

CURRICULUM VITAE

Name: Terence David Sanger

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Date of Birth: Dec. 6, 1963

Place of Birth: Boston, MA

Citizenship: USA

Current position: Assistant Professor (UTL), Stanford University Department of Neurology and Neurological Sciences, since July 1, 2000.

A. ACADEMIC HISTORY

Education:

1985 A.B. Harvard College Department of Applied Mathematics

1986 M.S. Harvard University Department of Applied Mathematics

1993 M.D. Harvard Medical School Division of Health Sciences and Technology

1993 Ph.D. Massachusetts Institute of Technology Department of Electrical Engineering and Computer Science. Thesis: "Theoretical Elements of Hierarchical Control in Vertebrate Motor Systems"

Scholarships and Honors:

1981 Westinghouse Science Talent Search 6th place winner.

1985 Highest departmental honors in Applied Mathematics, and *Magna Cum Laude* honors from Harvard College.

1985 Hoopes Prize for undergraduate thesis.

1985 National Science Foundation Graduate Fellowship.

1988 Medical Scientist Training Program Fellowship.

1990 National Defense Science and Engineering Fellowship.

Post-doctoral and Residency Training:

Internship and Residencies:

1993-1994 Intern in Pediatrics, USC/Los Angeles County Medical Center, Los Angeles

1995 Resident in Pediatrics, USC/Los Angeles County Medical Center, Los Angeles

1995-1996 Part-time clinical fellow, Children's Hospital Department of Neurology, Boston

1996-1999 Resident, Children's Hospital Department of Neurology, Boston

1999-2000 Fellow, Movement Disorders Unit, Toronto Western Hospital, Toronto

Post-doctoral Research Fellowships:

1993-1995 Research Staff, NASA Jet Propulsion Laboratory, with Jacob Barhen

1995-1996 Post-doctoral Research Fellow, MIT, with Emilio Bizzi

Licensure and Certification:

1995 Massachusetts Board of Registration in Medicine (80801)

1995 California Medical Board (G080612)

1995 U.S. Drug Enforcement Administration (BS4365462)

1994 Pediatric Advanced Life Support, Los Angeles County Hospital

1996 Advanced Cardiac Life Support, Massachusetts General Hospital

1996 Advanced Trauma Life Support, Massachusetts General Hospital

2000 National Board of Medical Examiners Certification in Neurology with Special Competence in Child Neurology

Languages:

French: 5 years study

Italian: 3 years study

Spanish: 2 years study

Funding:

Current:

UCP Pilot Grant active. United Cerebral Palsy Research and Education Foundation, 8/1/07-7/31/09, "Reflex contributions to abnormal movement in dyskinetic cerebral palsy." Role: PI. The major goal of this project is to determine the contribution of short-latency and long-latency abnormal reflexes to disturbances of voluntary reaching in children with CP.

Child Health Research Program Pilot Grant active. Lucile Packard Children's Hospital, 4/1/07-3/31/08, "Advanced Statistical Methods for Biofeedback in Children with Dyskinetic Cerebral Palsy." Role: PI. The major goal of this project is to perform preliminary clinical testing of a new biofeedback sensor and nonlinear signal processing algorithm that I have developed.

R01 NS052236 active. NIH/NINDS, 7/15/06-4/15/11, "Failure of Motor Learning in Childhood Dystonia." Role: PI. The major goal of this project is to investigate the sensory and motor mechanisms that prevent children with dystonia from improving their performance through practice.

U13 NS043180 active. NIH/NINDS/NICHHD, 9/1/02-8/31/07, "NIH task force on childhood motor disorders." Role: PI. The major goal of this project is to fund ongoing meetings of a task force to provide consensus definitions and propose candidate rating scales for assessment of children with motor disorders.

Unrestricted Educational Grant active. Allergan, Inc., 3/1/2001-continuing, “NIH task force on childhood motor disorders.” Role: PI. The major goal of this project is to fund ongoing meetings of a task force to provide consensus definitions and propose candidate rating scales for assessment of children with motor disorders.

