

Regan A. Zane

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EDUCATION

Institution	Degree	Year	Field of Study
University of Colorado at Boulder Dissertation title , “ <i>Development, analysis, and implementation of an ASIC controller for single-phase power factor correction.</i> ”	Ph.D.	1999	Electrical Engineering
University of Colorado Boulder	M.S. (GPA: 4.0)	1998	Electrical Engineering
University of Colorado Boulder	B.S. (GPA: 4.0)	1996	Electrical Engineering

RESEARCH INTERESTS

Design, modeling and control of high efficiency, high frequency, high power density, and high performance dc-dc, ac-dc, dc-ac power converters in emerging applications such as bidirectional power converters for hybrid ac and dc power systems in commercial and military applications, data centers, micro-grids, grid-integration of renewables, electric vehicles, wireless and wired EV charging

Application of advanced digital control techniques to power electronic systems such as stability and control of series/parallel combinations in modular and distributed systems, adaptive tuning in multi-input, multi-output control loops and online identification of loop stability, converter health, bus or line impedance

EMPLOYMENT

2012 – present	Professor, USTAR endowed , <i>Department of Electrical and Computer Engineering</i> , Utah State University. Founder and Director of the Electric Vehicle & Roadway (EVR) Research Facility and Test Track and USU Power Electronics Lab (UPEL).
2008 – present	Associate Professor , <i>Department of Electrical, Computer, and Energy Engineering</i> , University of Colorado at Boulder
2001 – 2008	Assistant Professor , <i>Department of Electrical and Computer Engineering</i> , University of Colorado at Boulder
1999 – 2001	Senior Research Scientist , <i>Electronic Power Conversion</i> , Corporate Research & Development Center, General Electric, Niskayuna, NY. Principle researcher in area of custom integrated circuits for power management applications within GE businesses with an emphasis on miniature controllers for energy efficient lighting systems.
1999	Graduate Part Time Instructor (GPTI) , <i>Department of Electrical and Computer Engineering</i> , University of Colorado at Boulder

HONORS AND AWARDS

2015	Inaugural Director of the USU Electric Vehicle and Roadway (EVR) Research Facility and Test Track, 2015 – present.
2011	Selected member of the 2012-2013 Defense Sciences Study Group (DSSG), Institute for Defense Analyses (IDA), US Defense Advanced Research Projects Agency (DARPA)
2011	Holland Teaching Award, University of Colorado
2009	IEEE Power Electronics Society Transaction Prize Letter Award
2008	IEEE Power Electronics Society Richard M. Bass Outstanding Young Power Electronics Engineer Award

- 2008 Coleman Institute Faculty Sabbatical Fellowship
- 2008 John and Mercedes Peebles Innovation in Teaching Award, University of Colorado
- 2007 IEEE Power Electronics Society Transaction Prize Letter Award
- 2007 Senior Member, IEEE
- 2006 Provost Faculty Achievement Award, University of Colorado
- 2006 Inventor of the Year Award, Technology Transfer Office, University of Colorado
- 2006 IEEE MTT Microwave Prize for best journal paper
- 2004 NSF Faculty Early Career Development (CAREER) Program Award Recipient
- 2001 Six-Sigma Green Belt Certificate, GE Corporate Research and Development.
- 2001 Manager's Award, General Electric Corporate Research and Development.
- 1993 – 1998 Member Dean's list, University of Colorado.
- 1995 – 1996 Marcellus and Geraldine Merrill Scholarship, University of Colorado.
- 1992 National DECA competition, 2nd place in marketing and business.

PUBLICATION RECORD

Books (published or in press)

- [1] L. Corradini, D. Maksimovic, P. Mattavelli, R. Zane, *Digital control of high-frequency switched-mode power converters*, Hoboken, NJ: Wiley, 2015.

Journals (published or in press)

- [2] M. Evzelman, M. Rehman, K. Hathaway, R. Zane, D. Costinett, D. Maksimovic, "Active balancing system for electric vehicles with incorporated low voltage bus," *IEEE Trans. Power Electron.*, vol. , no. , pp., in press, *online early access*, 2016.
- [3] H. Nguyen, R. Zane, D. Maksimovic, "On/off control of a modular DC-DC converter based on active-clamp LLC modules," *IEEE Trans. Power Electron.*, vol. 30, no. 7, pp. 3748 – 3760, Jul. 2015.
- [4] D. Costinett, D. Maksimovic, R. Zane, "Circuit-oriented treatment of nonlinear capacitances in switched-mode power supplies," *IEEE Trans. Power Electron.*, vol. 30, no. 2, pp. 985 – 995, Feb. 2015.
- [5] V. Lopez, F. Azcondo, R. Zane, "Universal digital controller for boost CCM power factor correction stages based on current rebuilding concept," *IEEE Trans. Power Electron.*, vol. 29, no. 7, pp. 3818 – 3829, Jul. 2014.
- [6] L. Corradini, D. Seltzer, D. Bloomquist, R. Zane, D. Maksimovic, B. Jacobson, "Zero voltage switching technique for bidirectional DC/DC converters," *IEEE Trans. Power Electron.*, vol. 29, no. 4, pp. 1585 – 1594, Apr. 2014.
- [7] Z. Popovic, S. Korhummel, S. Dunbar, R. Scheeler, A. Dolgov, R. Zane, E. Falkenstein, J. Hagarty, "Scalable RF Energy Harvesting," *IEEE Trans. Microw. Theory Tech.*, vol. 62, no. 4, pp. 1046 – 1056, Apr. 2014.
- [8] Z. Popovic, E. Falkenstein, D. Costinett, R. Zane, "Low-power far-field wireless powering for wireless sensors," *Proceedings of the IEEE*, invited paper, Vol. 101, No. 6, pp. 1397 – 1409, Jun. 2013.
- [9] R. Schnell, R. Zane, F. Azcondo, "Size reduction in low-frequency square-wave ballasts for high-intensity discharge lamps using soft-saturation magnetic material and digital control techniques," *IEEE Trans. Power Electron.*, vol. 28, no. 2, pp. 1036 – 1046, Feb. 2013.

- [10] D. Costinett, D. Maksimovic, R. Zane, “Design and Control for High Efficiency in High Step-Down Dual Active Bridge Converters Operating at High Switching Frequency,” *IEEE Trans. Power Electron.*, vol. 28, No. 8, pp. 3931 – 3940, Aug. 2013.
- [11] L. Corradini, D. Seltzer, D. Bloomquist, R. Zane, D. Maksimovic, B. Jacobson, “Minimum current operation of bi-directional dual-bridge series resonant DC/DC converters,” *IEEE Trans. Power Electron.*, Vol. 27, No. 7, pp. 3266 – 3276, Jul. 2012.
- [12] V. Lopez, A. Navarro, R. Schnell, C. Branas, F. Azcondo, R. Zane, “Current phase surveillance in resonant converters for electric discharge applications to assure operation in zero-voltage-switching mode,” *IEEE Trans. Power Electron.*, Vol. 27, No. 6, pp. 2925 – 2935, Jun. 2012.
- [13] C. Branas, F. Azcondo, R. Zane, “Power-mode control of multiphase resonant electronic ballast,” *IEEE Trans. Ind. Electron.*, vol. 59, no. 4, pp. 1770 – 1778, Apr. 2012.
- [14] E. Falkenstein, D. Costinett, R. Zane, Z. Popovic, “Far-field RF-powered variable duty-cycle wireless sensor platform,” *IEEE Trans. Circuits Syst. II*, vol. 58, no. 12, pp. 822 – 826, Dec. 2011.
- [15] Q. Hu, R. Zane, “Minimizing required energy storage in off-line LED drivers based on series-input converter modules,” *IEEE Trans. Power Electron.*, Vol. 26, No. 10, pp. 2887 – 2895, Oct. 2011.
- [16] L. Corradini, A. Bjeletic, R. Zane, D. Maksimovic, “Fully digital hysteretic modulator for DC-DC switching converters,” *IEEE Trans. Power Electron.*, vol. 26, no. 10, pp. 2969 – 2979, Oct. 2011.
- [17] T. Paing, E. Falkenstein, R. Zane, Z. Popovic, “Custom IC for ultra-low power RF energy scavenging,” *IEEE Trans. Power Electron.*, vol. 26, no. 6, pp. 1620 – 1626, Jun. 2011.
- [18] D. Maksimovic, R. Zane, L. Corradini, "Advances in digital control for high-frequency switched-mode power converters," *Power Electronics monthly*, sponsored by Xi'an Power Electronics Research Institute, China, vol. 44, no. 12, pp. 2-19, serial no. 217, Dec. 2010.
- [19] F. Diaz, F. Azcondo, C. Branas, R. Casanueva, R. Zane, “Digitally controlled low-frequency square-wave electronic ballast with resonant ignition and power loop,” *IEEE Trans. Ind. Appl.*, vol. 46, no. 6, pp. 2222 – 2232, Nov. 2010.
- [20] M. Doshi, R. Zane, “Control of solid state lamps using a multiphase pulse width modulation technique,” *IEEE Trans. Power Electron.*, vol. 25, no. 7, pp. 1894 – 1904, Jul. 2010.
- [21] A. Dolgov, R. Zane, Z. Popovic, “Power management system for online low power RF energy harvesting optimization,” *IEEE Trans. Circuits Syst.*, vol. 57, no. 7, pp. 1802 – 1811, Jul. 2010.
- [22] Q. Hu, R. Zane, “LED driver circuit with series-input-connected converter cells operating in continuous conduction mode,” *IEEE Trans. Power Electron.*, vol. 25, no. 3, pp. 574 – 582, Mar. 2010.
- [23] J. Morroni, R. Zane, D. Maksimovic, “An Online Stability Margin Monitor for Digitally Controlled Switched-Mode Power Supplies,” *IEEE Trans. Power Electron.*, vol. 24, no. 11, pp. 2639 – 2648, Nov. 2009.
- [24] J. Morroni, L. Corradini, R. Zane, D. Maksimovic, “Adaptive tuning of switched-mode power supplies operating in discontinuous and continuous conduction modes,” *IEEE Trans. Power Electron.*, vol. 24, no. 11, pp. 2603 – 2611, Nov. 2009.
- [25] M. Shirazi, R. Zane, D. Maksimovic, “An Auto-tuning Digital Controller for DC-DC Power Converters Based on On-line Frequency Response Measurement,” *IEEE Trans. Power Electron.*, vol. 24, no. 11, pp. 2578 – 2588, Nov. 2009.
- [26] M. Doshi, R. Zane, F. Azcondo, “Low frequency architecture for multi-lamp CCFL systems with capacitive ignition,” *IEEE J. Displ. Technol.*, vol. 5, no. 5, pp. 152 – 161, May 2009.
- [27] J. Morroni, R. Zane, D. Maksimovic, “Design and implementation of an adaptive tuning system based on desired phase margin for digitally controlled DC-DC converters,” *IEEE Trans. Power Electron.*, vol. 24, no. 2, pp. 559 – 564, Feb. 2009.

