

STEPHEN SCHULTZ

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EDUCATION

1999 Georgia Institute of Technology Atlanta, GA

Ph.D. Electrical Engineering

- Dissertation Title: High Efficiency Volume Grating Coupler

1994 Brigham Young University Provo, UT

M.S. Electrical Engineering

- Thesis title: Resonant Tunneling Analysis of Slab Waveguides

1992 Brigham Young University Provo, UT

B.S. in Electrical Engineering

COURSE TAUGHT

New Student Seminar (ECEn191)

Circuits (ECEn240)

Electronic Circuit Design 1 (ECEn340)

Fields and Waves (ECEn360)

Transmission Lines for High-Speed Digital Systems (ECEn 362)

Junior Design Project (ECEn 390)

Electromagnetic Radiation and Propagation (ECEn 462)

Optical Engineering (ECEn 466)

Senior Design Project (ECEn490)

Optical Communication Components and Systems (ECEn 562)

Advanced Optical Engineering (ECEn 661)

PROFESSIONAL EXPERIENCE

Professor (2014-Present)

Department of Electrical Engineering, Brigham Young University, Provo, UT

- Supervise and guide undergraduate and graduate research projects
- Manage optical fiber research program

Associate Professor (2008-Present)

Department of Electrical Engineering, Brigham Young University, Provo, UT

- Supervise and guide undergraduate and graduate research projects
- Manage optical fiber research program

Assistant Professor (2002-2008)

Department of Electrical Engineering, Brigham Young University, Provo, UT

- Teach undergraduate and graduate students
- Supervise and guide master's and doctorate students' thesis work

- Supervise and guide undergraduate research and senior level projects
- Establish and direct Optical Fiber Device research program

Consultant (2003-2004)

L-3 Communications, Communications Systems West, Salt Lake City, UT

- Analyzed the advantages and disadvantages of free space laser communications for air-to-air, air-to-satellite, and air-to-ground.
- Analyzed atmospheric propagation of lasers.

Senior Staff Engineer (1999-2002)

Raytheon Missile Systems, Tucson, AZ

- Performed optical design and stray light analysis on various passive infrared imaging missile seekers and active laser radar systems.
- Supplied support for the testing of the optical performance of existing missile seekers
- Contributed to various internal research and development programs including: hyper-spectral imaging, photonic bandgap structures applied to radar missiles, and other classified work.

Graduate Research Assistant (1994-1999)

Department of Electrical Engineering, Georgia Institute of Technology, Atlanta, GA

- Developed computer simulation code for analysis of gratings
- Built and tested sub-micron period surface-relief and volume gratings.
- Designed, built, and tested a guided wave optical interconnect

Graduate Internship (Apr. 1997-June 1997)

Motorola's Phoenix Applied Research Center, Tempe, AZ

- Investigated the application of diffractive optics onto vertical cavity surface emitting lasers for use in the commercial parallel optical interconnect system OPTOBUS™.

PUBLICATIONS AND PATENTS

Archival Journal Publications

1. K. Oman, B. Van Hoe, K. Aly, K. Peters, G. Van Steenberge, N. Stan, and S. Schultz, "Instrumentation of Integrally Stiffened Composite Panel with Fiber Bragg Grating Sensors for Vibration Measurements," *Smart Materials and Structures*, 24, 1-14, 2015.
2. F. Seng, N. Stan, C. Josephson, R. King, L. Shumway, R. Selfridge, and S. Schultz, "A Push-Pull Slab Coupled Optical Sensor (SCOS) for measuring electric fields in a vibrational environment," *Appl. Opt.*, 54, 5203-5209, 2015.
3. B. Whitaker, J. Noren, D. Perry, S. Schultz, R. Selfridge, R. Forber, W. Wang, and J. Schleher, "The Application of SCOS for HPM Field Measurements," *J. Directed Energy*, 5 (2014), 219-236.
4. Chadderdon, Spencer, LeGrand Shumway, Andrew Powell, Ailin Li, Daniel E. Austin, Aaron R. Hawkins, Richard H. Selfridge, and Stephen M. Schultz. "Ion Trap Electric Field Characterization Using Slab Coupled Optical Fiber Sensors." *Journal of The American Society for Mass Spectrometry* 25, no. 9 (2014): 1622-1627.