Investigator-initiated clinical research active. Carter Foundations, 8/1/01 - continuing, “Working Group on Childhood Motor Disorders.” Role: PI. The major goal of this project is to investigate, in detail, the complete set of motor impairments that lead to disabilities in a small number of children with severe movement disorders.

Pending:

R01 NS055039 pending. NIH/NINDS, 4/1/07-3/31/12, “Sensory-motor Information Processing in Childhood Dystonia.” Role: PI. The major goal of this project is to investigate the relationship between motor performance and the information-theoretic concept of channel capacity in children with secondary dystonia.

Completed:

K23 NS41243 completed. NIH/NINDS, 6/1/01-5/31/06, “Arm kinematics in hyperkinetic cerebral palsy.” Role: PI. The major goal of this project is to determine whether hyperkinetic arm movements are due to noise in the motor system or to a limitation of voluntary movement.

R13 NS055614 completed. NIH/NINDS, 4/1/06-3/31/07, “Neural Control of Abnormal Movement.” Role: PI. The major goal of this project is to support the organization of a satellite meeting to the Neural Control of Movement society meeting in order to encourage participation of clinicians and clinical investigators and collaboration between clinical and basic science investigators.

Investigator-initiated clinical research completed. Elan Pharmaceuticals, Inc., 4/1/02-3/30/05, “Does Myobloc improve functional hand use in young children with a hypertonic upper extremity.” Role: PI. The major goal of this project is to test whether a series of three escalating doses of Myobloc in the biceps and brachioradialis of children age 2-6 years old with restriction of arm movement due to increased tone in the arm flexor muscles can improve functional reaching.

R21 NS045638 completed. NIH/NINDS, 4/1/03-3/31/05, “Childhood motor impairment and assisted communication.” Role: PI. The major goal of this project is to investigate the relationship between measures of upper-extremity motor function and the design of optimal communication interfaces for children with motor disorders.

Investigator-initiated clinical research completed. United Cerebral Palsy Foundation, 2/1/02-1/31/05, “Cerebral Hypertonia of Central origin an Open-Label trial of Anticholinergic Treatment Effects.” Role: PI. The major goal of this project is to test whether there is an improvement in upper-extremity function in children with dystonia treated with an escalating dose of oral trihexyphenidyl. This is a multi-center trial performed as lead site of the Childhood Motor Study Group.

Pfizer Scholars Grant completed. Pfizer Pharmaceuticals Group, 7/1/01-6/30/02, “A Virtual-reality Training Environment for the Treatment of Pediatric Dystonia.” Role:

PI. The major goal of this project is to develop the hardware and software for an interactive environment that can be used to test the ability to retrain arm movements in children with upper extremity dystonia and improve their quality of reaching.

B. EMPLOYMENT HISTORY

1993-1994 Intern in Pediatrics, USC/Los Angeles County Medical Center, Los Angeles.

1993-1994 Research Staff, NASA Jet Propulsion Laboratory, Pasadena.

1995 Resident in Pediatrics, USC/Los Angeles County Medical Center, Los Angeles.

1995-1996 Clinical fellow, Children's Hospital Department of Neurology, Boston.

1995-1996 Postdoctoral Research Assistant, MIT, Boston.

1996-1999 Resident, Children's Hospital Department of Neurology, Boston.

1999-2000 Clinical Fellow, Movement Disorders Unit, Toronto Western Hospital.

7/1/2000-6/30/2003

7/1/2003-6/30/2004

7/1/2004-6/30/2005

7/1/2005-6/30/2007 Assistant Professor of Child Neurology (UTL), Dept. Neurology and Neurological Sciences, Stanford University.

C. PUBLIC AND PROFESSIONAL SERVICE

Professional groups:

- Childhood Motor Study Group (CMSG), co-director and principal investigator
- NIH Taskforce on Childhood Motor Disorders, principal investigator
- Child Neurology Society - Movement Disorders Special Interest Group
- Dystonia Medical Research Foundation - Scientific Advisory Board
- Neural Control of Movement Society - Executive Committee, Secretary
- Journal of Motor Behavior - Consulting Editor

Consulting:

- StemCells, Inc.