*Received IEEE Power Electronic Society 2009 Prize Transactions Letter Award

- [28] M. Shirazi, J. Morroni, A. Dolgov, R. Zane, D. Maksimovic, "Integration of frequency response measurement capabilities in digital controllers for DC-DC converters," *IEEE Trans. Power Electron.*, vol. 23, no. 5, pp. 2524 – 2535, Sep. 2008.
- [29] F. Javier Diaz, F. J. Azcondo, Ch. Branäs, R. Casanueva, R. Zane, "Digital control of a low-frequency square-wave electronic ballast with resonant ignition," *IEEE Trans. Ind. Electron.*, vol. 55, no. 9, pp. 3180 – 3191, Sep. 2008.
- [30] Y. Yin and R. Zane, "Dual low-voltage IC design for high-voltage floating gate drives," *IEEE Trans. Circuits Syst. I, Reg. Papers*, vol. 55, no. 6, pp. 1751 – 1758, Sep. 2008.
- [31] T. Carosa, R. Zane, D. Maksimović, "Scalable digital multiphase modulator," *IEEE Trans. Power Electron., Lett.*, vol. 23, no. 4, pp. 2201-2205, Jul. 2008.
- [32] T. Paing, J. Shin, R. Zane, Z. Popovic, "Resistor emulation approach to low-power RF energy harvesting," *IEEE Trans. Power Electron.*, vol. 23, no. 3, pp. 1494 – 1501, May 2008.
- [33] Y. Yin, M. Shirazi, R. Zane, "Electronic ballast control IC with digital phase control and lamp current regulation," *IEEE Trans. Power Electron.*, vol. 23, no. 1, pp. 11 – 18, Jan. 2008.
- [34] D. Maksimović, R. Zane, "Small-signal discrete-time modeling of digitally controlled DC-DC converters," *IEEE Trans. Power Electron., Lett.*, vol. 22, no. 6, pp. 2552 – 2556, Nov. 2007.
*Received the 2007 IEEE Power Electronics Society Transaction Prize Letter Award.
- [35] X. Zhao, T. Qian, G. Mei, C. Kwan, C. Walsh, T. Paing, R. Zane, Z. Popovic, "Active health monitoring of an aircraft wing with an embedded piezoelectric sensor/actuator network: II. Wireless approaches," *Smart Mater. Struct.* 16 (2007) 1218 – 1225.
- [36] F.J. Azcondo, R. Zane, Ch. Brañas, "Design of resonant inverters for optimal efficiency over lamp life in electronic ballast with phase control," *IEEE Trans. Power Electron., special issue on lighting*, vol. 22, no. 3, pp. 815 – 823, May 2007.
- [37] S. Johnson, R. Zane, "Custom spectral shaping for EMI reduction in high frequency inverters and ballasts," *IEEE Trans. Power Electron.*, vol. 20, no. 6, pp. 1499 – 1505, Nov. 2005.
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- [41] Y. Yin, R. Zane, "Digital phase control for resonant inverters," *IEEE Trans. Power Electron., Lett.*, vol. 2, no. 2, pp. 51 – 53, June 2004.
- [42] J. Hagerty, F. Helmbrecht, W. McCalpin, R. Zane, Z. Popovic, "Recycling ambient microwave energy with broadband rectenna arrays," *IEEE Trans. Microw. Theory Tech.*, vol. 52, no. 3, pp. 1014 – 1024, Mar. 2004.
*Received the 2006 IEEE MTT Microwave Prize for best journal paper.
- [43] Y. Yin, R. Zane, J. Glaser, R. Erickson, "Small-signal analysis of frequency-controlled electronic ballasts," *IEEE Trans. Circuits Syst. I: Fundam. Theory and Appl.*, vol. 50, No. 8, pp. 1103 – 1110, Aug. 2003.
- [44] R. Zane, D. Maksimović, "Nonlinear-carrier control for high-power-factor rectifiers based on up-down switching converters," *IEEE Trans. Power Electron.*, vol. 13, no. 2, pp. 213 – 221, Mar. 1998.

Full Conference Papers with Peer Review (published or in press)

- [1] M. Evzelman, R. Zane, "Burst mode control and switched-capacitor converter losses," in press, *IEEE Applied Power Electronics Conference, APEC 2016*, Long Beach, CA, Mar 2016.

- [2] F. Zhang, M. Rehman, R. Zane, D. Maksimovic, “Improved steady-state model of the dual-active-bridge converter,” *Proc. IEEE Energy Conversion Congress and Exposition, ECCE 2015*, Montreal, QC, Sept. 2015, pp. 630-636.
- [3] N. Hasan, I. Cocar, T. Amely, H. Wang, R. Zane, Z. Pantic, C. Bodine, “A practical implementation of wireless power transfer systems for socially interactive robots,” *Proc. IEEE Energy Conversion Congress and Exposition, ECCE 2015*, Montreal, QC, Sept. 2015, pp. 4935-4942.
- [4] A. Azad, T. Saha, R. Zane, Z. Pantic, “Design of hybrid energy storage systems for wirelessly charged electric vehicles,” *Proc. IEEE Vehicular Technology Conference, VTC 2015*, Boston, MA, Sept. 2015, pp. 1-5.
- [5] J. Quinn, B. Limb, Z. Pantic, P. Barr, R. Zane, T.H. Bradley, “Feasibility of wireless power transfer for electrification of transportation: Techno-economics and life cycle assessment,” *Proc. IEEE Conference on Technologies for Sustainability, SusTech 2015*, Ogden, UT, July 2015, pp. 245-249.
- [6] W. Chen, R. Zane, “Application of three-phase unfolders in electric vehicle drivetrain,” *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2015*, Vancouver, BC, July 2015, pp. 1-8.
- [7] F. Zhang, M. Rehman, H. Wang, Y. Levron, G. Plett, R. Zane, D. Maksimovic, “State-of-charge estimation based on microcontroller-implemented sigma-point Kalman filter in a modular cell balancing system for Lithium-Ion battery packs,” *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2015*, Vancouver, BC, July 2015, pp. 1-7.
- [8] H. Wang, M. Rehman, M. Evzelman, R. Zane, “SIMULINK based hardware-in-the-loop rapid prototyping of an electric vehicle battery balancing controller,” *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2015*, Vancouver, BC, July 2015, pp. 1-6.
- [9] M. Rehman, F. Zhang, M. Evzelman, R. Zane, D. Maksimovic, “Control of a series-input, parallel-output, cell balancing system for electric vehicle battery packs,” *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2015*, Vancouver, BC, July 2015, pp. 1-7.
- [10] N. Hasan, T. Yilmaz, R. Zane, Z. Pantic, “Multi-objective particle swarm optimization applied to the design of wireless power transfer systems,” *Proc. IEEE Wireless Power Transfer Conference, WPTC 2015*, Boulder, CO, May 2015, pp. 1-4.
- [11] J. Quinn, B. Limb, Z. Pantic, P. Barr, R. Zane, “Techno-economic feasibility and environmental impact of wireless power transfer roadway electrification,” *Proc. IEEE Wireless Power Transfer Conference, WPTC 2015*, Boulder, CO, May 2015, pp. 1-3.
- [12] Md. M. U. Rehman, M. Evzelman, K. Hathaway, R. Zane, S. Trimboli, G. Plett, K. Smith, D. Maksimovic, “Modular approach for continuous cell-level balancing to improve performance of large battery packs,” *Proc. IEEE Energy Conversion Congress and Exposition (ECCE 2014)*, Pittsburgh, PA, Sept. 14-18, 2014, pp. 4327 – 4334.
- [13] D. Seltzer, R. Zane, “Multi-Mode Control of Series and Parallel Converters for Bidirectional Power Systems,” *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2014*, Santander, Spain, Jun. 2014, pp. 1-8.
- [14] M. Evzelman, R. Zane, X. Zhao, “A low-power, self-tuning resonant driver for generating sinusoidal pulse trains with piezoelectric element loads,” *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2014*, Santander, Spain, Jun. 2014, pp. 1-5.
- [15] F. Azcondo, R. Zane, D. Maksimovic, D. Costinett, “A framework to share courses among universities: The case of a course on power electronics for electric vehicles,” *Tecnologias Aplicadas a la Ensenanza de la Electronica (Technologies Applied to Electronics Teaching) (TAEE)*, Spain, 11-13 Jun. 2014, pp. 1 – 8.
- [16] W. Chen, K. Kennedy, D. Seltzer, R. Zane, L. Corradini, “Isolated bidirectional DC/AC and AC/DC three-phase power conversion using series resonant converter modules and a three-phase unfolded,” *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2014*, Santander, Spain, Jun. 2014, pp. 1-6.
- [17] D. Costinett, K. Hathaway, M. Rehman, M. Evzelman, R. Zane, Y. Levron, D. Maksimovic, “Active balancing system for electric vehicles with incorporated low voltage bus,” *Proc. IEEE Appl. Power Electron. Conf. Expo*, Fort Worth, TX, Mar. 16-20, 2014, pp. 3230 – 3236.

