Curriculum Vitae:

Ronald J. Triolo, Ph.D.
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CURRENT POSITIONS:

August 1994 - Present

Assistant Professor
Departments of Orthopaedics and Biomedical Engineering
Case Western Reserve University
11100 Euclid Avenue
Cleveland OH 44106

Principal Investigator
Cleveland VA Center of Excellence in FES
11000 Cedar Ave.
Cleveland, OH 44106
(216) 791-3800 ext. 5808 (voice)
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November 1997 - Present

Bioscientific Staff
Department of Orthopaedics
Rehabilitation Engineering Center
MetroHealth Medical Center
2500 MetroHealth Drive
Cleveland, OH 44109-1998
(216) 778-7877 (voice)
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November, 1999 - Present

Director, Motion Study Laboratory
Louis B. Stokes Department of Veterans Affairs Medical Center
11701 East Blvd.
Cleveland, OH 44106
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EDUCATION:

Ph.D.	Biomedical Engineering 1986, Drexel University, Philadelphia PA
M.S.	Electrical Engineering 1984, Drexel University, Philadelphia PA
M.S.	Biomedical Engineering 1982, Drexel University, Philadelphia PA
B.S.	Electrical Engineering 1980, Villanova University, Villanova PA

HONORS AND AWARDS:

Associate Editor, *IEEE Transactions on Rehabilitation Engineering*, 1999 - present
Editorial Board, *Journal of Rehabilitation Research and Development*, 1999 - present

Editorial Board, *Journal of Electromyography and Kinesiology*, 1994 - present
Assistant Editor, *IEEE Transactions on Rehabilitation Engineering*, 1993 - 1999
Professional Achievement Award, Villanova University, 1992
Selected to Sigma Xi, Scientific Research Society, 1984
Calhoun Fellow, Drexel University, 1981-1983
Presidential Scholar, University of Pennsylvania, 1980
Rhode's Scholarship Candidate
Summa Cum Laude Graduate, Villanova University, 1980
Who's Who in American Colleges and Universities, 1980
Dean's Award for Academic Excellence, Villanova University, 1980
Dean's Award for Meritorious Service, Villanova University, 1980
Outstanding Engineer Award, Villanova University, 1978-1980
Presidential Scholar, Villanova University, 1976-1980

RESEARCH AND RELEVANT PROFESSIONAL EXPERIENCE:

October, 1995 - September, 1996
Director of Research, Health Hill Hospital for Children
2801 Martin Luther King Jr. Drive, Cleveland, OH
Developed independent research program in pediatric neurological rehabilitation focusing on children with central cord syndrome and spastic athetosis, cerebral palsy. Facilitated research proposal design from staff physicians, psychologists and physical/occupational therapists. Coordinated activity and administration of the Institutional Review Board. Responsible for educational programs on research design and clinical uses of functional electrical stimulation.

August, 1986 - August, 1994
Director of Research, Philadelphia Unit of Shriners Hospitals
Clinical Assistant Professor, Department of Orthopaedic Surgery
Temple University, Philadelphia PA
Responsible for conducting research in the application of functional neuromuscular stimulation to children with spinal cord injuries or cerebral palsy. Implemented and evaluated systems to control standing and walking with stimulation in children with paraplegia (or spastic diplegia), and to provide active grasp and release in children with tetraplegia (or spastic quadriplegia). Organized and coordinated interdisciplinary team of engineers and therapists to assess the physiological effects of stimulation and functional outcomes of upper and lower extremity systems. Supervised graduate students in Biomedical Engineering or Physical Therapy from local universities. Included one year post-doctoral study at Case Western Reserve University and the Department of Veterans Affairs Medical Center.

October, 1983 - August, 1986
Biomedical Engineer
Veterans Administration Medical Center
Philadelphia, PA

Responsible for the design, software realization and engineering evaluation of digital myo-electric signal processors. Developed a digital controller for an actively powered, volitional above-knee prosthesis.

September, 1981 - 1986
Biomedical Engineer and Research Assistant
Gait Analysis Laboratory
Moss Rehabilitation Hospital, Philadelphia, PA
Conceived and executed research investigating the nature of electromyographic signals and their application to prosthetic control. Successfully demonstrated several techniques to detect the direction and estimate the magnitude of motions of the lower extremity.

PROFESSIONAL SOCIETY MEMBERSHIPS:

ASIA: American Spinal Injury Association
NSCIA: National Spinal Cord Injury Association
RESNA: Rehabilitation Engineering Society of North America (officer 1998-2000))
GCMAS: Gait and Clinical Movement Analysis Society
EMBS: Engineering in Medicine and Biology Society
IEEE: Institute of Electrical and Electronic Engineers
IFESS: International Functional Electrical Stimulation Society
Tau Beta Pi: Engineering Honor Society
Eta Kappa Nu: Electrical Engineering Honor Society
Phi Kappa Phi: National Honor Society
Sigma Xi: Scientific Research Society

GRANTS HELD:

1. "Exercise, Standing and Ambulation with Implanted FES Systems," Rehabilitation Research and Developments Service, Department of Veterans Affairs. April 2002 – March 2005 ($1,212,000) **Principal Investigator** – SUBMITTED.
2. "Implantable FES for Control of the Extremities in Spinal Cord Injury," Rehabilitation Research and Development Service, Department of Veterans Affairs. January 2002 – December 2004 ($903,900). Co-investigator with P. Hunter Peckham.
3. "Development of a Networked Implantable Neuroprosthesis," National Institutes of Health (NINDS), June 2001-May 2006 ($7,990,021). Co-investigator with P. Hunter Peckham
4. "Pressure Sore Prevention Using Neuromuscular Electrical Stimulation," Rehabilitation Research and Development Service, Department of Veterans Affairs. April 2001 – March 2004 ($337,200) **Principal Investigator**.
5. "Collaborative Evaluation of an Implanted Neuroprosthesis for Standing Transfers," Rehabilitation Research and Development Service, Department of Veterans Affairs. April 2001 – March 2003 ($100,000) **Principal Investigator**.
6. "Design and Performance Considerations for Using Stimulating Nerve Cuff Electrodes in Motor System Neuroprostheses," CWRU Presidential Research Initiative. January 2001 – December 2001 ($50,000). Co-Investigator with J.A. Davis Jr., M.D. and J. Thomas Mortimer, Ph.D.

7. "Automatic Control of Standing Balance with Functional Electrical Stimulation," R01, National Institutes of Health (NINDS), September 2000 – July 2003 ($859,925) **Principal Investigator**.
8. "Preparatory Adjustments for Improved Standing with FNS," R01, National Institutes of Health (NCHHD), June 2000 – May 2003 ($588,488). Co-Investigator with J. Abbas, University of Kentucky.
9. "Improving Tissue Viability of Paralyzed Muscle with NMES," Spinal Cord Research Foundation/Paralyzed Veterans of America, March 2000 – February 2001 ($40,257), **Principal Investigator**.
10. "Individualizing the Design and Use of a FES-based Standing Neuroprosthesis," Rehabilitation Research and Development Service, Department of Veterans Affairs, April 2000 – March 2003 ($449,716). Co-Investigator with R. Kirsch.
11. "Implantable FNS Systems for Standing and Transfers," US Food and Drug Administration Office of Orphan Product Development, October 1999 – September 2002 ($818,359). **Principal Investigator**.
12. "Exercise, Standing and Ambulation with Implanted FES Systems," Rehabilitation Research and Development Service, Department of Veterans Affairs. January 1999 – December 2001 ($1,088,723), **Principal Investigator**.
13. Paraplegic Walking Made Practical with FNS and Orthoses," R01, National Institutes of Health (NINDS/NCHHD), June 1998 – May 2001. ($1,252,929) Co-investigator with E.B. Marsolais.
14. "Improving Tissue Viability of Paralyzed Muscle Using Neuromuscular Electrical Stimulation," Spinal Cord Research Foundation/Paralyzed Veterans of America, March 1997 – May 1999 ($108,312), **Principal Investigator**.
15. "Unassisted Standing by Functional Neuromuscular Stimulation," National Institutes of Health, NINDS Neural Prosthesis Program, October 1996 – September 2001 ($1,065,727). **Principal Investigator**.
16. "Implantable FNS Systems for Standing Transfers," Food and Drug Administration Office of Orphan Product Development, October 1996 – September 1999 ($385,552). **Principal Investigator**.
17. "FES Mobility in Paraplegia: RF Controlled Implanted System," Research and Development Service, Department of Veteran Affairs, April 1995 – March 1998. Co-investigator with E.B. Marsolais
18. "Paraplegic Walking Made Practical with FNS & Orthoses," R01, National Institutes of Health (NINDS/NCHHD), April 1994 – May 1997 ($1,189,049). Co-Investigator with E.B. Marsolais.
19. "Restoration of Standing Pivot Transfer for Quadriplegic Patients Using a Totally Implanted FNS System," Research and Development Service, Department of Veterans Affairs, April 1993 – March 1996 ($271,519). **Principal Investigator**.
20. "Development of Grasp and Upper Extremity Control with Functional Neuromuscular Stimulation in Children," Shriners Hospitals, January 1992 – December 1994 ($1,637,223). **Principal Investigator**.
21. "Functional Neuromuscular Stimulation of the Lower Extremities in Children with Spinal Cord Injuries," Shriners Hospitals, January 1992 – December 1994 ($3,757,476). **Principal Investigator**.