Teaching:

- NENS220, "Computational Neuroscience", co-instructor with John Huguenard
- ME281, "Biomechanics of Movement", co-instructor with Scott Delp, 2002.
- NSADA program for teaching translational research in Child Neurology, co-director
- Psychology 202, invited lecturer
- Neuro 205, invited lecturer
- BioDesign program "Bootcamp" director, 2003-2004.
- NENS299 "Computational Neural Networks", 2003
- resident and medical student teaching

Meeting Organization:

- 1995 “Neuroscience and Neural Networks”, workshop at Neural Information Processing Systems meeting, co-organizer.
- 1998 “Computational Motor Control”, satellite to NCM meeting. co-organizer.
- 2000 “Computational Motor Control”, satellite to NCM meeting. co-organizer.
- 2000 “Diagnosis of Hypertonia in Children”, symposium, Toronto. co-organizer.
- 2001-2006 “Taskforce on Childhood Motor Disorders”. organizer and PI.
- 2006 “Neural Control of Abnormal Movement”, satellite to NCM meeting. co-organizer.

Peer Review Panels:

1. Musculoskeletal Rehabilitation Study Group (MRS) *ad hoc 2006*
2. Function, Integration, and Rehabilitation Sciences Subcommittee (FIRS) *standing 2006-2010*
3. Child Neurology Foundation *ad hoc 2004*
4. Dystonia Medical Research Foundation *standing 2005-2008*

Committees:

1. Neuroscience Institute at Stanford, Director of working group on child motor disorders, 2004-2006.
2. NSADA Planning and Direction, 2003-2006.
3. Cerner Clinical Information System, MD design team, 2004.
4. MD Cerner Advisory Team, 2004.
5. Down Syndrome Clinic planning meetings, 2004.
6. Biodesign Planning Committee, 2000-2001.
7. Neuroscience faculty search committee, 2001.

Technical Referee:

Movement Disorders and Dystonia

1. *Movement Disorders*
2. *J. Neurology, Neurosurgery, Psychiatry*
3. *J. Child Neurology*
4. *Pediatric Neurology*
5. *Neurology*
6. *Lancet Neurology*

Movement Science and Biomechanics

1. *J. Motor Behavior*
2. *Exp. Brain Research*

Computational Neuroscience and Neural Networks

1. *Neural Computation*
2. *Neural Networks*
3. *IEEE Transactions on Neural Networks*
4. *IEEE Transactions on Pattern Analysis and Machine Intelligence*
5. *Biological Cybernetics*
6. *Physics Review Letters*

Neurophysiology and Neuroscience

1. *J. Neurophysiology*
2. *J. Neuroscience*
3. *Brain*
4. *J. Neuroscience Methods*
5. *Neurobiology of Disease*
6. *Brain and Cognition*
7. *Epilepsia*

Primary Research Goal: To understand and prevent adverse effects of childhood brain disorders on motor development.

Major Research Areas:

Computational Neuroscience and Neural Networks:

1. The mathematical description of dystonia and abnormal human movement
2. Mathematical models of abnormal basal ganglia function
3. Neural Network models of normal and disordered human motor learning
4. Neural Network control algorithms for robotics, and failure of control
5. Factors that enhance or prevent motor learning
6. Contribution of disordered sensory processing to dystonia
7. Information representation in neural population codes
8. Maximum-likelihood methods for interpreting bioelectric signals

Clinical Research in Childhood Movement Disorders:

1. Tools for quantification and diagnosis of dystonia in children
2. Quantification of ataxia, apraxia, and deficits of selective motor control
3. Role of botulinum toxin in the modification of learned motor patterns
4. Effect of early treatment of dystonia on motor developmental outcome
5. Feedback retraining of multiple-muscle patterned movement
6. Virtual-reality environments for motor retraining
7. Optimization of assisted communication interfaces for children with motor disorders

D. POST-DEGREE HONORS AND AWARDS

Honors And Awards

1995 McDonnell-Pew Postdoctoral Fellowship.

1996-1998 von Meyer Travelling Fellowship.