- [18] D. Costinett, R. Zane, D. Maksimovic, “Discrete time modeling of output disturbances in the dual active bridge converter,” *IEEE Appl. Power Electron. Conf. Expo*, Fort Worth, TX, Mar. 16-20, 2014, pp. 1171 – 1177.
- [19] D. Costinett, D. Maksimovic, R. Zane, A. Rodriguez, A. Vazquez, “Comparison of reverse recovery behavior of silicon and wide bandgap diodes in high frequency power converters,” *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2013*, Salt Lake City, UT, Jun. 2013, pp. 1 – 8.
- [20] D. Seltzer, R. Zane, “Feedback control of phase shift modulated half bridge circuits for zero voltage switching assistance,” *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2013*, Salt Lake City, UT, Jun. 2013, pp. 1 – 7.
- [21] H. Nguyen, D. Maksimovic, R. Zane, “On/off control of a modular DC-DC converter based on active-clamp LLC modules,” *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2013*, Salt Lake City, UT, Jun. 2013, pp. 1 – 6.
- [22] B. Jacobson, E. Holmanský, R. Zane, D. Seltzer, M. Uva, “Bidirectional power converters perform DC/DC, AC/DC, and DC/AC functions in shipboard power systems,” in press, *American Society of Naval Engineers Annual Conference*, Washington, D.C., Feb. 20 – 22, 2013.
- [23] D. Costinett, D. Seltzer, R. Zane, D. Maksimovic, “Inherent volt-second balancing of magnetic devices in zero-voltage switched power converters,” in press, *IEEE Appl. Power Electron. Conf. Expo*, Long Beach, CA, Mar. 17-21, 2013.
- [24] Hien Nguyen, R. Zane, D. Maksimovic, “Active clamp LLC resonant converter for point-of-load (POL) applications,” in press, *IEEE Appl. Power Electron. Conf. Expo*, Long Beach, CA, Mar. 17-21, 2013.
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- [26] D. Seltzer, D. Bloomquist, R. Zane, D. Maksimovic, “Gain-scheduled control of multi-angle phase shift modulated dual active bridge series resonant DC/DC converters,” in *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2012*, Kyoto, Japan, Jun. 2012, pp. 1 – 7.
- [27] D. Costinett, R. Zane, D. Maksimovic, “Circuit-oriented modeling of nonlinear device capacitances in switched mode power converters,” in *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2012*, Kyoto, Japan, Jun. 2012, pp. 1 – 8.
- [28] D. Costinett, R. Zane, D. Maksimovic, “Discrete-time small-signal modeling of a 1 MHz efficiency-optimized dual active bridge converter with varying load,” in *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2012*, Kyoto, Japan, Jun. 2012, pp. 1 – 7.
- [29] D. Costinett, R. Zane, D. Maksimovic, “Automatic voltage and dead time control for optimal efficiency in an unregulated dual active bridge converter,” in *Proc. IEEE Appl. Power Electron. Conf. Expo.*, Orlando, FL, Feb. 5 – 9, 2012, pp. 1104 – 1111.
- [30] V. Lopez, A. Navarro-Crespin, C. Branas, F.J. Azcondo, R. Schnell, R. Zane, “Frequency control and phase surveillance in resonant electronic ballast,” in *Proc. IEEE Ind. Electron. Soc. Annual Conf. (IECON)*, Nov. 7 – 10, 2011, pp. 2929 – 2934.
- [31] Q. Hu, R. Zane, “Off-line LED driver with bidirectional second stage for reduced energy storage,” in *Proc. IEEE Energy Conversion Congress and Exposition (ECCE 2011)*, Phoenix, AZ, Sep. 17 – 22, 2011, pp. 2302 – 2309.
- [32] D. Seltzer, L. Corradini, D. Bloomquist, R. Zane, D. Maksimovic, “Small signal phasor modeling of dual active bridge series resonant DC/DC converters with multi-angle phase shift modulation,” in *Proc. IEEE Energy Conversion Congress and Exposition (ECCE 2011)*, Phoenix, AZ, Sep. 17 – 22, 2011, pp. 2757 – 2764.
- [33] L. Corradini, D. Seltzer, D. Bloomquist, R. Zane, D. Maksimovic, B. Jacobson, “Zero voltage switching technique for bi-directional DC/DC converters,” in *Proc. IEEE Energy Conversion Congress and Exposition (ECCE 2011)*, Phoenix, AZ, Sep. 17 – 22, 2011, pp. 2215 – 2222.
- [34] R. Schnell, R. Zane, F. J. Azcondo, “Improved performance of low frequency square wave ballasts using soft saturation magnetic cores and digital control techniques,” in *Proc. International Power Conversion and Drive Conference (IPCDC)*, St. Petersburg, Russia, June 8 – 9, 2011.

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- [36] L. Corradini, A. Bjeletic, R. Zane, D. Maksimovic, “Specifications-driven design space boundaries for point-of-load converters,” in *Proc. IEEE Appl. Power Electron. Conf. Expo.*, Fort Worth, TX, Mar. 6 – 11, 2011, pp. 1166 – 1173.
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- [40] R. Schnell, R. Zane, “HID lamp driver with phase controlled resonant-mode ignition detection and fast transition to LFSW warm-up mode,” in *Proc. IEEE Workshop on Control and Modeling for Power Electronics, COMPEL 2010*, Boulder, CO, Jun. 2010, pp. 1 – 8.
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- [42] L. Corradini, R. Zane, D. Maksimović, “Fully Digital Hysteretic Modulator for DC-DC Switching Converters,” in press *IEEE Energy Conversion Congress and Exposition*, San Jose, CA, Sep. 2009, pp. 3312 – 3319.
- [43] Q. Hu, R. Zane, “LED drive circuit with series input connected converter cells operating in continuous conduction mode,” in *Proc. IEEE Appl. Power Electron. Conf. Expo.*, Washington, DC, Feb. 2009, pp. 1511 – 1517.
- [44] J. Morroni, R. Zane, D. Maksimovic, “Robust adaptive tuning of digitally controlled switched-mode power supplies,” in *Proc. IEEE Appl. Power Electron. Conf. Expo.*, Washington, DC, Feb. 2009, pp. 240 – 246.
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Patents, Issued

- [1] D. Maksimovic, R. Zane, A. Carosa, “Multi-phase modulator,” US patent #8,384,365, Feb. 2013.
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- [3] C. Hunt, R. Zane, R. Herring, “System and apparatus for cathodoluminescent lighting,” US patent #8,102,122, Jan. 2012.
- [4] J. Morroni, D. Maksimovic, R. Zane, “Monitoring and control of power converters,” US patent #7,956,592, Jun. 2011.
- [5] R. Zane, Z. Popovic, “Systems and methods for receiving and managing power in wireless devices,” US patent #7,956,572, Jun. 2011.
- [6] R. Zane, M. Doshi, “Systems and methods for driving multiple solid-state light sources,” US patent #7,948,468, May 2011.
- [7] C. Hunt, R. Zane, R. Herring, “System and apparatus for cathodoluminescent lighting,” US patent #7,834,553, Nov. 2010.
- [8] R. Zane, “Capacitive coupling to aid ignition in discharge lamps,” US Patent #7,764,023.
- [9] R. Zane, D. Maksimović, Y. Zhang, “Active current sharing multiphase DC-DC converter,” US Patent #7,479,772, Jan. 2009.
- [10] L. Stevanovic, R. Zane, “System and method for regulating resonant inverters,” US patent #7,262,981, Aug. 2007.
- [11] J. Glaser, R. Zane, “Dimmable self-oscillating electronic ballast for fluorescent lamp,” US patent #6,815,908, Nov. 2004.
- [12] J. Glaser, R. Zane, “Non-synchronous control of self-oscillating resonant converters,” US Patent #6,407,514, Jun. 2002.

