghanouni, A Payne (2021). Design and evaluation of an open-source, conformable skin-cooling system for body magnetic resonance guided focused ultrasound treatments. *Int J Hyperthermia*, 38(1), 679-690.
2. **C Dillon**, M Rezvani, H McLean, M Adelman, M Dassel, E Jarboe, M Janát-Amsbury, A Payne (2019). A tissue preparation to characterize uterine fibroid tissue properties for thermal therapies. *Med Phys*, 44 (6), 2793-2794.
3. B Svedin, **C Dillon**, D Parker (2019). Effect of k-space-weighted image contrast and ultrasound focus size on the accuracy of proton resonance frequency thermometry. *Magn Reson Med*, 81(1), 247-257.
4. S Johnson, D Christensen, **C Dillon**, A Payne (2018). Validation of hybrid angular spectrum acoustic and thermal modelling in phantoms. *Int J Hyperthermia*, 35 (1), 578-590.
5. **C Dillon**, A Farrer, H McLean, S Almquist, D Christensen, A Payne (2018). Experimental assessment of phase aberration correction for breast MRgFUS therapy. *Int J Hyperthermia*, 34(6), 731-743.
6. **C Dillon**, V Rieke, P Ghanouni, A Payne (2017). Thermal diffusivity and perfusion constants from in vivo MR-guided focused ultrasound treatments: a feasibility study. *Int J Hyperthermia*, 34(4), 352-362.
7. N Frazier, A Payne, **C Dillon**, N Subrahmanyam, H Ghandehari (2017). Enhanced Efficacy of Combination Heat Shock Targeted Polymer Therapeutics with High Intensity Focused Ultrasound. *Nanomed Nanotech Biol Med*, 13(3), 1235-1243.
8. N Frazier, A Payne, J de Bever, **C Dillon**, A Panda, N Subrahmanyam, H Ghandehari (2016). High intensity focused ultrasound hyperthermia for enhanced macromolecular delivery. *J Control Release,* 241, 186-193.
9. S Johnson, **C Dillon**, H Odéen, D Parker, D Christensen, A Payne (2016). Development and validation of a MRgHIFU non-invasive tissue acoustic property estimation technique. *Int J Hyperthermia*, 32(7), 723-734.

10. Y Shi, D Parker, **C Dillon** (2016). Sensitivity of tissue properties derived from MRgFUS temperature data to input errors and data inclusion criteria: ex vivo study in porcine muscle. *Phys Med Biol*, 61(15), N373-N385.
11. A Farrer, S Almquist, **C Dillon**, L Neumayer, D Parker, D Christensen, A Payne (2016). Phase aberration simulation study of MRgFUS breast treatments. *Med Phys*, 43(3), 1374-1384.
12. **C Dillon**, G Borasi, A Payne (2016). Analytical estimation of ultrasound properties, thermal diffusivity, and perfusion using magnetic resonance-guided focused ultrasound temperature data. *Phys Med Biol*, 61(2), 923-936.
13. H Odéen, N Todd, **C Dillon**, A Payne, D Parker (2016). Model predictive filtering MR thermometry: effects of model inaccuracies, k-space reduction factor, and temperature increase rate. *Magn Reson Med*, 75(1), 207-216. doi: 10.1002/mrm.25622.
14. **C Dillon**, R Roemer, A Payne (2015). Magnetic resonance temperature imaging-based quantification of blood flow-related energy losses. *NMR Biomed*, 28(7), 841-851. doi: 10.1002/nbm.3318.
15. **C Dillon**, A Payne, D Christensen, R Roemer (2014). The accuracy and precision of two non-invasive, magnetic resonance-guided focused ultrasound-based thermal diffusivity estimation methods. *Int J Hyperthermia*, 30(6), 362-371.
16. **C Dillon**, N Todd, A Payne, D Parker, D Christensen, R Roemer (2013). Effects of MRTI sampling characteristics on estimation of HIFU SAR and tissue thermal diffusivity. *Phys Med Biol*, 58(20), 7291-7307.
17. N Rapoport, A Payne, **C Dillon**, J Shea, C Scaife, R Gupta (2013). Focused ultrasound-mediated drug delivery to pancreatic cancer in a mouse model. *J Therapeutic Ultrasound*, 1(1), 1-11.
18. **C Dillon**, U Vyas, A Payne, D Christensen, R Roemer (2012). An analytical solution for improved HIFU SAR estimation. *Phys Med Biol*, 57(14), 4527-4544.