2000 Dystonia Medical Research Foundation New Millenium Award.

2001 Pfizer Faculty Scholars Award.

2003 United Cerebral Palsy Leaves of Hope Award.

2003 William M. Hume Faculty Scholar Award.

2004 Biodesign program teaching award.

Selected Invited Papers and Addresses (30):

1. "Failure of Motor Learning," invited lecture at MIT, May 2007.
2. "Pediatric Movement Disorders," invited lecture at the Movement Disorder Society, October 2006.
3. "New perspectives on pediatric dystonia", invited lecture, UCLA, March 2006.
4. "Diagnostic and Assessment measures of Ataxia-Telangiectasia", invited lecture at an NINDS-sponsored ataxia-telangiectasia clinical research workshop, March 2006.

5. "Movement disorders in degenerative and storage diseases", invited lecture at the Neurotrophic factors workshop of Children's Neurobiological Solutions, March 2006.
6. "Dystonia in children with cerebral palsy", invited lecture at the Rehabilitation Institute of Chicago, October 2005.
7. "Medication and Rehabilitation", invited lecture at the Dystonia Medical Research Foundation research meeting, September 2005.
8. "Dystonia, spasticity, and rigidity", invited lecture at U. Pittsburgh Medical Center, August 2005.
9. "Dystonia, spasticity, and rigidity", invited lecture at the Rehabilitation Institute of Chicago, August 2005.
10. "Dystonia, hypertonia, and co-contraction in children: It's not what we think", invited lecture at Northwestern University, August 2005.
11. "Pediatric Movement Disorders," invited lecturer at the Movement Disorder Society, March 2005.
12. "Movement disorders in cerebral palsy," invited lecturer at the American Academy of Neurology, April 2005.
13. "Failure of motor learning", invited lecture at the Redwood Neuroscience Institute, January 2005.
14. "US Taskforce on childhood motor disorders", invited lecture at the SPASM conference, Newcastle-on-Tyne, December 2004.
15. "Dystonia, spasticity, and rigidity - why are they important in cerebral palsy and how do we measure them?" course director and lecturer at the American Academy of Cerebral Palsy and Developmental Medicine, September 2004.
16. "New insights into the etiology of cerebral palsy", invited lecture at the American Academy of Pediatrics, October 2004.
17. "Tics, twitches, and Tourette syndrome", invited lecture at the American Academy of Pediatrics, October 2004.
18. "Acquired/Secondary movement disorders in childhood", invited lecture at the Movement Disorders Society, June 2004.
19. "Stiffness, spasticity, and dystonia: diagnosis and management of hypertonia in children", Brown University invited lecture, May 2004.
20. "Tools used to measure rigidity", invited lecture at the Kinetics Foundation, May 2004.
21. "New perspectives on pediatric dystonia", invited lecture at Oregon Health Sciences University, April 2004.
22. "Stiffness, spasticity, and dystonia: diagnosis and management of hypertonia in children", invited lecture at Oregon Health Sciences University, April 2004.
23. "Hypertonia in childhood," educational lecture at the American Academy of Neurology, April 2003.
24. "Botulinum toxin and the types of hypertonia", invited lecture at an Allergan-sponsored symposium on current uses of botulinum toxin, August 2003.
25. "Botulinum toxin type B", invited lecture at an Allergan-sponsored symposium on current uses of botulinum toxin, August 2003.

26. "Hypertonia in childhood," educational lecture at the Child Neurology Society, October 2002.
27. "Spasticity and other Hypertonias," World Congress on Disabilities, invited lecture, September 2002.
28. "Is pediatric dystonia a disorder of plasticity?" invited seminar at the Institute of Neurology and Gatsby Computational Sciences unit of the Queen Square Neurological Institute, December 2000.
29. "Interdisciplinary conference on childhood motor disorders", conference co-chairman and organizer, Toronto, September 2000.
30. "Neural Control of Movement", Satellite conference co-chairman and invited speaker, Key West, April 1999.