Patents, Filed, Pending

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- [2] R. Zane, D. Seltzer, D. Maksimovic, B. Jacobson, D. Desrosiers, “Zero voltage switching operation of a minimum current trajectory for a dc-to-dc converter,” US patent application filed, Jun 2015.
- [3] R. Zane, D. Seltzer, D. Maksimovic, B. Jacobson, D. Desrosiers, “Assisted zero voltage switching for a dc-to-dc converter,” US patent application filed, Jun. 2015.
- [4] R. Zane, D. Seltzer, D. Maksimovic, B. Jacobson, D. Desrosiers, “Multi-mode control for a dc-to-dc converter,” US patent application filed, Jun. 2015.
- [5] R. Zane, M. Evzelman, D. Costinett, D. Maksimovic, Y. Levron, R. Anderson, K. Smith, M. Trimboli, G. Plett, “Battery Control,” US paten filed Jan. 2015.
- [6] B. Jacobson, R. Zane, D. Seltzer, “High efficiency zero-voltage switching (ZVS) assistance circuit for power converter,” US patent application filed, Aug. 2013.
- [7] D. Costinett, D. Maksimovic, R. Zane, “Automatic voltage and dead time control in a dual active bridge converter,” US patent application filed, Feb. 2012.

Invited Presentations and Seminars

- [1] R. Zane, “Electrification: Towards a sustainable future for our transportation system,” USU Sunrise Session, Salt Lake City, UT, Jan. 2016
- [2] R. Zane, “Sustainable electrified transportation,” Institute of Transportation Engineers (ITE) Annual Conference, Salt Lake City, UT, Jan. 2016.
- [3] R. Zane, “Center for Sustainable Electrified transportation Systems (SELECT),” USTAR confluence annual conference, Salt Lake City, UT, Sept. 2015.

- [4] R. Zane, “Rush Hour. Transportation solutions for a sustainable urban Salt Lake,” invited panelist, public event at The Leonardo, Salt Lake City, Aug. 2015.
- [5] R. Zane, “USTAR advanced transportation institute,” USTAR confluence annual conference, Salt Lake City, UT, Nov. 3-4, 2014.
- [6] R. Zane, “Vehicle power management: research advances for cost and weight reduction,” Battery Show and Electric & Hybrid Vehicle Technology Conference, Novi, MI, Sep. 15 – 17, 2014.
- [7] R. Zane, “Research directions at the USU Power Electronics Lab (UPEL),” invited presentation, University of Cantabria, Santander, Spain, Jun. 26, 2014.
- [8] R. Zane, “Advances in electrified transportation and power electronics at the USU Power Electronics Lab (UPEL),” USU Foundation Board Meeting, Park City, May 7, 2014.
- [9] R. Zane, “High efficiency energy conversion for next generation energy systems and electronic loads,” National Academy of Engineering (NAE), EU-US Frontiers of Engineering (FOE) Symposium, Beckman Center, Irvine, CA, Nov. 3 – 5, 2011.
- [10] R. Zane, Z. Popovic, “Low power RF energy harvesting,” invited presentation, MIT MTL/MITEI Workshop on Next Generation u-Energy Systems, Cambridge, MA, Dec. 2010.
- [11] Z. Popovic, R. Zane, “Integrated design of power management and RF powering,” invited presentation, *Energy challenges in RFIDs and wireless sensors, European microwave conference*, Paris, France, Sep. 2010.
- [12] R. Zane, D. Maksimovic, “Digital control of SMPS,” invited industry short course, Analog Devices, Inc., Shanghai, China and San Jose, CA, Aug. 2010.
- [13] R. Zane, “Energy harvesting & power electronics,” invited presentation and panel session on energy harvesting, *IEEE Appl. Power Electron. Conf. Expo.*, Palm Springs, CA, Feb. 2010.
- [14] R. Zane, Z. Popovic, “RF energy harvesting: what, where, why and how,” invited presentation, *IDTechEx Energy Harvesting & Storage USA*, Denver, CO, Nov. 2009.
*Hosted an invited laboratory tour for the conference at UCB.
- [15] R. Zane, “Efficient low power energy harvesting for miniature wireless devices,” invited presentation, *CMOS Emerging Technologies Workshop*, Vancouver, BC, Sep. 2009.
- [16] R. Zane, “Efficient power management for low power energy harvesting,” invited presentation, *Darnell nanoPower Forum*, San Jose, CA, May 2009.
- [17] R. Zane, D. Maksimovic, J. Morroni, “Digital control of SMPS,” invited industry short course, Lockheed Martin, Grand Prairie, TX, Mar. 2009.
- [18] R. Zane, “Low Power Energy Harvesting -- Making the Difference with Efficient Power Management,” invited presentation, Future of DC-DC Conversion, IEEE Applied Power Electronics Specialists Conference (APEC), Washington D.C., Feb. 2009.
- [19] R. Zane, “Towards externally powered telemetric chronic neural implants,” invited seminar as part of the NSF international collaboration travel grant, Towards a Dynamic Brain Clamp, Federal University of Ceara, Sobral, Brazil, Jan 2009.
- [20] R. Zane, “Low power energy harvesting for wireless sensors,” Grainger invited seminar series, University of Illinois, Champaign-Urbana, Dec. 2008.
- [21] R. Zane, “Digital control in SMPS,” invited industry short course, On-semiconductor, Toulouse, France, May 2008.
- [22] Z. Popovic, R. Zane, “RF energy harvesting,” invited presentation, *Darnell nanoPower Forum*, San Jose, CA, Jun. 2008.
- [23] R. Zane, “Digital auto-tuning and adaptive techniques for SMPS,” invited seminar, IEEE PELS-IES joint technical session, Santander, Spain, Apr. 2008.

- [24] J. Shin, R. Zane, Z. Popovic, “Batteryless microPower sensors for context aware technologies,” invited presentation, RESNA 2007, sponsored by NSF Emerging Technology – Tools for the Future, Phoenix, AZ, Jun. 2007.
- [25] R. Zane, Z. Popovic, “Efficient low power RF energy harvesting and power management,” invited presentation, *Darnell nanoPower Forum*, San Jose, CA, Jun. 2007.
- [26] R. Zane, “CAREER: Modeling, control and design of energy-efficient lighting systems,” invited presentation, NSF 2004 Grantees workshop, Reno, NV, Apr. 2007.
- [27] R. Zane, D. Maksimović, “Digital control of switch-mode power supplies,” on-site invited industry short course, Analog Devices Inc., San Jose, CA, Jul. 2006.
- [28] R. Zane, D. Maksimović, “Digital control of switched-mode power supplies,” professional educational seminar, *IEEE Applied Power Electronics Conference and Exposition*, Dallas, TX, Mar. 2006.
- [29] R. Zane, Z. Popovic, “Harvesting ambient energy for low power sensors,” invited presentation, *IEEE Presents Innovation and Technology in Colorado*, Colorado Technology Week, Denver, CO, Oct. 2005.
- [30] R. Zane, Z. Popovic, “Batteryless MicroPower Sensors for Context Aware Technologies,” invited presentation, *Annual Coleman Institute Meeting*, Oct. 2005.
- [31] R. Zane, D. Maksimović, B. Miao, “Active identification and automated digital controller design in DC-DC power converters,” invited presentation, *Annual AFRL Space Power Workshop*, Apr. 2005.
- [32] T. Zhao, J. Israel, R. Zane, Z. Popovic, “Electronics for wireless neural sensors,” poster presentation, *Coleman Institute Annual Conference*, Oct. 2004.
- [33] R. Zane, “Digital control in switch mode power supplies,” on-site invited industry tutorial, Artesyn Technologies, Framingham, MA, May 2004.
- [34] D. Maksimović, A. Prodic, R. Zane, “Digital control of high-frequency switching power converters,” professional educational seminar, *IEEE Applied Power Electronics Conference and Exposition*, Anaheim, CA, Feb. 2004.
- [35] D. Restrepo, D. Finch, R. Zane, A. Sharp, “CEMS-based chronic brain implants,” poster presentation, *Coleman Institute Annual Conference*, Oct. 2003.
- [36] R. Zane, D. Maksimović, “Custom IC blocks for enabling digital control in switching power converters,” invited lecture series, *IEEE Solid-State Circuits Society*, Denver chapter, Jul. 2003.
- [37] R. Zane, D. Maksimović, “Digital control in switching converters,” *Annual AFRL Space Power Workshop*, Apr. 2003.
- [38] D. Restrepo, D. Finch, R. Zane, M. Stowell, A. Sharp, “CEMS-based chronic brain implants,” poster presentation, *Coleman Institute Annual Conference*, October 2002.
- [39] D. Maksimović, R. Zane, “Scalable digital control for switching power converters,” invited presentation, *Intel Technology Symposium*, Seattle, Aug. 2002.
- [40] R. Zane, D. Maksimović “Intelligent control in power converters and systems” *DARPA workshop on integrated smart power*, Arlington, VA, Nov. 2002.