5. Stan, Nikola, D. C. Bailey, S. L. Chadderdon, S. Webb, M. Zikry, K. J. Peters, R. H. Selfridge, and S. M. Schultz. "Increasing dynamic range of a fibre Bragg grating edge-filtering interrogator with a proportional control loop." *Measurement Science and Technology* 25, no. 6 (2014): 065206.
6. S Webb, P Shin, K Peters, M A Zikry, N Stan, S Chadderdon, R Selfridge, and S Schultz, Characterization of fatigue damage in adhesively bonded lap joints through dynamic, full-spectral interrogation of fiber Bragg grating sensors. 1 Experiments" *Smart Materials and Structures*, vol. 23 no. 2, 2014
7. S. Webb, P. Shin, K. Peters, M. A. Zikry., N. Stan., S. Chadderdon, R. Selfridge and S. Schultz, "Characterization of fatigue damage in adhesively bonded lap joints through dynamic, full-spectral interrogation of fiber Bragg grating sensors: 2. Simulations," *Smart Mat. And Struct.*, vol. 23, 1-10, Feb. 2014. doi:10.1088/0964-1726/23/2/025017
8. B. Whitaker, J. Noren, S. Chadderdon, W. Wang, R. Forber, R. Selfridge, and S. Schultz, "Slab coupled optical fiber sensor calibration," *Review Scientific Instrumentation*, vol. 84, No. 2, 023108, Feb. 2013.
9. "Full-spectral interrogation of fiber Bragg grating sensors exposed to steady-state vibration," *Exper. Mechanics*, vol. 53, No. 4, Apr. 2013.
10. S. Chadderdon, D. Perry, L. Woodard, R. Selfridge, and S. Schultz, "Single tunable laser interrogation of slab-coupled optical sensors through resonant tuning," *Appl. Opt.*, vol. 52, No. 12, 2682-2687, Apr. 2013.
11. D. Perry, S. Chadderdon, R. Forber, W. Wang, R. Selfridge, and S. Schultz, "Multiaxis electric field sensing using slab coupled optical sensors, *Appl. Opt.*, vol. 52, No. 9, 1968-1977, Mar. 2013.
12. S. Webb, K. Peters, M. Zikry, S. Chadderdon, N. Stan, R. Selfridge, and S. Schultz, "Full-Spectral Interrogation of Fiber Bragg Grating Sensors Exposed to Steady-State Vibration," *Experimental Mechanics*, 1-18, Aug. 2012.
13. S. Webb, K. Peters, M. Zikry, T. Vella, S. Chadderdon, R. Selfridge, and S. Schultz, "Wavelength hopping due to spectral distortion in dynamic fiber Bragg grating sensor measurements," *Meas. Sci. Technol.*, vol. 22, p. 065301, May 2011.
14. B. Shreeve, R. Gibson, D. Perry, R. Selfridge, S. Schultz, R. Forber, W. Wang, and J. Luo, "Nonintrusive field characterization in interior cavities with slab-coupled optical sensor," *J. Directed Energy*, vol. 4, p. 136-146, Winter 2010.
15. S. Chadderdon, R. Gibson, R. Selfridge, S. Schultz, W. Wang, R. Forber, J. Luo, and A. Jen, "Electric-field sensors utilizing coupling between a D-fiber and an electro-optic polymer slab," *Appl. Opt.*, vol. 50, p. 3505-3512, Jul. 2011.
16. Benjamin Todd, Brian D. Jensen, Stephen M. Schultz, Aaron R. Hawkins, "Design and Testing of a Thin-Flexure Bistable Mechanism Suitable for Stamping From Metal Sheets," *J. Mechanical Design*, vol. 132, p. 1-7, Jul. 2010.
17. Tao Shang, Eric Teng, Adam T. Woolley, Brian A. Mazzeo, Stephen M. Schultz, and Aaron R. Hawkins, "Contactless conductivity detection of small ions in a surface micro-machined CE chip," *Electrophoresis*, vol. 31, p. 2596-2601, Aug. 2010.
18. T. Vella, S. Chadderdon, R. Selfridge, S. Schultz, S. Webb, C. Park, K. Peters, and M. Zikry, "Full-spectrum interrogation of fiber Bragg gratings at 100 kHz for detection of impact loading," *Measurement Science and Technology*, vol. 21, p. 1-6, Sept. 2010.