22. "Application of Artificial Neural Networks to Control FNS-Generated Walking in Children with Spinal Cord Injuries," Shriners Hospitals, January 1992 – December 1994 ($135,000). Co-Investigator with J. Abbas.
23. "Voluntary Postural Responses During FNS-Induced Standing," Shriners Hospitals 1990-1993 ($135,000). Co-Investigator with M. Moynahan.
24. "Development of Grasp and Upper Extremity Control with Functional Neuromuscular Stimulation in Children," Shriners Hospitals 1989-1991 ($335,306). **Principal Investigator**.
25. "Functional Neuromuscular Stimulation of the Lower Extremities in Children with Spinal Cord Injuries," Shriners Hospitals 1989-1991 ($1,598,792). **Principal Investigator**.
26. "Functional Neuromuscular Stimulation of the Lower Extremities in Children with Spinal Cord Injuries," Shriners Hospitals 1986-1989 ($1,101,190). Co-investigator with R. Betz.
27. "Myoelectrically Controlled Above-Knee Prosthesis," Veterans Administration, 1984-1986 ($348,000). Co-investigator with G. Moskowitz and H. Hillstrom.
28. "Adaptive Spatial Pattern Recognition and Time Series Signal Analysis Techniques for Myoelectric Control of Lower Limb Prostheses," National Science Foundation 1984-1986 ($333,000). Co-investigator with G. Moskowitz and H. Hillstrom.

PUBLICATIONS:

Peer-Reviewed Papers (Submitted)

1. "Consumer Perspectives on Mobility: Implications for Neuroprosthesis Design," D.L. Brown-Triolo, M.J. Roach, **R.J. Triolo**, K Nelson. *Journal of Rehabilitation Research & Development* – (submitted April 2001).

Peer-Reviewed Papers (Published or Accepted for Publication)

1. "Preliminary Performance of a Surgically Implanted Neuroprosthesis for Standing and Transfers - Where Do We Stand?" J.A. Davis, **R.J. Triolo**, J.P. Uhlir, C. Bieri, L. Rohde, D. Lissy. *Journal of Rehabilitation Research & Development* 38(6): 609-617, 2001.
2. "Introduction to the Single Topic Issue on Functional Electrical Stimulation." **R. J. Triolo**, *Journal of Rehabilitation Research & Development* 38(6): vi-ix, 2001.
3. "Effects of Active Hip Extension Moment and Posture on Upper Extremity Support Forces During FNS-Induced Standing." **R.J. Triolo**, M.A. Wibowo, J.P. Uhlir, R. Kobetic, R.F. Kirsch. *Journal of Rehabilitation Research & Development* 38(5): 545-555, 2001.
4. "Selectivity of Intramuscular Stimulating Electrodes in the Lower Extremities." **R.J. Triolo**, M.Q. Liu, R. Kobetic, J.P. Uhlir. *Journal of Rehabilitation Research & Development* 38(5): 533-544, 2001.
5. "A Reusable, Self-Adhesive Electrode for Intra-Operative Stimulation in the Lower Extremities." **R.J. Triolo**, J.D. Moss, N. Bhadra. - *Journal of Rehabilitation Research & Development* 38(5): 527-532, 2001.
6. "Preface to the Special Millennium Paper Issue on Functional Electrical Stimulation," **R. Triolo**, R. Kirsch. *Neuromodulation* 4(4):139-141, 2001.
7. "Modeling the Postural Disturbances Caused by Upper Extremity Movements," **R.J. Triolo**, K.N. Werner, R.F. Kirsch. *IEEE Transactions on Rehabilitation Engineering* 9(2): 1-8, 2001.

8. "Surgical Technique for Installing an 8-Channel Neuroprosthesis for Standing," JA Davis, **R.J. Triolo**, J.P. Uhlir, N. Bhadra, D.A. Lissy, S. Nandurkar, E.B. Marsolais. *Clinical Orthopaedics and Related Research* 2001(4): 237-252, 2001.
9. "Architecture of the Rectus Abdominis, Quadratus Lumborum, and Erector Spinae." S. Delp, S. Suryanarayanan, W. Murray, J. Uhlir and **R. Triolo**. *Journal of Biomechanics* 34(3): 371-375, 2001.
10. "Implications of Hip Subluxation for FES-Assisted Mobility in Patients with Spinal Cord Injury," R. Betz, **R.J. Triolo**, M.J. Mulcahey, J. McCarthy, B.T. Smith. *Orthopaedics* 24(2):181-184, 2001.
11. "The Use of Selective Stimulation of the Quadriceps to Improve Standing Function in Paraplegia," J.P. Uhlir, **R.J. Triolo**, R. Kobetic. *IEEE Transactions on Rehabilitation Engineering*. 8(4): 514-522, 2000.
12. "Electrical Stimulation: Current Practice and Emerging Concepts – Introduction to the Special Issue of Assistive Technology on Electrical Stimulation." **R.J. Triolo**. *Assistive Technology* 12(1): 2-5, 2000.
13. "Neuromuscular Stimulation for Motor Neuroprostheses in Hemiplegia." J. Chae, **R. Triolo**, K. Kilgore, and D. Yu. *Critical Reviews in Physical Medicine and Rehabilitation* 12: 1-23, 2000.
14. "Implanted Functional Electrical Stimulation System for Mobility in Paraplegia: A Follow-up Case Report." R. Kobetic, **R.J. Triolo**, J. Uhlir, C. Bieri, M. Wibowo, G. Polando, E. B. Marsolais, J.A. Davis, K. Ferguson, M. Sharma. *IEEE Transactions on Rehabilitation Engineering* 7(4): 390-398, 1999.
15. "Walking with a Hybrid Orthosis System." K. Ferguson, G. Polando, R. Kobetic, **R.J. Triolo**, E.B. Marsolais. *Spinal Cord (formerly Paraplegia)* 37: 800-804, 1999.
16. "Lower Extremity Applications of Functional Neuromuscular Stimulation after Spinal Cord Injury," **R.J. Triolo**, K. Bogie. *Topics in SCI Rehabilitation* 5(1): 44-65, 1999.
17. "Implantation of a 16-Channel Functional Electrical Stimulation Walking System." M. Sharma, E.B. Marsolais, G. Polando, **R.J. Triolo**, J.A. Davis, N. Bhadra, J. Uhlir. *Clinical Orthopaedics and Related Research.* 347: 236-242, 1998.
18. "Clinical Perspectives on Neuromuscular Stimulation in Children with Incomplete Spinal Cord Injuries." **R.J. Triolo**. *Pediatric Physical Therapy*. 9(3): 139-143, 1997.
19. "Muscle Selection and Walking Performance of Multichannel FES Systems for Ambulation in Paraplegia." R. Kobetic, **R.J. Triolo**. *IEEE Transactions on Rehabilitation Engineering*. 5(1): 23-29, 1997.
20. "Experimental Evaluation of an Adaptive Feedforward Controller for Use in Functional Neuromuscular Stimulation Systems." J.J. Abbas, **R.J. Triolo**. *IEEE Transactions on Rehabilitation Engineering* 5(1): 12-22, 1997.
21. "Motor Responses to FES Electrodes in a Growing Limb," J.M. Akers, **R.J. Triolo**, R.R. Betz. *IEEE Transactions on Rehabilitation Engineering.* 4(4): 243-250, 1996.
22. "Implanted FNS Systems for Assisted Standing and Transfers for Individuals with Cervical Spinal Cord Injuries: Clinical Case Reports," **R.J. Triolo**, C. Bieri, J. Uhlir, R. Kobetic, A. Scheiner, E.B. Marsolais. *Archives of Physical Medicine & Rehabilitation*. 77(11): 1119-1128, 1996.
23. "The Bone Mineral Content of Children with Spinal Cord Injury." M. Moynahan, R.R. Betz, **R.J. Triolo**, A. Mauer. *Journal of Spinal Medicine.* 19(4):249-254, 1996.