RESEARCH GRANTS & CONTRACTS

Research Grants and Contracts Awarded

Department of Energy (DOE), ARPA-E AMPED, “Hybrid energy storage demonstration plus-up, advanced control of large battery packs,” Utah State University (USU). Total: \$500k.

Role: PI, Jan. 2016 – Dec. 2016.

Investigators: **R. Zane** (PI, USU), S. Trimboli (UCCS), D. Maksimovic (UCB), K. Smith (NREL).

USTAR, “Center for Sustainable Electrified Transportation Systems (SELECT),” Utah State University (USU). Total: \$750k. Role: PI, Jul. 2015 – Jun. 2016. Investigators: **R. Zane** (PI, USU), Z. Pantic (USU), J. Quinn (USU), R. Gerdes (USU), R. Sharma (USU), P. Barr, (USU).

Raytheon Integrated Defense Systems, “Analysis and design of series resonant converter (SRC) prototype with digital control,” USU total \$91,927. Role: PI, Jan 2015 – Dec 2015. Investigators: R. Zane (PI, USU).

Department of transportation, “Advance Radar based low ground clearance vehicle detection and warning system,” Intelligent Automation Inc (IAI) prime contractor, subcontract to USU. Role: PI, Sep. 2015 to Mar 2016. USU Total: \$10,350.

Utah State University, “Electric Vehicle and Roadway (EVR) Research Facility and Test Track,” **R. Zane** received \$2.4M award for EVR facility construction and selected as inaugural EVR Director. Construction Aug 2014 – Mar 2015.

Peery Foundation, “Bidirectional three phase power inverter for dual purpose grid tied and grid forming applications,” USU total: \$150,000.
Role: PI, Jan 2015 – Dec 2017. Investigators: **R. Zane** (PI, USU).

Department of Energy (DOE), ARPA-E AMPED, “Tech-to-market plus-up, advanced control of large battery packs,” Utah State University (USU). Total: \$170k.
Role: PI, Jan. 2015 – Dec. 2015.
Investigators: **R. Zane** (PI, USU), S. Trimboli (UCCS), D. Maksimovic (UCB), K. Smith (NREL), D. Anderson (Ford).

Office of Naval Research, “Phase I: Hybrid Energy Storage Modules (HESM), Advanced Bi-Directional Power Conversion (BDPC) System,” subcontract to Raytheon, USU Total: \$110K.
Role: PI, Aug 2014 – Jul 2015.
Investigators: **R. Zane** (PI, USU).

Department of Transportation, “A Novel Multi-Sensor Wireless Network for Bridge Structural Health Monitoring,” subcontract to Intelligent Automation, Inc. (IAI), USU total: \$25K. Jan 2014 – May 2015.
Investigators: **R. Zane** (PI, USU).

National Institute on Disability Rehabilitation Research, RERC-ACT, “Wireless power system for socially interactive robots,” subcontract to University of Colorado, USU total: \$106K. Nov. 2013 – Dec. 2014.
Investigators: **R. Zane** (PI, USU), Z. Pantic (USU), R. Baktur (USU).

Raytheon Integrated Defense Systems, “High Power Series Resonant Converter (SRC) 32 kW prototype,” USU total \$99K. May 2013 – Dec. 2013.
Investigators: **R. Zane** (PI, USU).

Raytheon Integrated Defense Systems, “High Power Series Resonant Converter (SRC) Proof of Concept,” USU total \$30K. May 2013 – Dec. 2013.
Investigators: **R. Zane** (PI, USU).

DARPA, “Hydraulic actuation for micro-scale robots (HAMR),” subcontract to MIT, USU total: \$252K. Role: Co-PI, Mar 2013 – Aug 2015.
Investigators: A. Hosoi (PI, MIT), K. Iagnemma (MIT), **R. Zane** (USU).

Department of Energy (DOE), ARPA-E AMPED, “Robust cell-level modeling and control of large battery packs,” Utah State University (USU) lead, team members: National Renewable Energy Labs (NREL), University of Colorado Boulder and Colorado Springs, Ford. Total: \$3.4M.
Role: PI, Jan. 2013 – Dec. 2015.
Investigators: **R. Zane** (PI, USU), S. Trimboli (UCCS), D. Maksimovic (UCB), K. Smith (NREL), D. Anderson (Ford).

Office of Naval Research, “Support integration and test of power management controller (PMC) for Phase II compact power conversion technology (CPCT) program,” subcontract to Raytheon, USU Total: \$167K.
Role: PI, Aug 2012 – Apr 2013.
Investigators: **R. Zane** (PI, USU).

Department of Energy (DOE), ARPA-E Solar ADEPT, “Wafer-Level Sub-Module Integrated DC/DC Converter,” CU-Boulder (lead), team members Nuvotronics LLC, National Renewable Energy Labs (NREL), Total: \$1.3M.
Role: Co-PI, Nov. 2011 – Oct. 2014.

Investigators: D. Maksimovic (Program PI, UCB), Z. Popovic (Co-PI, UCB), **R. Zane** (Co-PI, UCB), Jean Marc Rollin (Co-PI, Nuvotronics), F. Patrick McCluskey (Co-PI, NREL).

Office of Naval Research, “Compact Power Conversion Technologies (CPCT) ONR Phase II: Bidirectional Power Converter,” subcontract to Raytheon, Total: \$542K. Program split between UCB and USU in 2012.
Role: PI, May 2011 – Dec 2012.

Investigators: **R. Zane** (PI, USU), D. Maksimovic (UCB).

Office of Naval Research, “Support on power converter controls: Compact Power Conversion Technologies (CPCT) ONR Phase I PROGRAM,” subcontract to Raytheon, Total: \$54K.

Role: PI, Jan 2010 – Jun 2010.

Investigators: **R. Zane** (PI, ECE, UCB), R. Erickson (ECE, UCB), D. Maksimovic (ECE, UCB).

Texas Instruments, “Power control and management for ultra high efficiency data servers,” \$264K:

Role: Co-PI, Colorado Power Electronics Center (CoPEC), Jun 2010 – May 2013.

Investigators: D. Maksimovic (PI, ECE, UCB), **R. Zane** (Co-PI, ECE, UCB).

Analog Devices, Inc., “Specifications-driven design space boundaries for point-of-load converters,” Total award: \$44K:

Role: PI, Colorado Power Electronics Center (CoPEC), Jan 2010 – Dec. 2010.

Investigators: **R. Zane** (PI, ECE, UCB), D. Maksimovic (ECE, UCB).

Raytheon Integrated Defense Systems, “Cascade operation of bi-directional power converter (BDPC) using digital control and power factor corrected (PFC) rectifier,” Total: \$18k.

Role: PI, Colorado Power Electronics Center (CoPEC), Jun 2010 – Dec 2010.

Investigators: **R. Zane** (PI, ECE, UCB), D. Maksimovic (ECE, UCB)

Raytheon Integrated Defense Systems, “Power converter controls for 3-phase DC-AC inverter,” Total: \$50k.

Role: PI, Colorado Power Electronics Center (CoPEC), Jan 2010 – Dec 2010.

Investigators: **R. Zane** (PI, ECE, UCB), R. Erickson (ECE, UCB), D. Maksimovic (ECE, UCB)

Department of Education, National Institute on Disability Rehabilitation Research, RERC-ACT, “Non-linear context-aware prompting system for adults with cognitive disabilities in the workplace,” Total: \$1.1M.

Role: co-PI, subcontract to UCD, RERC-ACT “Rehabilitation Engineering Research Center on the Advancement of Cognitive Technologies,” program period: Jan 2010 – Dec 2015.

Investigators: M. Melonis (PI, UCB), **R. Zane** (co-PI, ECE, UCB), Z. Popovic (co-PI, ECE, UCB), A. Mihailidis (co-PI, UCD), S. Van Vuuren (Co-PI, UCB). Prime contract: C. Bodine (PI, Assistive Technology Partners Director, Physical Medicine and Rehabilitation, UCHSC), M. Lightner (ECE, UCB).

Department of Transportation, “A novel multi-sensor wireless network for bridge structural health monitoring,” Total: \$35K, subcontract to Intelligent Automation, Inc.

Role, PI, Jun. 2010 – Jul. 2011.

Investigators: **R. Zane** (ECE, UCB).

Northrop Grumman, “RF energy harvesting system miniaturization,” Total: \$22k.

Role: PI, Colorado Power Electronics Center (CoPEC), Jan 2009 – Dec 2009.

Investigators: **R. Zane** (PI, ECE, UCB), Z. Popovic (ECE, UCB).

On-Semiconductor, “Digitally controlled Class-D audio amplifiers for portable applications,” Total: \$44k

Role: PI, Colorado Power Electronics Center (CoPEC), Jan 2009 – Dec 2009.

Investigators: **R. Zane** (PI, ECE, UCB), L. Corradini (ECE, UCB), R. Erickson (ECE, UCB).

NSF, “Towards a Dynamic Brain Clamp,” International collaboration travel grant, Total: \$30K.

Role: Co-PI; travel grant lead by PI D. Restrepo, UCHSC, UC-Denver; Travel to Federal University of Ceara, Sobral, Brazil, Jan 2009.

Coleman Institute, “Low-power energy harvesting in cognitive disability applications,” Total: \$77K

Sabbatical Faculty Fellowship, Fall 2008 – Spring 2009.