19. C. Park, K. Peters, M. Zikry, T. Haber, S. Schultz, and R. Selfridge, "Peak wavelength interrogation of fiber Bragg grating sensors during impact events," *Smart Mater. Struct.*, vol. 19, p. 1-7, Mar. 2010.
20. A. Propst, K. Peters, M. A. Zikry, S. Schultz, W. Kunzler, Z. Zhu, M. Wirthlin, R. Selfridge, "Assessment of damage in composite laminates through dynamic, full-spectral interrogation of fiber Bragg grating sensors", *Smart Mater. Struct.*, vol 19, Structures and Materials, p. 1-11, Jan. 2010.
21. J. Kvavle, S. Schultz, and R. Selfridge, "Ink-jetting AJL8/APC for D-fiber electric field sensors," *Appl. Opt.*, vol. 48, p. 5280-5286, Oct. 2009.
22. B. Todd, M. Phillips, S. Schultz, A. Hawkins, and B. Jensen, "Low cost RFID shock sensors," *IEEE Sensors Journal*, vol. 9, No. 4, p. 464-469, Apr. 2009.
23. R. Gibson, R. Selfridge, and S. Schultz, "Electric field sensor array from cavity resonance between optical D-fiber and multiple slab waveguides," *Appl. Opt.*, vol. 48, no. 19, p. 3695-3701, Jul. 2009.
24. S Schultz, W Kunzler, Z Zhu, M Wirthlin, R Selfridge, A Propst, M Zikry and K Peters, "Full-spectrum interrogation of fiber Bragg grating sensors for dynamic measurements in composite laminates," *Smart Materials and Structures*, vol. 18, p. 115015, Sept. 2009.
25. C. Carron, M. Phillips, B. Phillips, L. Parks, S. Schultz, and A. Hawkins, "Photo-definable microchannels made with spin-on polymers and short sacrificial etch times," *Microfluidics and Nanofluidics*, vol. 7, p. 283-289, Jan. 2009.
26. J. Kvavle, S. S. Schultz, and R. H. Selfridge, "Low loss elliptical core D-fiber to PANDA fiber fusion splicing," *Opt. Expr.*, 2008.
27. T. L. Lowder, J. A. Newman, W. M. Kunzler, J. D. Young, R. H. Selfridge, and S. M. Schultz, "Temporal response of surface-relief fiber Bragg gratings to high temperature CO2 laser heating," *Appl. Opt.*, vol. 47, 3568-3573, Jul. 2008.
28. R. Gibson, R. Selfridge, S. Schultz, W. Wang, and R. Forber, "Electro-optic sensor from high Q resonance between optical D-fiber and slab waveguide," *Appl. Opt.*, vol. 47, No. 13, p. 2234-2240, May 2008.
29. H. Liu, A. R. Hawkins, S. M. Schultz, and T. E. Oliphant, "Fast nonlinear image reconstruction for scanning impedance imaging," *IEEE Trans. Biomed. Eng.*, Vol. 55, 970-977, Mar. 2008.
30. J. D. Gordon, T. L. Lowder, R. H. Selfridge, and S. M. Schultz, "Optical D-Fiber based volatile organic compound sensor," *Appl. Opt.*, vol. 46, p. 7805-7810, Nov. 2007.
31. Brian G. Buss*, Daniel N Evans*, Hongze Liu, Tao Shang, Travis E Oliphant, Stephen M Schultz, and Aaron R Hawkins, "Quantifying Resistivity Using Scanning Impedance Imaging," *Sensors and Actuators: A. Physical*, vol. 137, p. 338-344, 2007.
32. E. K. Johnson, J. M. Kvavle, R. H. Selfridge, S. M. Schultz, R. Forber, W. Wang, and D. Y. Zang, "Electric field sensing with a hybrid polymer/glass fiber," *Appl. Opt.*, vol. 46, p. 6953-6958, Oct. 2007.
33. T. L. Lowder, R. H. Selfridge, and S. M. Schultz, "Surface relief D-fiber Bragg gratings for high-temperature and multidimensional bend sensing," *Materials Evaluation*, vol. 65, pp. 1042-1047, Oct. 2007.
34. B J Hansen, C J Carron, B D Jensen, A R Hawkins, and S M Schultz "Plastic latching accelerometer based on bistable compliant mechanisms," *Smart Materials and Structures*, vol. 16, p. 1967-1972, Oct. 2007.