24. "Home Use of a FES System for Standing and Mobility in Adolescents with Spinal Cord Injury." M. Moynahan, C. Mullin, J. Cohn, C.A. Burns, E.E. Halden, **R.J. Triolo**, R.R. Betz. *Archives of Physical Medicine & Rehabilitation* 77(10):1005-1013, 1996.
25. "Challenges to Clinical Deployment of Upper Extremity Neuroprostheses," **R.J. Triolo**, R. Nathan, Y. Handa, M. Keith, R. Betz, S. Carroll, K. Kantor. *Journal of Rehabilitation Research and Development* 33(2):111-122, 1996.
26. "Effects of Functional Neuromuscular Stimulation on the Joints of Adolescents with Spinal Cord Injury." R. Betz, B. Boden, **R.J. Triolo**, M. Mesgarzadeh, E. Gardner, R. Fife. *Paraplegia* 34:127-136, 1996.
27. "Inter-rater Reliability of a Clinical Test of Standing Function," **R.J. Triolo**, G. Eisenhower, T. Stabinski, D. Wormser. *Journal of Spinal Cord Medicine*, 18(1):13-21, 1995.
28. "Application of Functional Neuromuscular Stimulation to Children with Spinal Cord Injuries: Candidate Selection for Research Applications," **R.J. Triolo**, R.R. Betz, M.J. Mulcahey, E.R. Gardner. *Paraplegia,* 32: 824-43, 1994.
29. "Reliability of Percutaneous Intramuscular Electrodes for Upper Extremity Functional Neuromuscular Stimulation in Adolescents with Tetraplegia," B.T. Smith, R.R. Betz, M.J. Mulcahey, **R.J. Triolo**. *Archives of Physical Medicine and Rehabilitation*, 75: 939-45, 1994
30. "Functional Neuromuscular Stimulation: Outcomes in Young People with Tetraplegia," M.J. Mulcahey, B.T. Smith, R.R. Betz, **R.J. Triolo**, P.H. Peckham. *Journal of the American Paraplegia Society,*17(1): 20-35, 1994.
31. "Development and Standardization of a Clinical Evaluation of Standing Function," **R.J. Triolo**, B. Reilley, W. Freedman, R. Betz. *IEEE Transactions on Rehabilitation Engineering*, 1(1): 18-25, 1993.
32. "The Functional Standing Test," **R.J. Triolo**, B. Reilley, W. Freedman, R.R. Betz. *IEEE Engineering In Medicine and Biology Magazine*, 11(4): 32-4, 1992.
33. "Bipolar Latissimus Dorsi Transposition and Functional Neuromuscular Stimulation to Restore Elbow Flexion in an Individual with C4 Tetraplegia and C5 Denervation," R.R. Betz, M.J. Mulcahey, B.T. Smith, **R.J. Triolo**, A.A. Weiss, M. Moynahan, M.W. Keith, P.H. Peckham. *Journal of the American Paraplegia Society*, 15(4): 220-8, 1992.
34. "The Application of a Modified Neuroprosthetic Hand System in a Child with a C7 Spinal Cord Injury," B.T. Smith, M.J. Mulcahey, **R.J. Triolo**, R.R. Betz. *International Journal of Paraplegia*, 30: 598-606, 1992.
35. "The Experimental Demonstration of a Multichannel Time Series Myoprocessor: System Testing and Evaluation," **R.J. Triolo**, G. Moskowitz. *IEEE Transactions on Biomedical Engineering*, 36(10): 1004-17, 1989.
36. "The Theoretical Development of a Multichannel Time Series Myoprocessor for Simultaneous Limb Function Detection and Muscle Force Estimation," **R.J. Triolo**, G. Moskowitz. *IEEE Transactions on Biomedical Engineering*, Vol. 36(10): 1018-27, 1989.
37. "Tetanic Responses of Electrically Stimulated Paralyzed Muscle at Varying Interpulse Intervals," S.G. Carroll, **R.J. Triolo**, H.J. Chizeck, R. Kobetic and E.B. Marsolais. *IEEE Transactions on Biomedical Engineering*, 36(7): 644-54, 1989.
38. "Identification of Time Series Models of Lower Extremity EMG for Control of Prostheses using Box Jenkins Criteria," **R.J. Triolo**, D. Nash, G. Moskowitz. *IEEE Transactions on Biomedical Engineering*, 35(8): 584-95 1988.

39. "Comments on Upper Extremity Limb Function Discrimination using EMG Signal Analysis and the Relationship between Parallel-Filtering and Hypothesis-Testing Limb Function Classifiers," **R.J. Triolo**, G. Moskowitz. *IEEE Transactions on Biomedical Engineering*, 32: 239-41, 1985.

Book Chapters:

1. "The Role of Electrical Stimulation in Management of Spinal Cord Injury Patients" with E.B. Marsolais, R. Kobetic and S. Nandurkar in Comprehensive Management of the Spinal Cord Injured Patient, B.Y. Lee and L.E. Ostrander, editors. Demos Publishing, New York NY, 2000. Chapter 16 (pp.201-230).
2. "Movement Synthesis and Regulation in Neuroprostheses" with P. Crago and R. Kirsch in Biomechanics and Neural Control of Movement, J.M. Winters and P.E. Crago, editors. Sringer-Verlag, New York, 2000. Chapter 42 (pp. 573-589).
3. "Functional Electrical Stimulation in Spinal Cord Injury" with J. Chae, K. Kilgore and G. Creasey in Physical Medicine and Rehabilitation Clinics of North America: Topics in Spinal Cord Injury Medicine G.H. Kraft and M.C. Hammond, editors W.B. Saunder Company (Harcourt Brace Jovanovich, Inc.), Philadelphia PA. February, 2000 (pp. 209-226).
4. "Functional Neuromuscular Stimulation" with J. Chae, K. Kilgore, and G. Creasey in Rehabilitation Medicine: Principles and Practices, Edition 3, J. DeLisa & B. Gans, editors. Lippencott Raven, Philadelphia PA, 1998. Chapter 24 (pp. 611-634).
5. "Standing and Walking with FNS: Technical and Clinical Challenges" with R. Kobetic and R. Betz, in Human Motion Analysis, G. Harris editor. IEEE Press, New York NY, 1996 (pp. 318-350).
6. "Overview of Research in Pediatric SCI" in The Child with a Spinal Cord Injury, R. Betz editor. American Academy of Orthopaedic Surgeons Press, Rosemont IL, 1996 (pp. 691-697).
7. "EMG Theory" with H. Hillstrom, in Gait Analysis: Theory and Application, R. Craik and C. Oatis editors. Mosby Yearbooks, St. Louis MO, 1995 (pp. 271-92).

Abstracts:

1. "Effects of Stimulated Trunk Extension on Seated Reach." S. Kukke, **R. Triolo**, J.A. Davis – submitted, *7th International FES Society Meeting*, Lublijana Slovenia, June 2002.
2. "Effect of Multi-channel Hybrid Orthosis Configuration on Walking in Paraplegia." E.B. Marsolais, Rudi Kobetic, D. Davy, R. Gaudio, S. Tashman, S. Nandurkar, R. Triolo, H.R. Lehneis– submitted, *7th International FES Society Meeting*, Lublijana Slovenia, June 2002.
3. "The Effects of Trunk Stimulation on Seated Workspace." S. Kukke, **R. Triolo**, J.A. Davis – submitted, *2002 Annual Rehabilitation Engineering Society of North America (RESNA) Conference*, Minneapolis MN, June 2002.
4. "Dynamic Pressure Relief for the Wheelchair User with Long-Term Therapeutic Neuromuscular Electrical Stimulation." K. Bogie, **R.J. Triolo**, J. Chae – submitted, *2002 Annual Rehabilitation Engineering Society of North America (RESNA) Conference*, Minneapolis MN, June 2002.
5. "The Effects of Trunk Stimulation on Seated Reach after SCI," S. Kukke, **R. Triolo**, J.A. Davis. *Joint ASIA/IMSOP meeting*, Vancouver BC, Canada, May 2002.