Sandia National Laboratories Internal Reports

1. J Suo-Anttila, C Fitzgerald, J Koenig, J Goar, S Altamirano, A Cruz-Cabrera, E Bystrom, R Flanagan, **C Dillon**, J Manuel, D Castillo. W80-4 Group 2 Firing Set Assembly Thermal and Pressurization Qualification Experiments. Sandia Report, 2021, in Review and Approval.
2. **C Dillon**, A Thermal Analyst's Guide to Modeling the Radiant Heat Array, Sandia Report, 2021, SAND 2021-XXXX.
3. **C Dillon**, N Grieb, K Son, W Hodges. Normal Thermal Environments Mobile Guardian Transporter Trailer Model Development Report. Sandia Report, 2021, SAND 2021-XXXX.
4. J Engerer, **C Dillon**, B Schroeder, H Silva. Unclassified reentry vehicle: impact of thermal protection mechanisms on thermal races. Sandia report, SAND2021-2790.
5. L Beghini, **C Dillon**, N Francis, A Hanson, A Murphy, S Tan-Torres. FY20 ASC V&V Level 2 Milestone #7184: Margins and uncertainty for weapon safety in combined abnormal environments. Sandia report, September 2020, SAND2020-10034.
6. **C Dillon**. Modeling of W80-4 Group 1 firing set assembly thermal qualification tests. Sandia Report, April 2020, SAND2020-4562.
7. J Suo-Anttila, J Manuel, J Steward, D Castillo, H Duong, V Valdez, C Fitzgerald, S Altamirano, C Hanks, **C Dillon**, J Tencer, T Johnson. W80-4 Group 1 firing set assembly thermal qualification. Sandia report, January 2020, SAND2020-0060.
8. A Murphy, S Tan-Torres, V Brunini, **C Dillon**, S Wiryadinata, S Espinosa, S Subia, D Moser, S Domino, J Clausen, B Houchens. FY19 ASC P&EM/IC Level 2 Milestone #6805: Demonstrate ability to assess crash and burn scenarios. Sandia report, September 2019, SAND2019-11238 R.
9. M Heinstein, J Clausen, V Brunini, J Thomas, B Houchens, **C Dillon**. Thermal/mechanical modeling for crash and burn use cases. Sandia report, September 2018, SAND2018-10755.

Conference Proceedings and Presentations: Podium

1. **C Dillon**, M Janát-Amsbury, A Payne, "Characterizing uterine fibroid tissue properties for thermal therapies," 34th Annual Society for Thermal Medicine Meeting, Cancun, Mexico, April 29-May 2, 2017.
2. **C Dillon**, M Janát-Amsbury, A Payne, "Characterization of uterine fibroid tissue properties for MRgFUS thermal therapies," BMES Annual Meeting, Minneapolis, MN, Oct 5-8, 2016.

3. A Payne, **C Dillon**, I Christofferson, E Hilas, J Shea, "Acute blood pressure response during renal denervation in a normotensive rat model," 5th International Focused Ultrasound Foundation Symposium, Washington, DC, Aug 28-Sept 1, 2016.
4. **C Dillon**, V Rieke, P Ghanouni, D Parker, A Payne, "In vivo pre-clinical and clinical MRgFUS estimation of thermal diffusivity and perfusion," 16th International Symposium of Therapeutic Ultrasound, Tel Aviv, Israel, March 14-16, 2016.
5. S Johnson, A Farrer, **C Dillon**, D Christensen, A Payne, "Non-invasive estimation of acoustic attenuation for high intensity focused ultrasound treatments," BMES Annual Meeting, Tampa, FL, Oct 7-10, 2015.
6. A Farrer, S Almquist, **C Dillon**, D Parker, D Christensen, A Payne, "Phase aberration simulation study of MRgFUS breast treatments," 15th International Symposium of Therapeutic Ultrasound, Utrecht, Netherlands, April 15-18, 2015.
7. **C Dillon**, R Roemer, A Payne, "Quantifying perfusion-related energy losses during magnetic resonance-guided focused ultrasound," 4th International Focused Ultrasound Foundation Symposium, Washington, DC, Oct 12-16, 2014.
8. **C Dillon**, R Roemer, D Parker, A Payne, "A novel method for quantifying perfusion-induced energy losses in magnetic resonance-guided focused ultrasound," 31st Annual Society for Thermal Medicine Meeting, Minneapolis, MN, May 6-10, 2014.
9. **C Dillon**, A Payne, D Christensen, R Roemer, "Non-invasive determination of bioheat transfer parameters for improved MRgHIFU treatment planning," 9th Annual Utah Biomedical Engineering Conference, Salt Lake City, UT, Sept 7, 2013.
10. N Rapoport, A Payne, **C Dillon**, J Shea, "MRI-guided focused ultrasound-mediated drug delivery to pancreatic cancer: safety and efficacy," ISMRM 21st Annual Meeting, Salt Lake City, UT, April 20-26, 2013.
11. N Rapoport, A Payne, N Todd, **C Dillon**, J Shea, C Scaife and R Gupta, "MRI-guided drug delivery to pancreatic cancer using ultrasound-activated perfluorocarbon nanoemulsions (research in progess)," International Society of Therapeutic Ultrasound Annual Conference, Heidelberg, Germany, June 10-13, 2012.