35. T. L. Lowder, J. D. Gordon, S. M. Schultz, and R. H. Selfridge, "Volatile organic compound sensing using a surface-relief D-shaped fiber Bragg grating and a polydimethylsiloxane layer," *Opt. Lett.*, vol. 32, p. 2523-2525, Sep. 2007.
36. R. H. Selfridge, S. M. Schultz, and A. R. Hawkins, "Free-space optical link as a model undergraduate design project," *IEEE Trans. Educ.*, vol. 50, p. 208-215, Aug. 2007.
37. Hongze Liu, Aaron R. Hawkins, Stephen M. Schultz, and Travis E. Oliphant, "Verification and application of a finite-difference model for quasi-electrostatic scanning impedance imaging," *Electrostatics*, vol. 65, pp. 244-250, Apr. 2007.
38. Seth W. Lloyd, Jason A. Newman, Daniel R. Wilding, Richard H. Selfridge, and Stephen M. Schultz, "A fiber sensor integrated monitor for embedded instrumentation systems," *Rev. of Sci Instrum.*, vol. 78, pp. 35108, Apr. 2007.
39. Tyson L. Lowder, Brian R. Tebbs, Richard H. Selfridge, Stephen M. Schultz, "Polarization analysis of surface relief D-fiber Bragg gratings," *Appl. Opt.*, vol. 46, pp. 2387-2393, May 2007.
40. R. Gibson, J. Ktavle, R. Selfridge, and S. Schultz, "Improved sensing performance of D-fiber/planar waveguide couplers," *Opt. Express* **15**, 2139-2144 (2007)
<http://www.opticsinfobase.org/abstract.cfm?URI=oe-15-5-2139>
41. Travis E. Oliphant, Hongze Liu, Aaron Hawkins, and Stephen Schultz, "Simple linear models of scanning impedance imaging for fast reconstruction of relative conductivity of biological samples," *IEEE trans. Biomed. Eng.*, vol. 53, pp. 2323-2332, Nov. 2006.
42. K. H. Smith, B. L. Ipson, T. L. Lowder, A. R. Hawkins, R. H. Selfridge, and S. M. Schultz, "Surface relief fiber Bragg gratings for sensing applications," *Appl. Opt.*, vol. 45, 1669-1675, Mar. 2006.
43. K. J. Campbell, J. C. Morine, Z. A. George, C. P. Lusk, L. L. Howell, S. M. Schultz, and A. R. Hawkins, "Polymer Stretching to Produce Flat Suspended Micro-Membranes," *J. Microlith., Microfab., Microsyst.*, vol. 4, pp. 1-6, Oct. – Dec. 2005.
44. T. L. Lowder, K. H. Smith, B. L. Ipson, A. R. Hawkins, R. H. Selfridge, and S. M. Schultz, "High temperature sensing using surface relief fiber Bragg gratings," *IEEE Photon. Techn. Lett.*, vol. 17, pp. 1926-1928, Sep. 2005.
45. J. Henrie, E. Parsons, A. R. Hawkins, and S. M. Schultz, "Spectrum Sampling Reflectometer," *Surface Interface Analysis*, vol. 37, p. 568-572, Apr. 2005.
46. Aaron Hawkins, R. Wang, G. Sanber, J. Beutler, and S. Schultz, "Color Pictures Using Dielectric Films," *Color Res. and Appl.*, vol. 30, p. 125-129, Apr. 2005.
47. K. Smith, B. Ipson, R. Selfridge, and S. Schultz, "Versatile in-fiber sensing using core-replaced D-fiber," *Appl. Opt.*, Vol. 44, p. 22-26, Jan. 2005.
48. B. Green, T. Shang, J. Morine, H. Liu, S. Schultz, T. Oliphant, A. Hawkins, "Resolution scaling in noncontact scanning impedance imaging," *Rev. Sci. Instr.*, vol. 75, p. 4610-14, Nov. 2004.
49. J. Ktavle, C. Bell, J. Henrie, S. Schultz, and A. Hawkins, "Improvement to reflective dielectric film color pictures," *Opt. Expr.*, vol. 12, p. 5789-5794, Nov. 2004.
50. A. Hawkins, H. Liu, T. Oliphant, and S. Schultz, "Noncontact scanning impedance imaging in an aqueous solution," *Appl. Phys. Lett.*, vol. 85, p. 1080-1082, Aug. 2004.
51. J. Henrie, S. Kellis, S. Schultz, and A. Hawkins, "Electronic color charts for dielectric films on silicon," *Opt. Exp.*, vol. 12, pp. 1464-1469, Apr. 2004.