6. "Dynamic Pressure Relief Using Therapeutic Neuromuscular Electrical Stimulation," K. Bogie, **R. Triolo**, John Chae. – submitted, *Joint ASIA/IMSOP Meeting*, Vancouver BC, Canada, May 2002.
7. "The CWRU Hybrid Orthosis with Controllable Joints and Implanted FES for Walking," E.B. Marsolais, R. Kobetic, D. Davy, R. Gaudio, P. Adamczyk, **R. Triolo**, R. Lehneis. – submitted, *Joint ASIA/IMSOP Meeting*, Vancouver BC, Canada, May 2002
8. "The Effect of Electrically-Induced Trunk Extension on Seated Posture and Balance," S.N. Kukke, **R.J. Triolo**, J.P. Uhlir, J.A. Davis. *Proceedings, 6th International FES Society Meeting*, Cleveland Ohio, June 2001 pp. 34-36. **Honorable Mention, Robbie Robertson Student Scientific Paper Award, Buckeye Paralyzed Veterans of America**
9. "Describing Passive Joint Moments with a Nonlinear Viscoelastic Model," K. Amankwah, R.F. Kirsch, **R.J. Triolo**. *Proceedings, 6th International FES Society Meeting*, Cleveland Ohio, June 2001 pp. 279-281.
10. "Adaptive Linearization of Agonist/Antagonist Muscle Systems," E.C. Hartman, R.J. Triolo, J.J. Abbas. *Proceedings, 6th International FES Society Meeting*, Cleveland Ohio, June 2001 pp. 297-299.
11. "The Effect of Stimulated Trunk Extension on the Upright Body Weight Distribution While Standing with Functional Neuromuscular Stimulation," J.P. Uhlir, **R.J. Triolo**, J.A. Davis. *Proceedings, 6th International FES Society Meeting*, Cleveland Ohio, June 2001 pp. 65-67.
12. "Improving the Health of Paralyzed Tissue Using Electrical Stimulation," K.M. Bogie, **R.J. Triolo**, J. Chae. *Proceedings, 6th International FES Society Meeting*, Cleveland Ohio, June 2001 pp. 163-165.
13. "Estimating the Ground Reaction Forces in Three-Dimensional Simulation of Standing Posture," M.L. Audu, R.F. Kirsch and R.J. Triolo. *Proceedings, 6th International FES Society Meeting*, Cleveland Ohio, June 2001 pp. 265-267.
14. "Hybrid Orthosis with Controllable Hip and Knee Joints and Multichannel FES for Walking in Paraplegics," R. Kobetic, E.B. Marsolais, R.M. Kolacinski, R. Gaudio, S. Nandurkar, R. Triolo. *Proceedings, 6th International FES Society Meeting*, Cleveland Ohio, June 2001 pp. 74-76.
15. "The Effect of Stimulated Trunk Extension on the Upright Body Weight Distribution While Standing with Functional Neuromuscular Stimulation," J.P. Uhlir, **R.J. Triolo**, J.A. Davis. *Journal of Spinal Cord Medicine* 2001, vol. 24, pp. S7.
16. "Performance of a Surgically Implanted Neuroprosthesis for Standing and Transfers," J.A. Davis , **R.J. Triolo**, J.P. Uhlir, C. Bieri, D. Lissy, L. Rohde, N. Bhadra. *Proceedings, 5th International FES Society Meeting*, Aalborg Denmark, pp 39-42.
17. "A Biomechanical Model of the Spine and Trunk for Simulation and Control of Posture and Balance," **R.J. Triolo**, S. Suryanarayanan, S. Delp, S. Kukke, J. Uhlir, W. Murray, N. Bhadra, R. Kirsch, J.A. Davis. *Proceedings, 2000 Annual Rehabilitation Engineering Society of North America (RESNA) Conference, Orlando FL, June 2000* , pp. 202-204
18. "A Real-Time Simulation System to Evaluate User-Device Interaction: an Application for Development of FNS Control Systems," EC Hartman, J Riess, **RJ Triolo**, JJ Abbas *Proceedings, 2000 Annual Rehabilitation Engineering Society of North America (RESNA) Conference, Orlando FL, June 2000* , pp. 181-183.
19. "Clinical Performance of a Surgically Implanted Neuroprosthesis for Exercise, Standing, Transfers and Upright Mobility," J.A. Davis, **R.J. Triolo**, J.P. Uhlir, C. Bieri, N. Bhadra,

R. Kobetic. American Spinal Injury Society Annual Meeting, Chicago IL, April 2000. **Winner, Acorda Therapeutics Prize for Best Scientific Paper.** *Journal of Spinal Cord Medicine* Spring 2000; vol 23 pp. 3.

20. "A Functional Performance Measure for Effort and Assistance Required for Sit-to-Stand and Standing Pivot Transfer Maneuvers," C. Bieri, **R.J. Triolo**, G.S. Danford, E. Steinfeld. American Spinal Injury Society Annual Meeting, Chicago IL, April 2000. *Journal of Spinal Cord Medicine.* Spring 2000; vol 23 pp. 3.
21. "Implantable FES Systems for Standing and Transfers," J.A. Davis, **R.J. Triolo**, J.P. Uhlir, C. Bieri, N. Bhadra,, R. Kobetic, D. Lissy, *Proceedings, 2nd National Meeting VA Rehabilitation Research & Development Service*, Washington DC, February 2000 , pp. 138.
22. "Performance of Implanted Epimysial Electrodes in the Lower Extremities of Individuals with Spinal Cord Injury," J.P. Uhlir, **R.J. Triolo**, J.A. Davis. *Proceedings, 2nd National Meeting VA Rehabilitation Research & Development Service*, Washington DC, February 2000, pp. 121.
23. "Maintenance of Tissue Health Through Long-Term Use of Neuromuscular Electrical Stimulation.," K. Bogie, **R.J. Triolo**, J. Chae. *Proceedings, 2nd National Meeting VA Rehabilitation Research & Development Service*, Washington DC, February 2000, pp. 128.
24. "A Measure of Functional Performance for Sit-to-Stand and Standing Pivot Transfer Maneuvers," **R.J. Triolo**, C. Bieri, G.S. Danford, E. Steinfeld. *Proceedings, 2nd National Meeting VA Rehabilitation Research & Development Service*, Washington DC, February 2000, pp. 185.
25. "A Clinical Interface for Control and Evaluation of FNS Systems," T. Vrabec, **R. Triolo**, J. Uhlir, D. Lissy, C. Bieri. *2nd National Meeting VA Rehabilitation Research & Development Service*, Washington DC, February 2000, pp. 187.
26. "Effects of System Nonlinearities on Posture Adjustments Using Functional Neuromuscular Stimulation," E. Hartman, **R.J. Triolo**, J. Abbas. *Proceedings, IEEE Engineering in Medicine and Biology Society*, Atlanta GA, October 1999, pp. 660-661.
27. "Task-Dependent Adjustments to Co-Stimulation Levels in Functional Neuromuscular Stimulation Systems," X. Zhang, **R.J. Triolo**, J.J. Abbas. *Proceedings, IEEE Engineering in Medicine and Biology Society*, Atlanta GA, October 1999, pp. 658-659.
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35. "Surgically Implanted FNS System for Standing, Transfers and Upright Mobility after Spinal Cord Injury," J.A. Davis, R.J. Triolo, J.P. Uhlir, N. Bhadra, M. Sharma, E.B. Marsolais. *Proceedings, First National Meeting VA Rehabilitation Research & Development Service*, Washington DC, pp. 127, October 1998.
36. "Functional Neuromuscular Stimulation for Standing and Mobility after Spinal Cord Injury," C. Bieri, J. Davis, R. Kirsch, R. Kobetic, E. Marsolais, G. Polando, **R. Triolo**, J. Uhlir, W. Zhao. *Proceedings, First National Meeting VA Rehabilitation Research & Development Service*, Washington DC, pp. 161, October 1998.
37. "Improving the Tissue Viability of Paralyzed Muscles Using Neuromuscular Electrical Stimulation," K.M. Bogie, **R.J. Triolo**, J. Chae, P.H. Peckham, F. Frost. *Proceedings, First National Meeting VA Rehabilitation Research & Development Service*, Washington DC, October 1998, pp. 162.
38. "Development of a Three-Dimensional Biomechanical Model of Unassisted Standing via FNS," W. Zhao, **R.J. Triolo**, R.F. Kirsch. *Proceedings, First National Meeting VA Rehabilitation Research & Development Service*, Washington DC, October 1998, pp. 166.
39. "Effects of Conditioning on Passive Moment Measurements," K. Amankwah, R.F. Kirsch, **R.J. Triolo**. *Proceedings, First National Meeting VA Rehabilitation Research & Development Service*, Washington DC, October 1998, pp. 167.
40. "Assessing the Effect of Neuromuscular Electrical Stimulation on Pressure Distribution at the Seating Interface," K. Bogie, **R. Triolo**, J. Chae *VI Emed Scientific Meeting*, Brisbane Australia, August 1998.
41. "Three-Dimensional Dynamic Modeling of Unassisted Standing of Individuals with Paraplegia by Functional Neuromuscular Stimulation," W. Zhao, **R.J. Triolo**, R.F. Kirsch, S. Delp. *Proceedings, Fifth International Symposium on the 3-D Analysis of Human Movement*, pp. 73-76, July 2-5 1998
42. "Modeling The Inverse Dynamics of Voluntary Arm Movements," K.N. Werner, **R.J. Triolo**, R.F. Kirsch, and W. Zhao. *Proceedings, Fifth International Symposium on the 3-D Analysis of Human Movement*, pp. 18-21, July 2-5 1998.
43. "Estimating Postural Disturbances from Voluntary Arm Movement," K.N. Werner, **R.J. Triolo**, R.F. Kirsch, W. Zhao. *Proceedings, 1998 Annual Rehabilitation Engineering Society of North America (RESNA) Conference*, pp 375-377, June 1998. **Winner, Whitaker Student Scientific Paper Competition.**
44. "Performance of Implanted Epimysial Electrodes in the Lower Extremities of Individuals with Spinal Cord Injury," J.P. Uhlir, **R.J. Triolo**, R. Kobetic, M. Wibowo. *Proceedings,*