Investigators: **R. Zane** (Co-PI, ECE, UCB), Z. Popovic (Co-PI, ECE, UCB).

MSI/DARPA, “PPeC: Parasitically Powered embedded Communication,” Total: \$88K

Role: Co-PI, subcontract to MicroSat Systems (MSI), Jan 2008 – Dec. 2008.

Investigators: **R. Zane** (Co-PI, ECE, UCB), Z. Popovic (Co-PI, ECE, UCB).

NASA, “Wireless Ultrasonic Transducer Network for Airframe Structure Health Management,” Total:

\$100K, subcontract to Intelligent Automation, Inc.

Role, PI, Jan. 2008 – Dec. 2010.

Investigators: **R. Zane** (ECE, UCB).

NSF, “IREE: Modeling, control and design of energy efficient lighting systems,” Total: \$44.5K

Role: PI, International Research and Education in Engineering (IREE) supplement on NSF CAREER grant. Sep. 2007 – Jun. 2008.

Investigators: **R. Zane** (PI, ECE, UCB).

NSF CNS, “NOSS: An integrated power aware sensor-simulation network system for long-term performance assessment of concrete infrastructures,” Total: \$600K:

Role, Co-PI, Sep. 2007 – Aug. 2010.

Investigators: X.C. Cai (PI, CS, UCB), **R. Zane** (ECE, UCB), Y. Xi (Civil, UCB).

DOE, “Miasolé Solar America Initiative, SAI,” Total: \$1,049,874 (Awarded by DOE, but later withdrawn by Miasole)

Role: Co-PI, DOE SAI, subcontract to Miasolé, Aug. 2007 – Jul. 2010.

Investigators: M. Brandemuehl (PI, CEAE, UCB), R.W. Erickson (ECE, UCB), **R. Zane** (ECE, UCB).

On-Semiconductor, “LED drives for general lighting applications,” Total award: \$88K:

Role: PI, Colorado Power Electronics Center (CoPEC), Jan. 2007 – Dec. 2008.

Investigators: **R. Zane** (PI, ECE, UCB).

National Semiconductor, “System IC controls for backlighting in LCD HDTV,” Total: \$326K:

Role: PI, Colorado Power Electronics Center (CoPEC), Aug. 2003 – July. 2009.

Investigators: **R. Zane** (PI, ECE, UCB).

Powercast Corp., “Integrated design of rectenna and power management circuit,” Total: \$44K:

Role: PI, Colorado Power Electronics Center (CoPEC), Aug. 2007 – July. 2008.

Investigators: **R. Zane** (PI, ECE, UCB), Z. Popovic (ECE, UCB).

Analog Devices, Inc., “Digital control loops in SMPS,” Total award: \$176K:

Role: PI, Colorado Power Electronics Center (CoPEC), Oct. 2006 – Dec. 2009.

Investigators: **R. Zane** (PI, ECE, UCB).

NASA Glenn, “Spacecraft Power Converter Health Monitoring and Prognostics,” Total: \$137K:

Role: PI, program period: Apr. 2006 – Mar. 2009.

Investigators: **R. Zane** (PI, ECE, UCB), D. Maksimović (ECE, UCB).

Astec / Artesyn Technologies, “Auto-tuning controller for POL converters” Total: \$88K

Role: PI, Colorado Power Electronics Center (CoPEC), Jan. 2006 – Dec. 2007.

Investigators: **R. Zane** (PI, ECE, UCB), D. Maksimović (ECE, UCB).

Luna Innovations, “Phase II SBIR: RF Power Scavenging for Wireless Sensors,” Total: \$100K

Role: Co-PI, subcontract to Luna Innovations on US Navy/Air Force SBIR Contract No. N00164-05-C-6088, program period: Nov. 2005 – Mar. 2007.

Investigators: Z. Popovic (PI, ECE, UCB), **R. Zane** (ECE, UCB).

CU TTO, “Energy harvesting for maintenance free operation of wireless devices,” Total: \$100K:

Role: PI, Proof-of-Concept (POC) competition, program period: July 2006 – May 2007.

Investigators: **R. Zane** (PI, ECE, UCB), Z. Popovic (ECE, UCB).

DARPA, “Planer Integrated Power Processor (PIPP),” Total: \$320K:

Role: PI, Phase I: Robust Integrated Power Electronics (RIPE), subcontract to General Electric, program period: Sep. 2005 – Aug. 2009.

Investigators: **R. Zane** (PI, ECE, UCB), D. Maksimović (ECE, UCB).

Intel, “High-frequency digital multi-phase controller and modulator,” Total: \$186K

Role: Co-PI, Colorado Power Electronics Center, program period: Jan 2005 – Dec 2006.

Investigators: D. Maksimović (PI, ECE, UCB), **R. Zane** (ECE, UCB).

Department of Education, “Batteryless power supplies for sensor technologies,” Total: \$150K:

Role: PI, subcontract to UCHSC, RERC-ACT “Rehabilitation Engineering Research Center on the Advancement of Cognitive Technologies,” program period: Jan 2005 – May 2007.

Investigators: Subcontract: **R. Zane** (PI, ECE, UCB). Prime contract: C. Bodine (PI, Assistive Technology Partners Director, Physical Medicine and Rehabilitation, UCHSC), M. Lightner (ECE, UCB).

NSF Faculty Early Career Development (CAREER) Program, “CAREER: Modeling, Control, and Design of Energy-Efficient Lighting Systems,” Total: \$400K + \$6K REU:

Role: PI, program period: Feb. 2004 – Jan. 2010.

Investigators: **R. Zane** (PI, ECE, UCB).

NSF, “SENSORS: Collaborative Research: Self-Configuring In Situ Wireless Sensor Networks for Prescribed Fire Management,” Total: \$300K:

Role: Co-PI, program period: Sept 2003 – May 2007.

Investigators: R. Han (PI, CS, UCB), **R. Zane** (ECE, UCB), L. Queen (School of Forestry, University of Montana), C. Seielstad (School of Forestry, University of Montana).

NASA Glenn Research Center, “Stability Control in PMAD Systems through Power Converter Modules with Direct Digital Control,” Total: \$74K,

Role: PI, program period: Aug 2003 – Nov. 2005.

Investigators: **R. Zane** (PI, ECE, UCB), D. Maksimović (ECE, UCB).

Artesyn Technologies, “Digital control in multiphase converters” Total: \$74K

Role: PI, Colorado Power Electronics Center (CoPEC), Jan. 2003 – Dec. 2005.

Investigators: **R. Zane** (PI, ECE, UCB), D. Maksimović (ECE, UCB)

Coleman Institute, “Feasibility study for CEMS-based chronic brain implants,” Total: \$370K:

Role: Co-PI, program period: Jan 2001 – Dec 2004.

Investigators: D. Restrepo (PI, Cell and Developmental Biology, Director Neuroscience, UCHSC), **R. Zane** (ECE, UCB), A. Sharp (Integrative Physiology, UCB), D. Finch (Mechanical Engineering, UCB).

DOE, “Modeling and IC-Control of High Frequency Electronic Ballasts,” Total: \$154K:

Role: PI, subcontract to General Electric, program period: Aug 2001 – Jul 2004.

Investigators: R. Zane (PI, ECE, UCB).

CoPEC associate memberships, various companies, Total: \$133K:

Role: Co-PI, Zilker Labs, 2003 – 2007, Intersil, 2003 – 2004, Northrop Grumman, 2005 – 2007.

Investigators: R. Erickson, D. Maksimović, **R. Zane** (all Co-PIs, ECE, UCB).

Philips Research, “Development of Solid-State LED Power Supply,” Total: \$30K:

Role: Co-PI, Colorado Power Electronics Center, Aug 2001 – Jul 2002.

Investigators: R. Erickson (PI, ECE, UCB), **R. Zane** (ECE, UCB).

TEACHING ACCOMPLISHMENTS

Educational development and research grants

Department of Energy (DOE), “GATE Center of Excellence, in Innovative Drivetrains in Electric Automotive Technology Education (IDEATE),” joint program with University of Colorado Colorado Springs, Total: \$954K.

Role: PI (for CU-Boulder campus), Oct. 2011 – Sep. 2016.

Investigators: G. Plett (Program PI, UCCS), **R. Zane** (sub-contract PI, UCB/USU), D. Maksimovic (UCB).

Teaching – Courses Taught at Utah State University

- Power Electronics for Electric Drive Vehicles, ECE 5930/6930, 3 credits.
 - Fall 2012, 2013, 2014, 2015: new course co-developed with CU-Boulder as part of the DOE IDEATE GATE Center. Course was offered via distance learning with lectures, assignments and materials shared between USU and CU-Boulder campuses.
- Electric Vehicles Design Lab, ECE 5930/6930, 3 credits (pre-requisite is Power Electronics for Electric Drive Vehicles theory course).
 - Spring 2013: new laboratory course co-developed with visiting instructor, Daniel Costinett.