Membership in Professional Associations:

- 1992** American Society of Composers, Authors, and Publishers (ASCAP)
- 1993** Sigma Xi Engineering Society
- 1993** American Medical Association (AMA)
- 1995** American Academy of Pediatrics (AAP)
- 1995** Massachusetts Medical Association (MMA)
- 1995** American Association for the Advancement of Science (AAAS)
- 1995** Institute for Electrical and Electronics Engineers (IEEE)
- 1998** American Physiological Society (APS)
- 1999** Child Neurology Society (CNS)
- 1999** American Academy of Neurology (AAN)
- 2000** Movement Disorders Society (MDS)
- 2002** American Academy of Cerebral Palsy and Developmental Medicine (AACPDM)

E. SCHOLARLY PUBLICATIONS

Peer-reviewed articles (41 published, 7 in press)

1. **Sanger T. D.**, 2007, The use of surface electromyography in the diagnosis of childhood hypertonia: a pilot study, *J. Child Neurology*, in press.
2. van Doornik J., Kukke S., McGill K., Rose J. A., Sherman-Levine S., **Sanger T. D.**, 2007, Oral baclofen increases maximal voluntary activation of ankle plantar flexors in children with spasticity due to cerebral palsy, *J. Child Neurology*, in press.
3. **Sanger T. D.**, 2007, Bayesian filtering of myoelectric signals, *J. Neurophys.*, 97:1839-1845
4. **Sanger T. D.**, Henderson J., Lerner-Durham J., 2006, Optimizing assisted communication devices for children with motor impairments using a model of information rate and channel capacity, *IEEE Transactions on Rehabilitation Engineering*, in press.
5. **Sanger T. D.**, Bastian A., Brunstrom J., Damiano D., Delgado M., Dure, L., Gaebler-Spira D., Hoon A., Mink J. W., Sherman-Levine S., Welty L. J., and the child motor study group, 2006, Prospective open-label clinical trial of trihexyphenidyl in children with secondary dystonia due to cerebral palsy, *J. Child Neurology* in press.