1998 Annual Rehabilitation Engineering Society of North America (RESNA) Conference, pp. 223-225, June 1998.

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46. "Shoulder Subluxation and Pain in Chronic Hemiplegia Treated by Intramuscular Electrical Stimulation," M.E. Walker, D.T. Yu, J. Chae, **R.J. Triolo**, Z.P. Fang. *Proceedings, 1998 Annual Rehabilitation Engineering Society of North America (RESNA) Conference*, pp. 217-219, June 1998.
47. "Selectivity of Intramuscular Stimulating Electrodes in the Lower Extremities," Q. Liu, **R.J. Triolo**. *Proceedings, 1998 Annual Rehabilitation Engineering Society of North America (RESNA) Conference*, pp. 235-237, June 1998.
48. "Therapeutic Application of Neuromuscular Electrical Stimulation to Improve Tissue Viability in Persons with Spinal Cord Injury," K. Bogie, **R.J. Triolo**, J. Chae. *Proceedings, 1998 Annual Rehabilitation Engineering Society of North America (RESNA) Conference*, pp. 241-243, June 1998.
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55. "Clinical Results from Implanted FNS Systems for Mobility after Spinal Cord Injury," **R.J. Triolo**, C. Bieri, J. Uhlir, D. Ferencz, G. Polando, R. Kobetic, K. Ferguson, A. Young. *Proceedings, 2nd Annual Meeting of the International FES Society (IFESS)*, pp. 170-1, August 1997.
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60. "Installation and Performance of a 16-Channel Implantable FES System for Upright Mobility," **R. Triolo**, D. Ferencz, C. Bieri, R. Kobetic, G. Polando, M. Sharma, E.B. Marsolais, J. Davis. *Proceedings, 1997 Annual Rehabilitation Engineering Society of North America (RESNA) Conference,* pp. 310-12, June 1997.
61. "Using Selective Electrical Stimulation of the Quadriceps to Improve Standing in Paraplegia." J. Uhlir, **R. Triolo**. *Proceedings, 1997 Annual Rehabilitation Engineering Society of North America (RESNA) Conference,* pp. 313-5, June 1997. **Honorable Mention, Whitaker Student Scientific Paper Competition**.
62. "A Reusable, Self-adhesive Electrode for Intraoperative Muscle Stimulation in the Lower Extremity," J.D. Moss, N. Bhadra, **R.J. Triolo**, *Proceedings, 1997 Annual Rehabilitation Engineering Society of North America (RESNA) Conference,* pp. 535-7, June 1997. **Winner, PVA Student Design Competition**.
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87. "Development and Standardization of an Evaluation for Standing Function in Children with Spinal Cord Injuries," **R.J. Triolo**, B. Reilley, M.J. Mulcahey, R.R. Betz, J. Cohn. The *Journal of the American Paraplegia Society*, 14(2): 101, April 1991.
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89. "Further Development of a Hybrid Orthosis for Prolonged Standing in Children with Complete Spinal Cord Injuries," **R.J. Triolo**, R. Barnett, B.J. Andrews. *Proceedings of the World Congress on Biomechanics*, La Jolla, CA, p. 330, August 1990.
90. "Agreement of EMG and Strength-Duration Tests in Determining a Lower Motor Neuron Lesion in Children with Spinal Cord Injuries," E.R. Gardner, T.M. Sweezy, **R.J. Triolo**, R.R. Betz. *American Physical Therapy Association Annual Conference*, Anaheim, CA, June 1990.
91. "Improvement of Hand Function in Children with Arthogryposis following Neuromuscular Stimulation (NMES) - A Preliminary Report," S. Weaver, E.R. Gardner, **R.J. Triolo**, R.R. Betz. *1990 Annual Meeting of the Association of Children's Prosthetic-Orthotic Clinics*, Valhalla, NY, June 6-9, 1990.
92. "Force-Velocity and Length-Tension Properties of Stimulated Human Quadriceps Muscle in Spinal Cord Injured Children," R.J. Triolo, R.R. Betz , D. Robinson. *Proceedings of 11th Annual IEEE Engineering in Medicine and Biology Conference*, Seattle, WA, p. 967-8, November 1989.
93. "Physiological Responses to FNS Exercise in Children with Spinal Cord Injuries," D. Robinson, **R.J. Triolo**, R. R. Betz. *Proceedings of 11th Annual IEEE Engineering in Medicine and Biology Conference*, Seattle, WA, p. 1498-9, November 1989.
94. "The Design of Output Stage Circuitry for Constant Current Neuromuscular Stimulation," A. Alm, R. Kobetic, **R.J. Triolo**, B. Smith, J. Buckett and G. Borges, *Proceedings of 11th Annual IEEE Engineering in Medicine and Biology Conference*, Seattle, WA, p. 1051-2, November 1989.
95. "Repeatability of Isometric Strength and Endurance of the Electrically Stimulated Quadriceps in Children with Spinal Cord Injuries," E.R. Gardner, **R.J. Triolo**, R.R. Betz. *Physical Therapy* 69(5): 369, June 1989.
96. "Effects of Stimulus Frequency on Contractile Properties of Paralyzed Muscle," S. Carroll, **R.J. Triolo**, H.J. Chizeck, R. Kobetic, E.B. Marsolais. *Proceedings of 10th Annual IEEE Engineering in Medicine and Biology Conference*, pp. 1936-7, New Orleans, LA, November 1988.

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98. "Experimental Demonstration of a Time Series Myoprocessor for the Control of an A/K Prosthesis," R.J. Triolo, G. Moskowitz. Invited paper, *Proceedings 8th Annual IEEE EMBS Conference*, Dallas-Fort Worth, TX, November 1986.
99. "Channel Selection for Multichannel Time Series Myoprocessors," **R.J. Triolo**, G. Moskowitz. *Proceedings 39th ACEMB Conference*, Baltimore, MD, September 1986.
100. "A 2D Force Feedback Monitor for Repeatable Muscle Contractions," **R.J. Triolo**, H. Hillstrom, G. Moskowitz. *Proceedings 39th ACEMB Conference*, Baltimore, MD, September 1986.
101. "A Multichannel Time Series Myoprocessor for Robust Classification of Limb Function and Estimation of Muscle Force," **R.J. Triolo**, G. Moskowitz. *IEEE Transactions on Biomedical Engineering*, Vol. BME-32, p. 875, October 1985.
102. "A Multichannel Time Series Myoprocessor for Robust Classification of Limb Function and Estimation of Muscle Force," R.J. Triolo, G. Moskowitz. *Proceedings 7th Annual IEEE EMBS Conference*, Chicago, IL, September 1985.
103. "Simultaneous Limb Function Identification and Muscle Force Estimation," **R.J. Triolo**, G. Moskowitz. Invited paper, *Proceedings 38th ACEMB*, Chicago, IL, 1985.
104. "Applications of Box-Jenkins Criteria to the Identification of Time Series Models of Lower Extremity EMG for the Control of Prostheses," **R.J. Triolo**, D. Nash, G. Moskowitz. *Proceedings of the 6th Annual Conference, IEEE Engineering in Medicine and Biology Society*, Los Angeles, CA, September 1984.
105. "Operating Range of Multichannel Time Series Myoprocessors," **R.J. Triolo**, G. Moskowitz. Invited paper, *Proceedings of the 37th Annual Conference on Engineering in Medicine and Biology*, Los Angeles, CA, September 1984.
106. "Variation of AR Parameters with Contraction Level," **R.J. Triolo**, G. Moskowitz. *Proceedings of the 36th Annual Conference on Engineering in Medicine and Biology*, Columbus, OH, September 1983.
107. "The Effects of AR Filter Design on Limb Function Classification," **R.J. Triolo**, G. Moskowitz. *Proceedings of the 36th Annual Conference on Engineering in Medicine and Biology*, Columbus, OH, September 1983.
108. "Autoregressive EMG Analysis and Prosthetic Control," **R.J. Triolo**, G. Moskowitz. *Proceedings of the 35th Annual Conference on Engineering in Medicine and Biology*, Philadelphia, PA, September 1982.