Conference Proceedings and Presentations: Poster

1. **C Dillon**, M Janát-Amsbury, A Payne, "A unique tissue preparation for characterizing uterine fibroid tissue properties for MRgFUS thermal therapies," 5th International Focused Ultrasound Foundation Symposium, Washington, DC, Aug 28-Sept 1, 2016.
2. A Farrer, S Almquist, **C Dillon**, D Parker, D Christensen, A Payne, "Experimental assessment of phase aberration in MRgFUS breast treatments," 5th International Focused Ultrasound Foundation Symposium, Washington, DC, Aug 28-Sept 1, 2016.
3. M Holbrook, **C Dillon**, S Almquist, A Payne, D Christensen, "Phantom development to verify ultrasound scattering in HIFU simulations," BMES Annual Meeting, Tampa, FL, Oct 7-10, 2015.
4. S Johnson, A Farrer, **C Dillon**, H Odéen, D Christensen, A Payne, "Non-invasive estimation of acoustic properties by minimization of experimental and simulated SAR," 15th International Symposium of Therapeutic Ultrasound, Utrecht, Netherlands, April 15-18, 2015.
5. **C Dillon**, R Roemer, A Payne, "Quantifying perfusion-related energy losses during magnetic resonance-guided focused ultrasound," 4th International Focused Ultrasound Foundation Symposium, Washington, DC, Oct 12-16, 2014.
6. S Almquist, **C Dillon**, D Parker, D Christensen, "A full-wave phase aberration correction method for transcranial high-intensity focused ultrasound brain therapies," 4th International Focused Ultrasound Foundation Symposium, Washington, DC Metro Area, USA, Oct 12-16, 2014.
7. H Odéen, N Todd, **C Dillon**, A Payne, D Parker, "Effects of model inaccuracies in model predictive filtering MRTI," ISMRM 22nd Annual Meeting, Milan, Italy, May 10-16, 2014.
8. **C Dillon**, D Christensen, R Roemer, "Non-invasive determination of bioheat transfer parameters for improved MRgHIFU treatment planning," BMES Annual Meeting, Seattle, WA, Sept 25-28, 2013.
9. **C Dillon**, A Payne, R Roemer, "Comparison of two techniques for estimation of thermal diffusivity with MRgHIFU," ISMRM 21st Annual Meeting, Salt Lake City, UT, April 20-26, 2013.

10. **C Dillon**, N Todd, J de Bever, A Payne, D Parker, D Christensen and R Roemer, "Effects of using MR thermometry for estimation of HIFU SAR, beam FWHM, and tissue thermal diffusivity," 3rd International Focused Ultrasound Foundation Symposium, Washington, DC, Oct 14-17, 2012.
11. A Payne, N Todd, **C Dillon**, J Shea, R Gupta and N Rapoport, "MRI-guided focused ultrasound mediated drug delivery to pancreatic cancer: safety and efficacy," 3rd International Focused Ultrasound Foundation Symposium, Washington, DC, Oct 14-17, 2012.
12. **C Dillon**, N Todd, D Christensen, D Parker and R Roemer, "Magnetic resonance-guided HIFU SAR estimation," 29th Annual Society for Thermal Medicine Meeting, Portland, OR, April 13-16, 2012.
13. **C Dillon**, U Vyas, A Payne, D Christensen and R Roemer, "Comparison of SAR estimation techniques in MRgHIFU," International Society of Therapeutic Ultrasound Annual Conference, New York, NY, April 10-13, 2011.
14. **C Dillon**, U Vyas, J de Bever, D Christensen and R Roemer, "Patient treatment planning for HIFU cancer therapy," Canyons Symposium, Park City, UT, Sept 10-11, 2010.
15. **C Dillon**, A Payne, U Vyas, Y Wang, R Roemer, "Critically evaluating thermal models of perfused human tissue," Canyons Symposium, Park City, UT, Sept. 11-12, 2009.