52. Kevin H. Smith, Doug J. Markos, Stephen M. Schultz, Richard H. Selfridge, Thomas D. Monte, and Richard B. Dyott, "Fabrication and analysis of a low-loss in-fiber polymer waveguide," *Appl. Opt.*, vol. 43, pp. 933-939, Feb. 2004.
53. Kevin H. Smith, Richard H. Selfridge, Stephen M. Schultz, Douglas J. Markos, and Benjamin L. Ipson, "Analysis of replacing and optical fiber core with polymer," *Opt. Exp.*, vol. 12, pp. 354-360, Feb. 2004.
54. Aaron R. Hawkins, Ran Wang, Mark Lowther, and Stephen M. Schultz, "Teaching Microfabrication Based Materials Processing Using Color Pictures From Dielectric Films," *Journal of Materials Education*, vol. 25, p. 179-188, (2003).
55. Douglas J. Markos, Benjamin L. Ipson, Kevin H. Smith, Stephen M. Schultz, Richard H. Selfridge, Thomas D. Monte, Richard B. Dyott, and Gregory Miller, "Controlled core removal from a D-shaped optical fiber," *Appl. Opt.*, vol. 42, pp. 7121-7125, Dec. 2003.
56. S. M. Schultz, E. N. Glytsis, and Thomas K. Gaylord, "Design, Fabrication, and Performance of Preferential-Order Volume Grating Waveguide Couplers," *Appl. Opt.*, vol. 39, p. 1223-1232, Mar 2000.
57. S. M. Schultz, E. N. Glytsis, and Thomas K. Gaylord, "Volume Grating Preferential-Order Focusing Waveguide Coupler," *Opt. Lett.*, vol. 24, p. 1708-1710, Dec. 1999.
58. S. M. Schultz, T. K. Gaylord, E. N. Glytsis, "Design of a High-Efficiency Volume Grating Coupler for Line Focusing," *Appl. Opt.*, vol. 37, p. 2278-2287, Apr. 1998.

CONFERENCE PROCEEDINGS

1. F. Seng, N. Stan, S. Chadderdon, C. Josephson, R. King, L. Shumway, R. Selfridge, and S. Schultz, "Optical Electric Field Sensor using Push-Pull for Vibration Noise Reduction," in *Optical Fiber Communication Conference*, 2015.
2. N. Stan, R. Selfridge, S. Schultz, "High electric field measurement using slab coupled optical sensors," *Proc. SPIE*, vol. 9480, Apr. 2015.
3. R. King, N. Stan, F. Seng, R. Selfridge, S. Schultz, "Measuring arc dynamics using a slab coupled optical sensor (SCOS)." *Circuits and Systems (MWSCAS), 2015 IEEE 58th International Midwest Symposium on. IEEE*, 2015.
4. L. Shumway, N. Stan, R. King, R. Selfridge, S. Schultz, "High voltage measurements using slab coupled optical sensors (SCOS)." *Circuits and Systems (MWSCAS), 2015 IEEE 58th International Midwest Symposium on. IEEE*, 2015.
5. Webb, Sean, Kara Peters, Mohammed Zikry, Nikola Stan, Spencer Chadderdon, Richard Selfridge, and Stephen Schultz. "Fiber Bragg grating spectral features for structural health monitoring of composite structures." In *OFS2014 23rd International Conference on Optical Fiber Sensors*, pp. 9157A3-9157A3. International Society for Optics and Photonics, 2014.
6. Bram Van Hoe, Kyle Oman, Kara Peters, Geert Van Steenberge, Nikola Stan, and Stephen Schultz, "High-Speed Interrogation of Multiplexed Fiber Bragg Gratings Enabling Real-Time Visualization of Dynamic Events Such as Impact Loading," *Proc. IEEE Sensors Conf.*, Nov. 2014.
7. Nikola Stan, Spencer Chadderdon, Richard H. Selfridge, and Stephen M. Schultz "Non-intrusive high voltage measurement using slab coupled optical sensors," *Proc. SPIE*, vol. 9062, p. 90620J-90620J, Mar. 2014.
8. Shumway, L., S. Chadderdon, A. Powell, A. Li, D. Austin, A. Hawkins, R. Selfridge, and S. Schultz. "Ion trap electric field measurements using slab coupled optical sensors." *Proc. SPIE*, vol. 9062, pp. 90620I-90620I, Mar. 2014.