PROFESSIONAL ACTIVITIES:

- Board of Directors, International FES Society (IFESS) 2002-2005.
- Grant Reviewer/Consultant, Whitaker Foundation, 2002.
- Conference Chair, IFESS 2001: 6th Annual Scientific Meeting of the International Functional Electrical Stimulation Society, Cleveland Ohio, 2001.
- Guest Editor, *Journal of Rehabilitation Research & Development* special issue on Functional Electrical Stimulation, Winter 2001.
- Guest Editor, *Neuromodulation* special issue on Functional Electrical Stimulation, Fall 2001
- Reviewer, *Neurorehabilitation and Neural Repair*, December 2000.

- Guest Editor, *Assistive Technology* special issue on Functional Electrical Stimulation, Spring, 2000.
- Editorial Board, *Journal of Rehabilitation Research and Development*, 1999 - present
- Associate Editor, *IEEE Transactions on Rehabilitation Engineering*, 1999 - present
- Special Scientific Grant Reviewer, Spinal Cord Research Foundation/Paralyzed Veterans of America, 1999-2000.
- External Reviewer, Louisiana Board of Regents Health Excellence Fund (HEF) program, 2000
- Chair, Functional Electrical Stimulation Special Interest Group, Rehabilitation Engineering Society of North America (RESNA), 1999-00.
- Chair, Functional Electrical Stimulation Scientific Session, Rehabilitation Engineering Society of North America (RESNA), Annual Meeting, June 1999.
- Chair, Functional Electrical Stimulation Special Interest Group, Rehabilitation Engineering Society of North America (RESNA), 1998-99.
- Session Chair, Physiologic Motor Systems (Rehabilitation Engineering Track), Biomedical Engineering Society Meeting, Cleveland OH, October 12, 1998.
- CWRU representative and exhibitor, Bioengineering Conference (BECON), National Institutes of Health, February 1998.
- Proposal Reviewer, *Spinal Cord Research Foundation*, 1998.
- Co-chair, Functional Electrical Stimulation Special Interest Group, Rehabilitation Engineering Society of North America (RESNA), 1997-98.
- Ad hoc reviewer, *Proceedings, Rehabilitation Engineering Society of North America*, 1996
- Organizing Committee, First Conference of the International FES Society. Cleveland OH, 1995-96.
- Organizing Committee, NIH Conference on Gait Analysis and Rehabilitation Medicine. Baltimore MD, 1995-96.
- Proposal Reviewer, *Ministry of Science and Technology, Republic of Slovenia*. 1995.
- Reviewer, *Medical and Biological Engineering & Computing,* 1995
- Editorial Board, *Journal of Electromyography and Kinesiology*, 1994 - present
- Program Organizing Committee, IEEE Engineering in Medicine and Biology Conference, Baltimore, MD. October 1994. Session Chair: Neuromuscular Systems and Fatigue.
- Program Organizing Committee, Engineering Foundation Conference - Neural Prostheses: Motor Systems IV. Deer Creek, OH. July 1994. Session Chair: Clinical Applications - Upper Extremity.
- Program Organizing Committee, IEEE Engineering in Medicine and Biology Conference, San Diego, CA. October, 1993. Session Chair: Functional Electrical Stimulation.
- Special Faculty, Shriners Workshop on Human Motion Analysis, San Diego, CA. October, 1993. Lecturer: "Standing and Walking with Functional Neuromuscular Stimulation: Technical and Clinical Challenges."
- National Science Foundation (NSF) Study Section, Biological and Engineering Systems. June 1993.
- Assistant Editor, *IEEE Transactions on Rehabilitation Engineering*, 1993 – 1999

- Proposal Reviewer, *National Science Foundation,* 1991
- Reviewer, *IEEE Transactions on Biomedical Engineering*, 1990 - present
- Program Organizing Committee, IEEE Engineering in Medicine and Biology Conference, Philadelphia, PA, October,1990. Session Chair: EMG.
- Special Faculty, Combined Sections of the American Physical Therapy Association Annual Meeting, Philadelphia, PA October, 1990. Lecturer: "Upper and Lower Extremity Applications of Functional Neuromuscular Stimulation."
- Reviewer, *CRC Press, Inc.*, 1986.

SERVICE ACTIVITIES:

- Judge, Craftsman/NSTA Young Inventors Awards, Cleveland Municipal School District Instructional Technology, Science and Mathematics Education Office.
- Board of Directors, "RePlay for Kids" (a nonprofit organization for the repair of therapeutic toys and assistive technologies for children with disabilities), May 2001 – present.
- Dean's Committee Representative, Research & Development Committee, Cleveland VA Medical Center, 1998-present.
- Member, Executive Committee, Cleveland VA Center of Excellence in FES. 1998-present
- Member, Research Committee, CWRU Department of Orthopaedics. June 1995 - present.
- Organizing Committee, CWRU Orthopaedics Research Day, June 22-23, 2001.
- CWRU Biomedical Engineering Research Day and Open House – Student Scientific Paper Judge, February 2001.
- Professional Advisory Committee, Matching Persons with Technology (MPT) Training and Evaluation Program (R43 HD38220-01A1 to The Institute for Matching Person & Technology, Inc.), October – December 2000.
- Organizing Committee, CWRU Orthopaedics Research Day, January 28-29, 2000.
- Interviewer, CWRU Biomedical Engineering Open House (screening prospective graduate students). February 1999.
- Member, Research Advisory Committee, Department of Physical Medicine and Rehabilitation, MetroHealth Medical Center. November 1997 – 1999.
- Member and coordinator, Institutional Review Board (IRB) Health Hill Hospital for Children, 1995 – 1999.
- Member, Community Advisory Board, FES Resource Guide, Cleveland FES Center. 1994-1995.
- Faculty Advisor, Case Engineering Service Group (student rehabilitation engineering organization). 1996.

EDUCATIONAL ACTIVITIES:

University Courses

- **CWRU EBME 307:** Advanced Biomechanical Prosthetic Systems, Spring 2001. Lectured on human gait analysis, biomechanics of bipedal walking, and principles of lower extremity neuroprostheses. Introduced concepts of kinematic and kinetic measurements. Organized and conducted hands-on data collection and analysis experiences with VICON 700 motion capture system for measuring seated work volumes.

- **CWRU REHAB 5001:** Introduction to Rehabilitation Medicine, Spring 2001.
  Conducted lecture and interactive demonstrations regarding rehabilitative and functional applications of electrical stimulation after spinal cord injury and stroke for exercise, standing and ambulation.
- **CWRU EBEM 313:** Biomedical Engineering Laboratory, Fall 2000.
  Conceived, organized and conducted 3 day laboratory experience for 12 students on the effects of lumbar spine mobility on seated workspace in three dimensions using quantitative motion capture instrumentation.
- **CWRU REHAB 5001:** Introduction to Rehabilitation Medicine, Fall 2000.
  Conducted lecture and interactive demonstrations regarding rehabilitative and functional applications of electrical stimulation after spinal cord injury and stroke for exercise, standing and ambulation.
- **CWRU EBME 314:** Biomedical Engineering Laboratory, Spring 2000.
  Organized, conducted and graded an undergraduate laboratory on the biomechanics of the lower extremities, specifically the measurement of passive joint properties and the effects of biarticular muscles.
- **CWRU EBME 307:** Advanced Biomechanical Prosthetic Systems, Spring 2000.
  Taught lectures on biomechanics of human gait, and lower extremity neuroprosthetic systems. Presided over two laboratory sessions in the Motion Study Laboratory of the Cleveland VA Medical Center
- **CWRU EBME 105:** Special Topic Report in Biomedical Engineering, Fall 1999.
  Advised undergraduate students preparing research papers on neuroprostheses and applications of functional neuromuscular stimulation.
- **CWRU REHAB 5001:** Introduction to Rehabilitation Medicine. Lower Extremity Electrical Stimulation (with Dr. John Chae) Spring & Fall 1997, 1998, 1999.
  Conducted lectures and demonstrations regarding rehabilitative and functional applications of electrical stimulation after spinal cord injury and stroke for exercise, standing and ambulation.
- **CWRU EBME 507:** Motor Systems Neuroprostheses, Spring 1999.
  Organized and taught series of lectures on lower extremity FES systems, bracing and gait analysis for graduate level course.
- **CWRU EBEM 313:** Biomedical Engineering Laboratory, Fall 1998.
  Organized, conducted and graded undergraduate laboratory dealing with posturography and biomechanics of human standing and balance.
- **CWRU EBME 313:** Biomedical Engineering Laboratory, Fall 1997.
  Organized, instructed and moderated undergraduate laboratory on computer-aided modeling and biomechanical simulations for surgical decision making.
- **CWRU EBME 507:** Motor System Neuroprostheses, Spring 1996.
  Organized and taught sections on lower extremity FES systems and hybrid orthoses for graduate level course.
- **CWRU EBME 307:** Biomechanical Prosthetic Systems, Spring 1995, 1996, 1997, 1998.
  Developed and conducted new Senior-level undergraduate course of study in motor prosthesis design. Capstone course in undergraduate curriculum. Reviewed principles of assistive technology, clinical aspects of spinal cord injury and stroke, outcome assessment, regulatory procedures and related design criteria for devices to assist upper and lower extremity function.