6. **Sanger T. D.**, Kukke S. N., Sherman-Levine, S., 2006, Botulinum toxin B improves speed of reaching in children with cerebral palsy and arm dystonia: An open-label dose-escalation pilot study, *J. Child Neurology*, in press.
7. Ben-Pazi, H, Kukke S. N., **Sanger T. D.**, 2006, Poor penmanship in children correlates with abnormal rhythmic tapping: A broad functional temporal impairment, *J. Child Neurology*, in press.
8. **Sanger T. D.**, Kukke S. N., 2006, Abnormalities of tactile sensory function in children with dystonic and diplegic cerebral palsy, *J Child Neurol*, in press.
9. Malfait N., **Sanger T. D.**, 2006, Does dystonia always include co-contraction? A study of unconstrained reaching in children with primary and secondary dystonia, *Exp Brain Res*, 176(2):206-216.
10. **Sanger T. D.**, 2006, Arm trajectories in dyskinetic cerebral palsy have increased random variability, *J. Child Neurol.*, 21:551-557.
11. Ishihara A. K., van Doornik J., **Sanger T. D.**, 2006, Failure Modes in Feedback Error Learning, *IEEE World Congress on Computational Intelligence*, (full-length refereed paper) pp.669-676.
12. Ishihara A. K., van Doornik J., **Sanger T. D.**, 2006, Feedback Error Learning with Basis Function Networks, *IEEE Int. Symp. Intelligent Control*, (full-length refereed paper).
13. Espay A. J., Hung S. W., **Sanger T. D.**, Lang A. E., 2005, A writing device improves writing in primary writing tremor, *Neurology*, 64(9):1648-1650. (cited by 2)
14. **Sanger T. D.**, Kaiser J., Placek B., 2005, Reaching movements in childhood dystonia contain signal-dependent noise, *J. Child Neurol.*, 20:489-496. (cited by 1)
15. Enns G. M., Barkovich A. J., van Kuilenburg A.B.P., Manning M., **Sanger T. D.**, Witt D.R., van Gennip A. H., 2004, Head imaging abnormalities in dihydropyrimidine dehydrogenase deficiency, *J. Inherit. Metab. Dis.*, 27:513-522.
16. **Sanger T. D.**, 2004, Severe resting clonus caused by thyrotoxicosis in a 16-year-old girl with hereditary spastic paraparesis, *Movement Disorders*,19(6): 712-713.
17. **Sanger T. D.**, 2004, Failure of motor learning for large initial errors, *Neural Computation*, 16(9):1873-1886. (cited by 2)
18. **Sanger T. D.**, 2003, Childhood-onset generalized dystonia can be modeled by increased gain in the indirect basal ganglia pathway. *J. Neurol Neurosurg Psychiatr*, 74:1509-1515. (cited by 3)
19. **Sanger T. D.**, Lang A. E., 2003, Case studies in pediatric movement disorders, *Movement Disorders*, special supplement (CD-ROM).
20. Thelen D. D., Riewald S. A., Asakawa D. S., **Sanger T. D.**, Delp S. L., 2003, Abnormal coupling of knee and hip moments during maximal exertions in persons with cerebral palsy. *Muscle Nerve* 27(4):486-493. (cited by 3)
21. **Sanger T. D.**, 2002, Decoding neural spike trains: calculating the probability that a spike train and an external signal are related, *J. Neurophysiology*, 87(3):1659-1663. (cited by 3)
22. **Sanger T. D.**, Pascual-Leone A., Tarsy D. M., Schlaug G., 2002, Nonlinear sensory cortex response to simultaneous tactile stimuli in Writer's Cramp, *Movement Disorders*, 17(1):105-111. (cited by 17)

23. **Sanger T. D.**, Tarsy D. M., Pascual-Leone A., 2001, Abnormalities of spatial and temporal sensory discrimination in writer's cramp, *Movement Disorders*, 16(1):94-99. (cited by 41)
24. **Sanger T. D.**, Garg R. R., Chen R., 2001, Interactions between two different inhibitory systems in human motor cortex revealed by transcranial magnetic stimulation, *J. Physiology*, 530(pt 2):307-317. (cited by 85)
25. **Sanger T. D.**, 2000, Human arm movements described by a linear superposition of principal components, *J. Neuroscience*, 20(3):1066-1072. (cited by 13)
26. **Sanger T. D.**, Merzenich M. M., 2000, Computational model of the role of sensory disorganization in focal task-specific dystonia, *J. Neurophysiology*, 84(5):2458-2464. (cited by 20)
27. Bara-Jimenez W., Shelton P., **Sanger T. D.**, Hallett M., 2000, Sensory discrimination capabilities in patients with focal hand dystonia, *Annals of Neurology*, 47(3):377-380. (cited by 38)
28. So G. M., Thiele E. A., **Sanger T. D.**, Schmid R., Riviello J. J. Jr., 1998, Electroencephalogram and clinical focalities in juvenile myoclonic epilepsy, *J. Child Neurology*, 13(11):541-545.
29. **Sanger T. D.**, 1998, Probability density methods for smooth function-approximation and learning in populations of tuned spiking neurons, *Neural Computation*, 10:1567-1586. (cited by 6)
30. **Sanger T. D.**, 1996, Probability density estimation for the interpretation of neural population codes, *J. Neurophysiology*, 76(4):2790-2793. (cited by 42)
31. **Sanger T. D.**, Jain K. D., 1996, MERRF syndrome with overwhelming lactic acidosis, *Pediatric Neurology*, 14(1):57-61. (cited by 3)
32. **Sanger T. D.**, 1995, Eleven-year-old girl with *Plasmodium falciparum* malaria and nephrotic syndrome, *Pediatric Infectious Disease Journal*, 14(12):1107-1108.
33. **Sanger T. D.**, 1994, Theoretical considerations for the analysis of population coding in motor cortex, *Neural Computation*, 6(1):12-21. (cited by 46) Reprinted in L. Abbott and T. Sejnowski, ed.s, *Neural codes and distributed representations*, MIT Press, 1999, pp. 45-53.
34. **Sanger T. D.**, 1994, Optimal unsupervised motor learning for dimensionality reduction of nonlinear control systems, *IEEE Trans. Neural Networks*, 5(6):965-973.
35. **Sanger T. D.**, 1994, Neural network learning control of robot manipulators using gradually increasing task difficulty, *IEEE Trans. Robotics and Automation*, 10(3):323-333. (cited by 22)
36. **Sanger T. D.**, 1994, Optimal unsupervised motor learning predicts the internal representation of barn owl head movements, *Advances in Neural Information Processing Systems*, J. D. Cowan, G. Tesauero, J. Alspector, ed.s, Morgan Kaufmann, p. 614-621.
37. **Sanger T. D.**, 1994, Two iterative algorithms for computing the singular value decomposition from input/output samples, *Advances in Neural Information Processing Systems*, J. D. Cowan, G. Tesauero, J. Alspector, ed.s, Morgan Kaufmann, p. 144-151. (cited by 4)
38. Dornay M., **Sanger T. D.**, 1993, Equilibrium point control of a monkey arm simulator by a fast learning artificial neural network, *Biological Cybernetics*, 68(6):499-508. (cited by 5)