Teaching – Courses Taught at CU-Boulder

- Electronics Design Laboratory, ECEN 2830, 3 credits.
 - Spring 2011: co-developed and co-taught this new sophomore level laboratory as part of a new undergraduate curriculum development at CU-Boulder. 70 students.
 - Fall 2011: continued course development and taught course. 31 students.
- Renewable Sources and Efficient Electrical Energy Systems, ECEN 2060.
 - Spring 2008: co-developed and co-taught this new sophomore level course as a first step in developing a new curriculum in energy and energy efficiency.
- Circuits / Electronics III, Introduction to Microelectronic Circuits, ECEN 3250, 5 credits, combined lecture and laboratory required core undergraduate course.
 - Fall 2006: 20 undergraduate.
 - Fall 2007: 33 undergraduate enrolled.
 - Received the 2008 John and Mercedes Peebles Innovation in Teaching Award, University of Colorado
 - Fall 2011: 51 students. Developed and taught course as the first version within new undergraduate curriculum as a 3 credit theory course.
- Introduction to Power Electronics, dual-listed ECEN 4797/5797 + online CAETE remote delivery
 - Fall 2001: 19 undergraduate, 20 graduate
 - Fall 2009: 21 undergraduate, 54 graduate
- Power Electronics Laboratory, dual-listed ECEN 4517/5517
 - Spring 2004: 54 undergraduate (lecture included 10 graduate)
 - Spring 2005: 10 graduate
 - Spring 2006: 46 undergraduate (lecture included 16 graduate)
 - Spring 2007: 42 undergraduate and 10 graduate
 - Spring 2008: Co-developed and co-taught a major modification to the laboratory, with the new name: Power Electronics and Photovoltaic Power Systems Laboratory
 - Developed a mobile solar power system cart and re-designed the laboratory experiments to focus on power electronic components in the solar power system.
- Analog IC Design, dual-listed ECEN 4228/5228 – now ECEN 4827/5827 + online CAETE
 - Spring 2002: 12 undergraduate, 22 graduate
 - Spring 2003: 26 undergraduate, 37 graduate
 - Spring 2004: 22 undergraduate, 27 graduate
 - Developed detailed course notes, additional assignments, and adjusted course content to create a two-semester sequence, with Analog IC as a prerequisite for Mixed-Signal IC.
 - Fall 2004: 14 undergraduate, 9 graduate
 - Detailed course notes posted online in place of a formal textbook. Additional changes made to syllabus to coordinate with mixed-signal IC design. Submitted formal course proposals for the two-semester IC design sequence.
 - Fall 2010: 3 undergraduate, 27 graduates

- Mixed-Signal IC Design (new course developed in 2002), ECEN 5018 – Now ECEN 5837
 - Fall 2002: 15 graduate
 - Developed new course in Fall 2002, including detailed course notes (see website, ece.colorado.edu/~ecen5007), assignments, on-line tutorials for Cadence tools, and final project designs. Course notes are used in place of a formal text book.
 - Fall 2003: 22 graduate
 - Spring 2005: 21 graduate
 - Developed new on-line tutorials and two-week design assignments integrating theory and extensive use of CAD tools for complete custom IC design.
 - Spring 2006: 16 graduate
 - Spring 2008: 16 graduate
 - Spring 2010: 5 graduate
- Digital Control in SMPS, Industry Short Course, University of Colorado, Boulder, CO, July 2005, August 2006, August 2007. Enrolled 28 industry participants in two sessions three days each. Instructors: R. Zane, D. Maksimović, B. Miao.
 - Materials on digital control of SMPS from this course have now been integrated into ECEN 5807: Modeling and control of power electronic systems, with detailed notes, tutorials and simulation models posted online: <http://ece-www.colorado.edu/~ecen5807>
- Student evaluations on Faculty Course Questionnaire (FCQ) results for Instructor to date
 - a. *Fall 2006 and on:* 6.0, 5.7, 5.5, 5.4, 5.2, 4.9, 4.3, 4.2 (out of 6)
 - b. *Spring 2006 and before:* 1 A+, 2 A, 1 A-, 4 B+, 3 B

Graduate Final Thesis Examinations – Serving as Primary Advisor

1. Hien Ngyuen, Ph.D., “Design and Control of a Modular Resonant DC-DC Converter for Point-of-Load Applications,” July 2014. Currently at a start-up solar company in CA.
2. Daniel Seltzer, Ph.D., “Modeling and Control of the Dual Active Bridge Series Resonant Converter,” May 2014.
3. Daniel Costinett, Ph.D., “Analysis and Design of High Efficiency, High Conversion Ratio, DC-DC Power Converters,” June 2013. Currently an Assistant Professor of ECE at University of Tennessee, Knoxville.
4. Qingcong Hu, Ph.D., “Techniques to improve LED drivers by reducing voltage stress and required energy storage,” Sep. 2011. Current employed at CREE Semiconductor, Durham, NC.
5. Thurein Paing, Ph.D., “Power management techniques for micropower energy scavenging,” May, 2011. Currently employed at Volterra Semiconductor Corporation, Fremont, CA.
6. Ryan Schnell, Ph.D., “Digital control of LFSW HID lamp drivers with soft saturation magnetic materials and integrated resonant lamp ignition,” August, 2010. Currently employed at Analog Devices, Longmont, CO.
7. Jeffery Morroni, Ph.D., “Adaptive tuning and monitoring of digitally controlled switched mode power supplies,” October, 2009. Currently employed at National Semiconductor Corporation, Santa Clara, CA and Longmont, CO.
8. Mariko Shirazi, Ph.D., “Embedded frequency response measurement capability for monitoring and tuning of system dynamics in digitally-controlled DC-DC converters,” September, 2009. Currently employed at the National Renewable Energy Lab (NREL), Golden, CO.
9. Montu Doshi, Ph.D., “Power control architectures for CCFL and HBLED based light sources,” August, 2009. Currently employed at National Semiconductor Corporation, Longmont, CO.
10. Arseny Dolgov, M.S. Thesis, “Power management system for online low power RF energy harvesting optimization,” May 2009. Currently employed at Ball Aerospace, Boulder, CO.
11. Yang Zhang, Ph.D., “Digital control in modular masterless multiphase microprocessor power supplies,” August, 2006. Currently employed at National Semiconductor Corporation in Santa Clara, CA.
12. Yan Yin, Ph.D., “Modeling and IC control of electronic ballasts,” June 2004. Currently employed at National Semiconductor Corporation in Longmont, CO.

13. Preeti Bhandarkar, M.S. Thesis, “Design of a low-power sigma-delta A/D converter for chronic brain implants,” April 2004.

Current Graduate Students – Serving as Primary Advisor (paid as RA or Fellowship)

1. Mohamed Ahmed Kamel, Ph.D. candidate, entered Jan. 2016.
2. Anindya Bagchi, Ph.D. candidate, entered Aug. 2015.
3. Anindya Ray, Ph.D. candidate, entered Aug. 2015.
4. Tarak Saha, Ph.D. candidate, entered Aug. 2014, co-advised with Prof. Pantic.
5. Hongjie Wang, Ph.D. candidate, entered Aug. 2014.
6. Ahmed Azad, Ph.D. candidate, entered program Aug. 2013, co-advised with Prof. Pantic.
7. Muhammad Muneeb, Ph.D. candidate, entered program Aug. 2013.
8. Warren Chen, Ph.D. candidate, entered program Aug. 2013.

Past Graduate Students, Non-Thesis MS – Serving as Primary Advisor

1. Aaron Mattmiller, M.S. graduate, Aug. 2010.
2. Jiyeon Choi, M.S. graduate, May 2010.
3. Jim Patterson, M.S. graduate, May 2008.
4. Jeffrey Israel, M.S. graduate, May 2007.
5. Michael Weimer, M.S. graduate, May 2006.
6. Tony Carosa, M.S. graduate, Spring 2006.
7. Kevin Lybarger, M.S., expected graduation: May 2007.
8. Steve Scroggs, M.S. graduate, Fall 2005.
9. Sandra Johnson, M.S. graduate, Spring 2004.
10. Jonathan Gray, M.S. graduate, Fall 2002.

Undergraduate Students Advised and Independent Study

1. Justin Jones, BS student, research on bidirectional power supplies, Jan 2014 – 2015.
2. William Balling, BS student, research on high voltage, low power, pulse generation circuit for piezoelectric structural health monitoring systems, Jan 2014 – 2015.
3. Justin Cox, BS student, research on high voltage, low power pulse power supply design for solid-state pumps and valves, May 2013 – present.
4. Kelly Hathaway, MS/BS student, research on bidirectional DC-DC converter modules for battery management systems in electric vehicles. May 2013 – 2015.
5. Kevin Kennedy, BS student, research on digital control of bidirectional resonant power converters, Aug 2012 – 2015.
6. Douglas Bloomquist, BS student, research on low power wireless sensor networks and energy harvesting, DLC apprentice, Aug. 2009 – Aug. 2010. Continued on as a graduate research assistant.
7. Daniel Costinett, BS student, research on low power energy harvesting for wireless sensors, DLC apprentice, Aug. 2008 – 2009. Continued as a Ph.D. student.
8. Daniel Seltzer, MS/BS student, research on low power piezo-electric element drive circuit for aircraft wing integrity monitoring, Mar. 2008 – 2009. Continued as a Ph.D. student.
9. Adam Bierman, MS/BS student, research on energy efficient lighting systems, Sep 2007 – present. Sponsored by NSF REU and IREE supplements, including international exchange in Spain.