- **CWRU EBME 313:** Biomedical Engineering Laboratory, Fall 1995.
  Organized, instructed and moderated undergraduate laboratory on contractile properties of stimulated muscle.

Primary Research Advisor: Current Students or Projects in Progress

- K. Amankwah (Ph.D.), Department of Biomedical Engineering, CWRU
  VA Rehabilitation R&D Pre-Doctoral Fellowship
- S. Kukke (M.S.), Department of Biomedical Engineering, CWRU
- B. Heilman (M.S.), Department of Biomedical Engineering, CWRU
- M. Kates (M.S.), Department of Biomedical Engineering, CWRU

Primary Research Advisor: Completed Master's Thesis Projects

- J. Uhlir, "Selective Electrical Stimulation of the Quadriceps to Improve Standing Function in Paraplegia." Master's Thesis, Department of Biomedical Engineering, CWRU, 1998.
  Honorable Mention, 1997 Whitaker Student Paper Competition
- M. Wibowo, "Selection and Activation of Hip Extensor Muscles for Standing with FNS." Master's Thesis, Department of Biomedical Engineering, CWRU, 1998.
  Winner, 1998 Whitaker Student Paper Competition
- K. Werner, "Modeling the Postural Disturbances Caused by Upper Extremity Movements." Master's Thesis, Department of Biomedical Engineering, CWRU, 1998.
  Winner, 1998 Whitaker Student Paper Competition
- M. Walker, "The Effects of Intramuscular Electrical Stimulation Treatment on Shoulder Subluxation, Pain, Motor Function, and Self-Care Skills in Chronic Hemiplegia." Master's Thesis, Department of Biomedical Engineering, CWRU, 1998.
- D. Wormser, G. Eisenhower & T. Stabinski. "Inter-rater Reliability of the Functional Standing Test." Master's Thesis, Department of Physical Therapy, Beaver College, Glenside, PA 1993.
- T. Houdayer. "Prolonged Standing for Children with Paraplegia by Means of Hybrid Orthosis: A Case Study." Master's Thesis, Biomedical Engineering & Science Institute. Drexel University, Philadelphia, PA, 1993.
- B. Dodge & S. Sheehan. "The Functional Reach Test: Its Reliability and Utility with a Young Population." Master's Thesis, Department of Physical Therapy, Beaver College, Glenside, PA 1992.
- N. Barnett & H. Lamite. "A Comparison of Energy Expenditure Between FNS Supported Standing and KAFO Supported Standing with Paraplegic Patients." Master's Thesis, Department of Physical Therapy, Beaver College, Glenside, PA 1991.
- B. Billau. "Development and Standardization of an Evaluation for Function in Standing." Master's Thesis, Biomedical Engineering & Science Institute, Drexel University, Philadelphia, PA,1990
- S. Albright & M. Pettit. "The Effect of Electrical Stimulation on Upper Extremity ROM and Function in Children with Spastic CP." Master's Thesis, Department of Physical Therapy, Beaver College, Glenside, PA 1989.

Student Examining Committees

- M. Pierre, Master's Degree, Department of Biomedical Engineering, CWRU (in progress)
- P. Yoo, Doctoral Degree, Department of Biomedical Engineering, CWRU (in progress).
- P. Spooner, Doctoral Degree, Department of Electrical and Electronic Engineering, University of Melbourne, Melbourne Australia, 2001.
- E. Hartman, Master's Degree, Department of Biomedical Engineering, University of Kentucky, Lexington KY, 2000.
- M. Tarler. Doctoral Degree, Department of Biomedical Engineering, CWRU, 1999
- S. Chang. Doctoral Degree, Department of Systems & Industrial Engineering, CWRU, 1997.
- J. Abbas. Master's Degree, Department of Biomedical Engineering, CWRU, 1990.

Post-Doctoral Fellows Sponsored & Advised

- M. Audu, Ph.D. (2000-2001)
- N. Lan, Ph.D. (1999)
- K. Bogie, D.Phil. (1996-1999)
- W. Zhao, Ph.D. (1996-1999)
- J. Abbas, Ph.D. (1992-93)
- M. Moynahan, M.S. - pre-doctoral fellowship (1990-93)
- R. Barnett, Ph.D. (1989-90)
- G. Phillips, Ph.D. (1989)

Senior Projects Advised

- M. Finlay (B.S.), Department of Mechanical and Aerospace Engineering, CWRU 1/02-5/02 "A Flexible Locking Thoracic-Lumbar-Sacral Orthosis (TLSO)."
- M. Liu (B.S), Department of Biomedical Engineering, CWRU 9/97-12/97 "Selectivity of Intramuscular Stimulating Electrodes in the Lower Extremities."
- J. Moss (B.S.), Department of Biomedical Engineering, CWRU 6/96-12/96 "A Reusable, Self-adhesive Electrode for Intraoperative Muscle Stimulation in the Lower Extremity" *Winner, 1997 Paralyzed Veterans of America Student Design Competition*.
- K. Haycook (B.S.), Department of Biomedical Engineering, CWRU 9/96-12/96

Undergraduate Research Projects

- P. Shaw, Department of Biomedical Engineering, CWRU 1/01 – present
- B. Bowers, Department of Biomedical Engineering, CWRU 1/00 – 5/01
- S. Gartman, Department of Biomedical Engineering, CWRU 9/99 – 12/99.
- A. Ratzler, Department of Biomedical Engineering, CWRU 5/99 – 8/99.

Other Students Advised or Research Projects Supervised

- I. Sayed, CWRU School of Medicine, 6/00 – present
  Winner, Crile Summer Research Fellowship
- A. Winkenfeld, CWRU School of Medicine, 9/00 – present
  Winner, Crile Summer Research Fellowship