39. **Sanger T. D.**, 1993, A practice strategy for robot learning control *Advances in Neural Information Processing Systems*, S. J. Hanson, J. D. Cowan, C. L. Giles, ed.s, Morgan Kaufmann, p. 335-341. (cited by 2)
40. **Sanger T. D.**, Sutton R. S., Matheus C. J., 1992, Iterative construction of sparse polynomial approximations *Advances in Neural Information Processing Systems*, J. E. Moody, S. J. Hanson, R. P. Lippmann, ed.s, Morgan Kaufmann, p. 1064-1071. (cited by 5)
41. **Sanger T. D.**, 1991, A tree-structured algorithm for reducing computation in networks with separable basis functions, *Neural Computation*, 3(1):67-78. (cited by 41)
42. **Sanger T. D.**, 1991, Optimal hidden units for two-layer nonlinear feedforward neural networks, *International Journal of Pattern Recognition and Artificial Intelligence*, 5(4):545-561, (cited by 4) Also appears in C. H. Chen, ed., *Neural Networks in Pattern Recognition and Their Applications*, World Scientific, 1991, pp. 43-59.
43. **Sanger T. D.**, 1991, A tree-structured adaptive network for function approximation in high dimensional spaces, *IEEE Trans. Neural Networks*, 2(2):285-293. (cited by 40)
44. **Sanger T. D.**, 1991, Basis-function trees as a generalization of local variable selection methods for function approximation *Advances in Neural Information Processing Systems*, R. P. Lippmann, J. E. Moody, d. S. Touretzky, ed.s, Morgan Kaufmann, p. 700-706. (cited by 5)
45. **Sanger T. D.**, 1990, Analysis of the two-dimensional receptive fields learned by the generalized Hebbian algorithm in response to random input, *Biological Cybernetics*, 63:221-228. (cited by 11)
46. **Sanger T. D.**, 1989, Optimal unsupervised learning in a single-layer linear feedforward neural network, *Neural Networks*, 2:459-473. (cited by 345)
47. **Sanger T. D.**, 1988, Stereo disparity computation using Gabor filters, *Biological Cybernetics*, 59:405-418. (cited by 94)
48. Salama G., **Sanger T. D.**, Cohen L. B., 1981, Optical recordings of action-potential propagation in intact heart, *Biological Bulletin*, 161(2):316.