9. Webb, Sean, Kyle Oman, Kara Peters, Nikola Stan, Spencer Chadderdon, Richard Selfridge, and Stephen Schultz. "Localized measurements of composite dynamic response for health monitoring." *Proc. SPIE*, vol. 9062, pp. 906206-906206, Mar. 2014.
10. Schultz, S. M., R. Selfridge, S. Chadderdon, D. Perry, and N. Stan. "Non-intrusive electric field sensing." *Proc. SPIE*, vol. 9062, pp. 90620H-90620H, Mar. 2014.
11. (0) S. Webb, P. Shin, K. Peters, R. Selfridge, and S. Schultz, "Nondestructive inspection of CFRP adhesively bonded joints using embedded FBG sensors," *Proc. SPIE*, vol. 8722, May 2013.
12. (0) N. Stan, D. Bailey, S. Chadderdon, R. Selfridge, S. Schultz, S. Webb, K. Peters, and M. Zikry, "High dynamic range high sensitivity FBG interrogation," *Proc. SPIE*, vol. 8694, Mar. 2013.
13. (2) S. Webb, P. Shin, K. Peters, M. A. Zikry, S. Chadderdon, N. Stan, R. Selfridge, and S. Schultz, "Characterization of fatigue damage in adhesively bonded lap joints through dynamic, full-spectral interrogation of fiber Bragg grating sensors," *Proc. SPIE*, vol., Mar. 2013.
14. (0) R. Selfridge, S. Chadderdon ; S. Schultz, L. Woodard, and D. Perry, "Improvements in electric field sensor sensitivity by exploiting a tangential field configuration," *Proc. SPIE*, vol. 8693, Mar. 2013.
15. (0) D. Bailey, N. Stan, S. Chadderdon, D. Perry, S. Schultz, and R. Selfridge, "Dynamic shape sensing using a fiber Bragg grating mesh," *Proc. SPIE*, vol. 8693, Mar. 2013.
16. (0) S. Webb, K. Peters, M. A. Zikry, S. Chadderdon, R. Selfridge, and S. Schultz, "Full spectral interrogation of fiber Bragg grating sensors for measurements of damage during steady-state vibration," *Proc. SPIE*, vol. 8346, Mar. 2012.
17. N. Stan, S. Chadderdon, R. Selfridge, S. Schultz, S. Webb, K. Peters, and M. Zikry, "High-speed full-spectrum interrogation of fiber Bragg grating sensor application in reducing sensor strain sensitivity," *Proc. SPIE*, vol. 8347, Mar. 2012.
18. (3) S. Chadderdon, D. Perry, J. Van Wagoner, R. Selfridge, and S. Schultz, "Multi-Axis, All-Dielectric Electric Field Sensors," *Proc. SPIE*, vol. 8376, May 2012.
19. S. Chadderdon, R. Selfridge, S. Schultz, S. Webb, C. Park, K. Peters, M. Zikry, "High-speed full-spectrum fiber Bragg grating interrogator system and testing," *Proc. SPIE*, vol. 7753, May 2011.
20. S. Webb, A. Noevere, K. Peters, M. Zikry, T. Vella, S. Chadderdon, R. Selfridge, and S. Schultz, "Full-spectral interrogation of fiber Bragg gratings sensors for damage identification," *Proc. SPIE*, vol. 7982, Mar. 2011.
21. J. Noren, R. Selfridge, and S. Schultz, "Interrogation systems for slab coupled optical fiber sensors," vol. 7982, Mar. 2011.
22. (1) D. Perry, S. Chadderdon, R. Gibson, B. Shreeve, R. Selfridge, S. Schultz, W. Wang, R. Forber, and J. Luo, "Electro-optic polymer electric field sensor," vol. 7982, Mar. 2011.
23. B. Shreeve, R. Selfridge, S. Schultz, C. Gaeta, and R. Forber, "Magnetic field sensing using D-fiber coupled Bi:RIG slab," *Proc. SPIE*, vol. 7753, May 2011.