Invited Lectures, Seminars and Short Courses

- "Surgical Implantation of FES Hardware for Functional Standing in Persons with SCI." Invited lecture, Kentucky Spinal Cord & Head Injury Research & Training Center: Clinical Advances in Neurorehabilitation Science Conference, Lexington KY, September 27, 2001.
- "Standing Transfer and Walking after Spinal Cord Injury," invited lecture 2001 Charles Herndon Alumni Society, Cleveland OH, June 22 2001.
- "A Surgically Implanted Lower Extremity Neuroprosthesis for Exercise, Standing and Transfers after Spinal Cord Injury." Neurosurgery Grand Rounds, Jackson Memorial Hospital and the Miami Project to Cure Paralysis, Miami Florida, April 5, 2001
- "Preliminary Performance of a Surgically Implanted Neuroprosthesis for Exercise, Standing and Transfers after Spinal Cord Injury." Rehabilitation Engineering Center of Excellence on Aging with a Disability, Houston VA Medical Center, December 1, 2000, Houston TX.
- "Lower Extremity Neuroprostheses." American Academy of Physical Medicine and Rehabilitation, Instructional Course. November 4, 2000, San Francisco CA.
- "Unassisted Standing with Functional Neuromuscular Stimulation." 31st Neural Prosthesis Workshop, National Institutes of Health, Bethesda MD, October 26, 2000.
- "Preliminary Clinical Performance of an Implanted Neuroprosthesis for Standing and Mobility after Spinal Cord Injury." Department of Anatomy and Neuroscience, University of Kentucky, October 12, 2000, Lexington KY.
- "Neuroprostheses for Lower Extremity Function after Spinal Cord Injury." Center for Ergonomics, Department of Industrial Engineering, University of Michigan, September 19,2000, Ann Arbor, MI.
- "A Surgically Implanted Neuroprosthesis for Exercise, Standing and Transfers." NeuroControl Corporation, July 17, 2000, Cleveland OH.
- "A Surgically Implanted Neuroprosthesis for Exercise and Standing, Transfers." Department of Physical Medicine and Rehabilitation, University of Kentucky and Cardinal Hill Rehabilitation Hospital, July 10, 2000, Lexington KY.
- "A Surgically Implanted Neuroprosthesis for Exercise and Standing, Transfers." Department of Orthopaedics, Medical College of Albany, June 1, 2000, Albany NY.
- "Implanted Lower Extremity Neuroprostheses." Orthopaedic Rehabilitation Association instructional course, May 12, 2000. Cleveland, Ohio.
- "Lower Extremity Neuroprostheses: Fundamental Studies to Clinical Research." Grand Rounds, CWRU Department of Orthopaedics, April 1, 2000.
- "Multicenter Clinical Trial of a Neuroprosthesis for Exercise, Standing and Transfers." Rehabilitation Engineering Center Seminar, Department of Orthopaedics, MetroHealth Medical Center. March 15, 2000.
- "Measurement Issues in FES-Assisted Standing, Transfers and Ambulation." 2nd National VA Rehabilitation Research R&D Meeting, Washington DC, February 21 & 22, 2000.
- "A Biomechanical Model of the Kinematics and Moment-Generating Capacity of the Spine and Trunk Musculature." CWRU Department of Orthopaedics Research Day, January 28, 2000.

- "Performance of Implanted Epimysial Electrodes in the Lower Extremities of Individuals with Spinal Cord Injury." CWRU Department of Orthopaedics Research Day, January 28, 2000.
- "Implantable FNS Systems for Standing Transfers." CWRU Department of Orthopaedics Research Day, January 28, 2000.
- "Unassisted Standing by Functional Electrical Stimulation." 30th Neural Prosthesis Workshop, National Institutes of Health, Bethesda MD, October 13, 1999.
- "Lower Extremity Applications of FNS in Paraplegia and Incomplete Tetraplegia," in a course entitled "Restoring Limb and Bladder Function with Electrical Stimulation" at the 1999 Meeting of the American Paraplegia Society (APS), Las Vegas NV, September 1999.
- "Biomechanics of Human Quadriceps Muscles During Electrical Stimulation." Rehabilitation Engineering Center Seminar, Department of Orthopaedics, MetroHealth Medical Center. June 2, 1999.
- "Unassisted Standing by Functional Electrical Stimulation," CWRU Neuroprosthesis Seminar, CWRU, January 8, 1999.
- "Human Lumbosacral Spinal Cord Interprets Loading During Stepping." Rehabilitation Engineering Center Seminar, Department of Orthopaedics, MetroHealth Medical Center. December 16, 1998.
- "Clinical Results from Implanted Lower Extremity Neuroprostheses," Resident Research Conference, CWRU Department of Orthopaedics, November 11, 1998.
- "Unassisted Standing with Functional Neuromuscular Stimulation," 29th Neural Prosthesis Workshop, National Institutes of Health, Bethesda MD, October 28-30, 1998.
- "Implanatable Systems: What's Going Right, and What's Gone Wrong." Rehabilitation Engineering Center Seminar, Department of Orthopaedics, MetroHealth Medical Center. June 4, 1998.
- "Maximizing Hip Extension Moment with Two Channels of Electrical Stimulation for FES-Induced Standing," Poster Presentation, Annual Rehabilitation Engineering Society of North America (RESNA) Conference, June 1998.
- "Performance Results of Epimysial Electrodes in the Lower Extremities of Individuals with Spinal Cord Injuries," American Spinal Injury Association (ASIA) annual meeting, Cleveland Ohio, April 21, 1998.
- "Future Directions: FES for Standing and Transfers," in pre-conference course entitled "Restoring Limb & Bladder Function with Electrical Stimulation." Presented at the 1998 meeting of the American Spinal Injury Association (ASIA) Cleveland Ohio, April 19, 1998.
- "Lower Extremity FES," Multidisciplinary Spine Conference, MetroHealth Medical Center, Cleveland Ohio, April 17 1998.
- "Implantable FNS Systems for Standing and Walking Mobility: Surgical Considerations," Resident Research Conference, CWRU Department of Orthopaedics. November 1997.
- "Unassisted Standing with Functional Neuromuscular Stimulation," 28th Neural Prosthesis Workshop, National Institutes of Health, Bethesda MD, October, 1997.

- "Functional Electrical Stimulation for Ambulation after Spinal Cord Injury," Living Well into the Next Century: An Educational Forum for People with Spinal Cord Injuries, MetroHealth Medical Center, October 7, 1997.
- "Clinical Results from Implanted FNS Systems for Mobility after Spinal Cord Injury," 2nd Annual Meeting of the International FES Society (IFESS), August 1997.
- "Installation and Performance of a 16-Channel Implantable FES System for Upright Mobility," 1997 Annual Rehabilitation Engineering Society of North America (RESNA) Conference, June 1997.
- "Implanted FNS Systems for Lower Extremity Mobility: Developing a Strategy," 12th Annual Applied Neural Control Laboratory Research Day, CWRU. May 1997.
- "Unassisted Standing with Functional Neuromuscular Stimulation," 27th Neural Prosthesis Workshop, National Institutes of Health, Bethesda MD, October 17, 1996.
- "Implanted FNS Systems for Standing and Transfers," Department of Veterans Affairs Research R&D Committee, Cleveland OH, October 15, 1996.
- "Research Directions in Lower Extremity Applications of Functional Neuromuscular Stimulation," Research Retreat, Department of Orthopaedics, CWRU. October, 1996.
- "Functional Electrical Stimulation Hand Grasp Neuroprostheses: Impact on Impairment, Disability and Handicap," Department of Physical Therapy, Beaver College, Glenside, PA. April, 1996.
- "Lower Extremity Applications of Functional Electrical Stimulation: Exercise, Standing, Transfers and Walking," Department of Physical Therapy, Beaver College, Glenside, PA. April, 1996.
- "FES Facilitated Standing Transfers in Low Tetraplegia: Fundamental Studies and Clinical Outcomes," Grand Rounds, CWRU Department of Orthopaedics. March 1996.
- "The Effects of FNS on the Bones, Joints and Functional Independence of Adolescents with Spinal Cord Injuries," Resident Research Conference, CWRU Department of Orthopaedics. November 1995.
- "Sit to Stand Motor Prostheses," 10th Annual Applied Neural Control Research Day, CWRU. May 1995.
- "Challenges to Clinical Deployment of Upper Extremity Neuroprostheses," Platform presentation, *Neural Prostheses: Motor Systems IV* Conference, Engineering Foundation, Deer Creek OH. July 1994.
- "Lower Extremity Applications of FNS in Children with Spinal Cord Injuries," Neural Prosthesis Seminar, CWRU. March 1994.
- "Standing and Walking with Functional Neuromuscular Stimulation: Technical and Clinical Challenges," Special Workshop on Human Motion Analysis, IEEE Engineering in Medicine & Biology Society Meeting, Sand Diego, CA. October 1993
- "Functional Electrical Stimulation: Engineering and Clinical Aspects," Rehabilitation Engineering Summer Internship Program, Department of Bioengineering, University of Pennsylvania, Philadelphia, PA. August 1993.
- "Clinical Considerations for the Application of Functional Electrical Stimulation in Children with Spinal Cord Injuries or Cerebral Palsy," Grand Rounds, Kessler Institute for Rehabilitation, West Orange, NJ. July 1993.

- "Technology Transfer from Academic to Clinical Environments," Platform presentation, *Neural Prostheses: Motor Systems III* Conference, Engineering Foundation, Banff Canada. July 1991.
- "Upper and Lower Extremity Applications of Functional Neuromuscular Stimulation," Combined Sections of the American Physical Therapy Association Annual Meeting, Philadelphia, PA. October, 1990.
- "Basic Electrophysiology," Department of Physical Therapy, Beaver College, Glenside, PA. 1986, 1988-94.
- "Physical Principles of Electrical Stimulation," Department of Physical Therapy, Beaver College, Glenside, PA. 1986, 1988-94.
- "Clinical Research: Principles and Design," Department of Orthopaedics, Temple University, Philadelphia, PA. 1988-93.