10. Ryan Dolan, MS/BS student, research on lighting electronics, Jun 2007 – Dec. 2007.
11. Carey Davis, BS student, research on energy efficient lighting systems, DLC apprentice, Jan 2007 – May 2008.
12. Michael Weimer, MS/BS student, independent study in 2005 on harvesting power and electronics design for NSF Sensors project: Fire sensors.
13. Arseny Dolgov, B.S. candidate, research work on an NSF REU project in lighting electronics and on a Coleman Foundation project on wireless sensors, graduation: May 2007.
 - a. Received the **Dean's Outstanding Graduate for Research** award, May 2007.
14. Eric Hicks, independent study project, "A/D converter design and Cadence software tutorial development," Fall 2002.
15. Deirdre Lynch, independent study project, "Electronics 4 laboratory," Fall 2002.
16. Andrew Kowles, independent study project, "Analysis of resonant LCC circuits," Spring 2002.

Postdoctoral Researchers Advised

1. Dr. Shijie Zhou, Jun 2015 – present.
2. Dr. Mehmed Celebi, Sep 2015 – present.
3. Dr. Michael Evzelman, Sep 2013 – present.
4. Dr. Tuba Yilmaz, Nov 2013 – Dec 2014.
5. Dr. Sara Dadras, Nov 2012 – Jun 2013.
6. Dr. Victor Manuel Lopez Martin, Jun 2012 – Dec 2012.
7. Dr. Luca Corradini, Jun 2009 – Dec 2011.
8. Dr. Botao Miao, Jun 2004 – Dec 2006.

SERVICE ACTIVITIES

Service – Conference Committees, Session Chair or Co-chair, other Outside Service

1. Associate Editor, IEEE Transactions on Power Electronics, Jan. 2006 – present.
2. Associate Editor, IEEE Journal of Emerging and Selected Topics in Power Electronics, 2013 – present.
3. General Co-Chair, Conference on Electric Roads and Vehicles, 2015 and 2016.
4. IEEE Power Electronics Society (PELS), Administrative Committee (AdCom)
 - a. Elected member-at-large, Jan 2008 – Jan 2011
 - b. Appointed as society Publicity Chair, 2010 – 2014
 - c. Attend all meetings (~3 per year at leading conferences), participate in e-mail discussions and society voting (~1 topic every two to three weeks)
5. IEEE Standards Committee, PAR 1789, "Recommending practices for modulating current in High Brightness LEDs for mitigating health risks to viewers," Dec. 2008 – present.
 - a. Participate in monthly teleconferences and online web forum discussions.
6. IEEE Applied Power Electronics Conference and Exposition (APEC) conference committee member (2001 – present)
 - a. *2005 Topic Chair for "General Electrical Design"*: responsible for assigning reviewers for ~80 paper submissions and organizing associated conference sessions.
 - b. *2005 and 2006 Web Content Editor*: responsible for soliciting and editing website content
 - c. Session chairman every year since 2005.
7. IEEE Power Electronics Specialists Conference (PESC) committee member (2001 – 2010)
 - a. Session chairman, 2004, 2005, 2006, 2008.
8. IEEE Power Electronics Society (PELS) committees
 - a. Simulation, Modeling, and Control Committee member (2003 – 2009)

- i. Elected committee vice-chair (Dec 2006), secretary (July 2005)
 - b. Power & Control Core Technologies committee member
 - c. Power Conversion Systems and Components member
 - d. Sustainable Energy Systems member
9. IEEE Workshop on Control and Modeling for Power Electronics (COMPEL)
 - a. Program Chair & Treasure, COMPEL 2014, University of Oviedo, Spain
 - b. Program Chair, COMPEL 2010, hosted at the University of Colorado, Boulder, CO
 - c. Session Chairman, 2006 – present.
10. IEEE Energy Conversion Congress & Exposition (ECCE)
 - a. Participate annually in reviews and serve as session chair since first conference, 2009 – present.
 - b. Participated as 2016 Topic Vice Chair, Emerging Technologies and Applications.
11. IEEE Industrial Electronics Society Annual Conference (IECON) 2001 Session Chairman (two sessions)
12. Society memberships
 - a. IEEE Power Electronics Society
 - b. IEEE Industrial Applications Society
 - c. IEEE Industrial Electronics Society
 - d. IEEE Circuits and Systems Society
 - e. IEEE Solid State Circuits Society
 - f. IEEE Electron Devices Society
 - g. American Society of Naval Engineers

Service – Major Internal, Utah State University

- College of Engineering undergraduate research committee, 2013 – present.
- ECE department graduate studies committee, 2013 – present.
- Faculty search committee chair, 2012 – 2013
 - a. Led faculty search for a power / power electronics systems area faculty in the ECE department.
- Director, Center for Sustainable Electrified transportation (SELECT), 2015 – present.
 - a. Founded new multi-campus research center, secured USTAR and industry funding, developed legal framework, organized industry board

Service – Major Internal, University of Colorado Boulder

- Faculty search committee chair, 2011 – 2012
 - a. Led faculty search for energy engineering area faculty in the ECEE department.
- Undergraduate curriculum committee, 2010 – 2012
 - a. Participate in weekly department committee meetings and provide materials and updates on curriculum for circuits, electronics and power courses.
- Curriculum development
 - a. Participated in new curriculum development teams for analog courses (3 core circuits courses, new sophomore Electronics Design Lab, and sophomore elective on renewable energy)
- Course assessment teams, 2004 – 2008
 - a. Team member, ECEN 3250, Circuits III
 - b. Team member, ECEN 3100 Digital Logic
- Internal review committee, 2003
 - a. Participated in department review meetings, reviewed final committee report, participated in discussions with external review board
- Graduate studies committee, 2001-2010
 - a. Participate annually in graduate student admissions, departmental teaching assistant (TA) offers and fellowships; periodic meetings on graduate studies and curriculum
- Chairman, power area Ph.D. preliminary examination committee
 - a. Committee chairman in 2002, 2005, 2007; committee member in 2003, 2004, 2006.

- Colorado power electronics center (CoPEC) faculty member
 - a. Assist in hosting annual CoPEC industry sponsor meeting and laboratory exposition and coordinate weekly group meetings with student presentations
 - b. Participate in student recruiting, curriculum development, and lab management

Service – Journal and Conference Paper Reviews

- IEEE Journal of Emerging and Selected Topics in Power Electronics (~2 papers per year)
- IEEE Transactions on Power Electronics (full papers and letters) (~ 6 papers per year)
- IEEE Journal of Solid-State Circuits (~ 2 papers per year)
- IEEE Transactions on Circuits and Systems, Parts I & II (~ 2 papers per year)
- IEEE Industrial Applications Society Transactions (~ 1 paper per year)
- IEEE Transactions on Industrial Electronics (~1 paper per year)
- IEEE Transactions on Microwave Theory and Techniques (~1 paper per year)
- IEEE Energy Conversion Congress & Exposition (ECCE) (~ 10 papers per year)
- IEEE Applied Power Electronics Conference (APEC) (~ 10 papers per year)
- IEEE Transportation Electrification Conference & Expo, ITEC (~10 papers per year)
- IEEE Workshop on Control and Modeling for Power Electronics (COMPEL) (~10 papers per year)
- IEEE International Symposium on Circuit and Systems (ISCAS) (~ 10 papers per year)
- IEEE International Symposium on Industrial Electronics (ISIE) (~ 2 papers per year)

Service – Consulting Positions

- Jan 2015 – present. Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P., on behalf of Koninklijke Philips N.V. and Philips Lighting North America Corporation. Patent consultant.
- Jan 2012 – Dec 2013. Institute for Defense Analysis (IDA). Selected as member of the 2012-2013 Defense Sciences Study Group (DSSG), US Defense Advanced Research Projects Agency (DARPA).
- Feb 2010 – Aug. 2011. Friedman, Suder & Cooke, patent consultant. Served as an expert witness on electronic ballast case, including expert report, deposition, and testimony at trial.
- May 2008 – present: Intelligent Automation Inc., low power piezo-electric driver design consultant.
- Nov 2008 – Nov 2009: Cymbet Corporation, low power energy harvesting design consultant.
- Jun. 2006 – Nov 2009: Telegen / Vu1, electronic ballast design consultant.
- Oct. 2005 – Mar. 2007: Luna Innovations, low power management design consultant.
- Aug. 2005 – Dec. 2005: Intertainment, low power management design consultant.
- June 2005 – Dec. 2006: Intelligent Automation Inc., power converter design consultant.
- Dec. 2004 – May 2005: Cooley Godward LLP, patent consultant.
- Nov. 2004 – Jan 2005: ITU Ventures, technology consultant.
- Nov. 2004 – Dec. 2006: Winstead Sechrest & Minick P.C., patent consultant.
- May 2004: Zilker Labs, consultant on digital control and custom IC design in power converters.
- May 2004: Artesyn Technologies, 3-day short course on digital control in switching power converters.
- 2002 – 2005: Jet Propulsion Labs, University of Washington, Neptune Project Power Group Review Committee

- 2001 – 2005: General Electric Global Research, consulting on application of digital and custom mixed-signal IC controls in lighting electronics and related applications