24. R. Selfridge, S. Schultz, J. Kvavle, T. Lowder, and R. Gibson, "Multi-use D-fiber sensors," Proc. SPIE, vol. 7982, p. Mar. 2011.
25. (2) S. Schultz, R. Gibson, and R. Selfridge, "Slab Coupled Optical Fiber Electric Field Sensors," Proc. 12th International Conference on Engineering, Science, Construction, and Operation in Challenging Environments, 2010.
26. (1) S. Webb, K. Peters, M. Zikry, T. Vella, S. Chadderdon, R. Selfridge, and S. Schultz, "Impact induced damage assessment in composite laminates through embedded fiber Bragg gratings," Proc. SPIE, vol. 7648, p. 76404, Mar. 2010.
27. (4) D. Perry, R. Gibson, B. Shreeve, S. Schultz, and S. Selfridge, "Multi-axial fiber-optic electric field sensor," Proc. SPIE, vol. 7648, p. 76480D, Mar. 2010.
28. S. Chadderson, T. Vella, R. Selfridge, S. Schultz, S. Webb, C. Park, K. Peters, and M. Zikry, "High-speed full-spectrum interrogation of fiber Bragg gratings for composite impact sensing," Proc. SPIE, vol. 7648, p. 744803, Mar. 2010.
29. (4) A. Propst, K. Peters, M. Zikry, W. Kunzler, Z. Zhu, M. Wirthlin, R. Selfridge, and S. Schultz, "Dynamic, full-spectral interrogation of fiber Bragg grating sensors for impact testing of composite laminates," Proc. SPIE, vol. 7503, Oct. 2009.
30. (2) W. Kunzler, Z. Zhu, M. Wirthlin, R. Selfridge, S. Schultz, A. Propst, K. Peters, M. Zikry, "High repetition-rate full-spectrum interrogation of FBG sensors for dynamic measurements in composite laminates," Proc. SPIE, vol. 7293, Mar. 2009.
31. (12) R. S. Gibson, R. H. Selfridge, S. M. Schultz, "Electric-field sensor array from cavity resonance between optical D-fiber and multiple slab waveguides," Proc. SPIE 7293, Mar. 2009.
32. R. Gibson, R. Selfridge, and S. Schultz, "Non-intrusive Field Characterization in Interior Cavities with Slab Coupled Optical Sensor (SCOS)," Directed Energy Professional Society, San Antonio, TX 2009.
33. S. Schultz, "Optical fiber sensors using D-fiber," US China Workshop on Optical Fiber Sensor Research, Development and Applications, Wuhan, China, 2009.
34. (3) W. Kunzler, J. Newman, D. Wilding, Z. Zixu, T. Lowder, R. Selfridge, and S. Schultz, "Advanced FBG sensing through rapid spectral interrogation," Proc. SPIE, vol. 6933, 69330D, Mar. 2008.
35. (0) J. D. Young, T. L. Lowder, R. H. Selfridge, and S. M. Schultz, "Packaging of surface relief fiber Bragg gratings for harsh high temperature environments," Proc. SPIE, vol. 6933, p. 693308, Mar. 2008.
36. R. Gibson, R. Selfridge, S. Schultz, "Electro-optic sensor from high-Q resonance between optical D-fiber and slab waveguide," Proc. CLEO, p. 1-2, May 2008.
37. (2) W. Kunzler, Z. Zhu, R. Selfridge, S. Schultz, M. Wirthlin, "Integrating fiber Bragg grating sensors with sensor networks," Proc. IEEE AUTOTESTCON, p. 354 – 359, Sep. 2008.
38. B. Todd, M. Phillips, S. Schultz, A. Hawkins, B. Jensen, "RFID threshold accelerometer," IEEE AUTOTESTCON, p. 55-59, Sept. 2008.

39. S. M. Schultz, "Teaching Fourier Optics using MATLAB," *Proc. SPIE*, vol. 6695, 2007. (invited paper)
40. W. Kunzler, J. Newman, D. Wilding, R. Selfridge, S. Schultz, and M. Wirthlin, "Accelerating an integrated FOS system for flight on a small UAV," *Proc. SPIE*, vol. 6530, Mar. 2007.
41. B. Hansen, C. Carron, S. Schultz, and A. Hawkins, "Zero-power shock sensors using bistable compliant mechanisms," *Proc. SPIE*, vol. 6525, Mar. 2007.
42. E. Johnson, R. Selfridge, and S. Schultz, "Electric field sensor based on core-replaced optical D-fiber," *Proc. SPIE*, vol. 6525, Mar. 2007.
43. J. Gordon, S. Schultz, and R. Selfridge, "In-situ monitoring of volatile organic compounds using a single-mode D-fiber and polydimethylsiloxane-evanescent field interaction," *Proc. SPIE*, vol. 6525, Mar. 2007.
44. (17) R. Gibson, J. Kivavle, R. Selfridge, and S. Schultz. "Improved sensing performance of D-fiber/planar waveguide couplers." In *Integrated Photonics and Nanophotonics Research and Applications*. Optical Society of America, 2007.

45. (1) T. Lowder, B. Tebbs, S. Schultz, and R. Selfridge, "Multi-axis bend sensing using a single surface relief fiber Bragg grating," *Optical Sensors Conference*, Oct. 2006.
46. J. Newman, S. Schultz, R. Selfridge, "A fiber sensor integrated monitor for embedded instrumentation systems," *Proc. Intern. Telem. Conf.*, Oct. 2006.
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PROFESSIONAL ACTIVITIES

Research Funding

Project Name	Period	Funding Source	Role	Total Grant
Optical fiber sensors for nonintrusive voltage measurements in HPM targets	2013-2016	Office of the Secretary of Defense	PI	\$719k
Electric Field Sensors for Railgun Applications	2010-2011	Office of the Secretary of Defense	PI	\$141k
Advanced Magnetic Field Sensing	2009-2011	Office of the Secretary of Defense	PI	\$231k
Electric Field Sensor System	2009	Office of Naval Research (ONR)	PI	\$35k