Consensus Statements (2)

1. **Sanger T. D.**, Taskforce on childhood motor disorders, 2006, Definition and classification of negative motor signs in childhood, *Pediatrics*, 118(5):2159-2167.
2. **Sanger T. D.**, Taskforce on childhood motor disorders, 2003, Classification and definition of disorders causing hypertonia in childhood, *Pediatrics*, 111:e89-e97. (cited by 43)

Review Articles and Book Chapters (11)

1. **Sanger T. D.**, 2006, Hyperkinetic movement disorders in childhood, *Continuum*, in press
2. **Sanger T. D.**, Mink J. W., 2006, Movement disorders, *Pediatric Neurology: Principles and Practice*, 4th edition, Swaiman K. F., Ashwal, S., Ferriero D. M. ed.s, Mosby, Philadelphia, 1271-1311.
3. **Sanger T. D.**, 2006, Tic disorders and Tourette syndrome, *Continuum*, in press

4. **Sanger T. D.**, 2005, Hypertonia in children: how and when to treat, *Curr Treat Options Neurol*, 7(6):427-439.
5. **Sanger T. D.**, 2004, Toward a definition of childhood dystonia, *Curr Opin Pediatrics*, 16(6):623-627.
6. Hahn J. S., **Sanger T. D.**, 2004, Neonatal movement disorders, *NeoReviews*, 5:321-326.
7. **Sanger T. D.**, 2003, Pediatric movement disorders, *Curr Opin Neurol*, 16(4):529-535. (cited by 4)
8. **Sanger T. D.**, 2003, Neural population codes, *Curr Opin Neurobio*, 13(2):238-249. (cited by 10)
9. **Sanger T. D.**, 2003, Pathophysiology of pediatric movement disorders, *J Child Neurology*, 18(supp 1):S9-S24. (cited by 7)
10. **Sanger T. D.**, 1997, A probability interpretation of neural population coding for movement, In Morasso P., Sanguineti V., ed.s, *Self-Organization, Computational Maps and Motor Control*, Elsevier, North Holland.
11. **Sanger T. D.**, 1990a, A theoretical analysis of population coding in motor cortex, In Antognetti P., Milutinovic V., ed.s, *Neural Networks: Concepts, Applications, and Implementations*, volume 2, Prentice Hall, New Jersey.

Selected Abstracts and Technical Reports (21)

1. **Sanger T. D.**, 2006 Recursive Bayesian Estimation of Surface EMG, *Society for Neuroscience*
2. Chu V., **Sanger T. D.**, 2006 Signal dependent noise during isometric force contraction in childhood hypertonic dystonia, *Society for Neuroscience*
3. Van Doornik J., Ishihara A., **Sanger T. D.**, 2006 Uniform Boundedness of Feedback Error Learning for a Class of Stochastic Nonlinear Systems, *International Conference on Control, Automation, Robotics and Vision*, Singapore
4. Ishihara A., Van Doornik J., **Sanger T. D.**, 2006 Feedback Error Learning with Basis Function Networks *IEEE Control Systems Society*
5. Ishihara A., Van Doornik J., **Sanger T. D.**, 2006 Estimation of motor learning rate in humans based on a feedback-error learning model, *Neural Control of Movement Society*
6. **Sanger T. D.**, child motor study group, 2005 Childhood hypertonia of cerebral origin - an open-label trial of anticholinergic treatment effects (CHOCOLATE), *American Academy of Cerebral Palsy and Developmental Medicine*
7. Kukke S., **Sanger T. D.**, 2005 Failure of motor learning, *Neural Control of Movement Society*
8. Malfait N., **Sanger T. D.**, 2005 Is bradykinesia in cerebral palsy due to co-contraction? *Neural Control of Movement Society*
9. **Sanger T. D.**, 2004 Optimal sensory processing may cause sub-optimal motor performance, *Society for Neuroscience*
10. **Sanger T. D.**, 2004 When the best strategy is wrong: Optimal allocation of cortex may cause focal dystonia, *American Neurological Association*
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