Mentoring Experience

Undergraduate Student Advisor Provo, UT January 2022-Present
Brigham Young University
- Training and supervising undergraduate students on instrumenting lab equipment and learning computational tools for MRgFUS research.

Undergraduate Student Advisor Salt Lake City, UT September 2016-December 2017
University of Utah
- Trained and supervised undergraduate student on through-transmission and radiation force balance techniques for determining tissue acoustic properties.

Graduate Student Advisor Salt Lake City, UT August 2014-December 2017
University of Utah
- Mentored and advised three graduate students in weekly group meetings and individual consultations regarding thermal modeling, tissue property measurements, MR temperature data analysis, and individual development plans.

Summer Intern Adviser Salt Lake City, UT June 2015-August 2016
University of Utah, Tsinghua University
- Mentored high school student intern in establishing protocol for acoustic tissue property characterization using through-transmission technique.
- Mentored foreign student intern in developing MATLAB GUIs, using analytical methods for property estimation, and writing technical scientific papers.

Senior Design Project Co-Adviser Salt Lake City, UT August 2013-May 2015
University of Utah: MeEn 4000 & BioEn 4200
- Team 1: Design of a skin cooling system for breast cancer MRgFUS treatments.
- Team 2: Development of a dynamic tissue substitute that mimics human blood flow.
- Team 3: Validation of isotropic tissue thermal conductivity for MRgFUS applications.

Teaching Experience

Instructor Provo, UT January 2022-April 2022
Brigham Young University: MeEn 321- Thermodynamics
- Instructed 37 students on introductory principles and analysis of thermodynamic systems.

Guest Lecturer Salt Lake City, UT March 2014, April 2016, March 2017
University of Utah: MeEn 6960- Special Topics: Bioheat Transfer
- Guided an 80-minute discussion on deriving a general bioheat transfer equation for thermal therapy applications from basic conservation of energy principles.
- Presented an 80-minute lecture on analytical solutions and validation studies of the Pennes bioheat transfer equation.

Lecturer Salt Lake City, UT March 2016, February 2017
University of Utah: BioEn 5602- Introduction to Bioimaging
- Developed and taught a two-week module on ultrasound physics, diagnostic and therapeutic ultrasound applications including three 80-minute lectures and a two-hour lab.

Co-instructor Salt Lake City, UT August 2016-December 2016
University of Utah: BioEn 5480 & ECEn 5480- Ultrasound
- Developed material and delivered lectures covering half the semester on therapeutic ultrasound, FDA regulations, and ultrasound safety.
- Developed and supervised three labs covering clinical diagnostic ultrasound, therapeutic focused ultrasound, and characterization of acoustic tissue properties.

Teaching Assistant Salt Lake City, UT January 2013-May 2013
University of Utah: MeEn 2510- Intro Energy Sys Des II
- Developed and administered biweekly in-class TurningPoint clicker quizzes.
- Developed and implemented grading rubrics for all homework assignments and exams.

- Tutored 90 students on principles of thermodynamics during lectures and regular office hours.

Math Tutor Draper, UT September 2010-May 2012
Mathnasium: The Math Learning Center
- Deepened students' understanding of mathematical concepts ranging from counting to calculus.

Teaching Assistant Provo, UT January 2008-April 2008
Brigham Young University: ME 335- Dynamic System Modeling
- Tutored 49 students in modeling and analyzing the dynamics of mechanical systems.

Professional Service

Peer-review of Manuscripts

- Physics in Medicine and Biology 2022
- ASME Journal of Thermal Science and Engineering Applications 2019
- International Journal of Hyperthermia 2016-2018
- Journal of Magnetic Resonance Imaging 2014-2017
- Medical Physics 2016
- Journal of Thermal Biology 2016
- International Journal for Computer Assisted Radiology and Surgery 2013

Professional Memberships

- Phi Kappa Phi
- Biomedical Engineering Society
- Society for Thermal Medicine