Project Name	Period	Funding Source	Role	Total Grant
Full spectral interrogation of fiber Bragg grating sensors for damage identification	2009-2012	National Science Foundation (NSF)	PI	\$148k
Advanced Polymer Optical Sensors (APOS)	2008-2011	Office of the Secretary of Defense	PI	\$360k
MRI: Acquisition of chlorine based reactive ion etcher	2007	National Science Foundation (NSF)	Co-PI	\$300k
D-fiber sensors in harsh environments	2007-2009	Office of the Secretary of Defense	PI	\$356k
D-fiber surface relief gratings	2006-2007	Harris Corporation	PI	\$35k
Impedance measurement of micro-fluidic channels	2006	BYU	Co-PI	\$15k
Impedance Measurement of Micro-Fluidic Channels	2006 - 2007	BYU	Co-PI	\$12k
Compact integrated monitoring system for fiber sensors	2004-2005	Office of the Secretary of Defense	PI	\$164
MEMS display elements based on optical interference	2004-2005	BYU	PI	\$5k
An optical fiber high-speed survivable transducer for high power microwaves	2004-2007	Office of the Secretary of Defense	PI	\$297k
Nanosopic Imaging Based on Optical Tomography	2003	BYU	Co-PI	\$10k
D-fiber for multidimensional sensor applications	2003-2004	Office of the Secretary of Defense	PI	\$116k
IMMERSE – Intensive Mentoring and Research in Micro-Electronics for Students in Engineering	2003 - 2013	BYU	PI	\$220k
D-fiber Tunable Filters	2002-2003	BYU	PI	\$14k
Phase Mask Recording of Diffractive Components	2002-2003	BYU	PI	\$11k

Project Name	Period	Funding Source	Role	Total Grant
				\$3.03 M

Undergraduate Research Program

Together with Prof. Aaron Hawkins of BYU's Electrical and Computer Engineering Department, I initiated the Intensive Mentoring and Micro-Electronic Research for Students in Engineering (IMMERSE) program in 2003. Its goal is to prepare students for entry into top tier graduate programs and provide them an opportunity to author or co-author a technical paper. Each year approximately 15 undergraduate students participate in the program that involves one-on-one training by faculty and senior students, imbedding students into existing research projects, and assigning each student an independent project. Students are offered full time employment in the summer and part time employment during the school year. Funding is provided by an existing BYU mentoring program, MICRON Corp., and through external research grants.

IMMERSE Highlights:

- 180 Students employed since 2003
 - > 80% of students have authored or co-authored a technical paper
 - > 75% of students have pursued graduate degrees
- <http://www.immerse.byu.edu>

Web Based Reference Tools

An effort was begun in 2003 to provide on-line instructions for the tools in BYU's cleanroom facility, the Integrated Microfabrication Laboratory. This work rapidly expanded to include basic reference information on semiconductors, microfabrication, and equipment operation, including tutorials and interactive calculators and graphs. This information is now contained at the following website: www.cleanroom.byu.edu and contains over 250 separate pages of information. The site receives over 70,000 hits per month from external visitors who use it as an essential reference. A companion site was launched in 2005 dedicated to providing reference information on photonics topics: www.ee.byu.edu/photonics. This site contains over 100 separate pages and receives 20,000 hits per month from external visitors. Most of the HTML coding is done by students participating in the IMMERSE program.

Outreach Activities

Under the frame work of the IMMERSE program, I coordinated the development of various outreach activities. These include the development of various demonstrations that have been used at Engineering Week, New Student Orientation, and Open Major Fair. We also worked with the Multicultural Center at BYU to introduce under-represented minority students to engineering through hands on activities every summer as part of the Summer Of Academic Refinement (www.immerse.byu.edu/soar.phtml). I have also helped develop a summer engineering camp for junior high school aged students called Chip Camp (chipcamp.ce.byu.edu).

Curriculum Development

- Increased amount of optics taught
 - Developed a graduate course called Advanced Optical Engineering (ECE661)

- Developed a senior level course called Optical Engineering (ECE466)
- Developed a senior design project related to optics called Free Space Optical Communications (ECE490). The development of this project resulted in a journal publication (IEEE Trans. on Education)
- Developed a senior design project called Laser Tag (ECE490)
- Developed a senior level class on power electronics
- Developed an Introduction to Electrical and Computer Engineering course. This development included writing a book, developing Flash based online activities and the transition of the book over to an eBook format.
- Developed a coordinated curriculum for the junior year that is called Junior Core. This new curriculum will be fully implemented in the Fall Semester of 2014. In this curriculum the students will build a laser tag system.

Students Graduated

MS Students: 7

PhD Students: 4