

Daniel Graupe

Professor

Education

Ph.D. Electrical Engineering
University of Liverpool, England, 1963

Dipl. Ing. Electrical Engineering
Israel Institute of Technology, Technion, 1960

B.S. Electrical Engineering
Israel Institute of Technology, Technion, 1959

B.S. Mechanical Engineering
Israel Institute of Technology, Technion, 1958

Fellow, IEEE (elected: 1.1.85)

BIOSKETCH - D. GRAUPE

Daniel Graupe, Ph.D., is Emeritus Professor of Electrical and Computer Engineering, Emeritus Professor of Bioengineering and Emeritus Adjunct Professor of Neurology and Rehabilitation Medicine at the University of Illinois at Chicago where he co-directs the signal and image processing laboratory. Dr. Graupe is Life Fellow of the IEEE (Institute of Electrical and Electronics Engineers). He received his BSME and BSEE degrees from the Technion, Israel Institute of Technology, and a Ph.D. in electrical engineering from the University of Liverpool, England.

He served as Associate Editor of the IEEE Transactions on Circuits and Systems, with responsibility to Signal Processing (1989-91) and of the IEEE Transactions on Neural Systems and Rehabilitation Engineering 2002-2004). He is presently associate editor of the International Journal of Software Engineering and Knowledge Engineering (with responsibility to neural networks), of Neurological Research (with responsibility to Neuroengineering), of Psychline and on the advisory board of the BAM (Basic & Appl. Myology) journal.

He is member of the Executive Committee of the Board of Directors of the International Society of Bioelectromagnetism. He serves on several committees of the IEEE's Signal Processing Society and Bioengineering society.

He authored four text books in his field of research, one of which was translated into Russian and into Serbo-Kroatian, another into Chinese and a Spanish translation was recently completed. He

also authored chapters in several other books, 90 papers in major scientific journals and over 120 papers in scientific conference proceedings.

Prior to joining the University of Illinois, he held the rank of Distinguished Professor and of the Bodine Chair Professor at Illinois Institute of Technology, Chicago. In addition, Dr. Graupe is Attending Member of the Staff of the Michael Reese Hospital, Chicago, and has been Springer Visiting Chair Professor at the University of California, Berkeley and visiting professor in the Medical School of Tel-Aviv University, Israel, at the Swiss Federal Institute of Technology, Zurich, at the University of Notre Dame, at Academia Sinica, Beijing and Northwestern University, Evanston, IL. He also served on the faculties University of Liverpool, Technion-Israel Institute of Technology and Colorado State University.

Dr. Graupe is the holder of over 20 U.S. patents and of several foreign patents, including the patents for the Parastep electrical stimulation system for ambulation by paraplegics.

Dr. Graupe's functional electrical stimulation system for ambulation by paraplegics was approved in 1994 for sale as safe and effective by the FDA (Food and Drug Administration, USA) - as the first unbraced ambulation system for traumatic paraplegics so approved. It was approved in 2002 for full reimbursement by Medicare and Medicaid.

Dr. Graupe's research interests include: Control Systems, Time Series Analysis, Signal Processing, Biomedical Control, Neural Networks, Blind Adaptive Filtering, Wavelets and Electrical Stimulation.

D. Graupe was the inventor of the Zeta Blocker blind adaptive filter incorporated in several hearing aids (e.g., Strakey Labs and others), which was the first digital system to be part of a hearing aid (1985 and on)

Fig 1

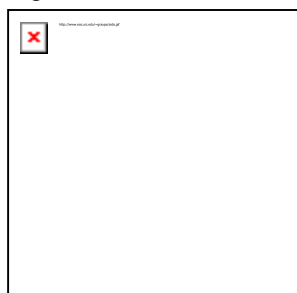


Fig 1: Image in -28 dB noise (Unknown noise or signal)

Fig 2

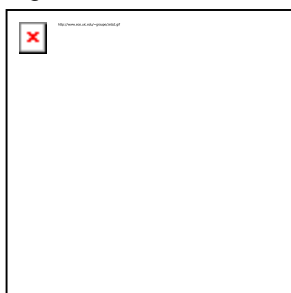
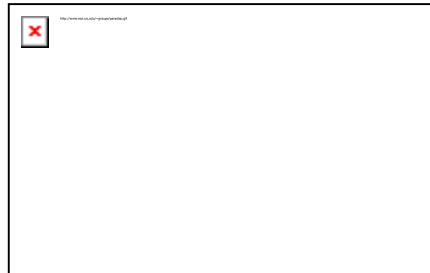


Fig 2: Image as in Fig 1 after passing through blind adaptive filter based on Zeta Noise Blocker of D. Graupe.

Dr. Graupe was the inventor (1987 and on) of the Parastep Functional Electrical Stimulation System to allow complete upper-motor-neuron paraplegics to walk short distances without braces. This was the first (and as of 8.1998, the only) electrical stimulation system for ambulation by paraplegics that received FDA (Food & Drugs Administration, USA) approval

and is commercially manufactured by Sigmedics, Inc. of Northfield, IL. He is also the inventor of Predictive On-Demand Control of Deep-Brain Stimulation for Parkinson and Essential-Tremor (ET) neurological disorders

[Video clip of the Parastep Functional Electrical Stimulation System \(320MB\)](#)



T-7 complete paraplegic (severed spinal cord) ambulating with Parastep Electrical Stimulation System invented and developed by D. Graupe; FDA approved: 1994

PUBLICATIONS - D. Graupe

Also: Google Scholar:

<http://scholar.google.com/citations?user=2S9ahUkAAAAJ&hl=en&oi=ao>

Text books

Identification of System, Van Nostrand Reinhold and Robert E. Krieger Publ. Co. 1972 and 1976 (2nd Ed.), Huntington, NY.

Translation of above book into Serbo-Kroatian (Yugoslavian), Univ. of Sarajevo Press, Yugoslavia, 1977.

Translation of above book into Russian, MIR Publishing Co., Moscow, 1979.

Time Series Analysis, Identification and Adaptive Filtering, R.E. Kreiger, Publ. Co., Melbourne, FL, 1984, second revised edition, 1989.

Translation of above book (Time Series etc.) into Chinese (Science Press, Peking, 1987).

Functional Electrical Stimulation for Ambulation by Paraplegics (D.Graupe and K.H.Kohn), Krieger Publ. Co. Malabar, FL. 1994.

Translation of above book into Spanish, Buenos Aires, Argentina, (in print).

Principles of Artificial Neural Networks, World Scientific Publishing Co. 1997, incl. E-Book edition

.Principles of Artificial Neural Networks, (revised 2nd edition), World Scientific Publishing Co. 2007. incl. E-Book edition

Principles of Artificial Neural Networks: Theory and Applications, (revised 3rd edition), World Scientific Publishing Co. 2013, incl. KINDLE electronic edition

Encyclopedia Chapters

The Encyclopedia of Physical Science of Technology, Vol. 3, pp. 589-617, Academic Press, Editors: R.A. Meyers, Chandrasekhan, L. Pauling, etc.), 1987

Chapters in Books

Chapter in: Blood Flow Through Organs and Tissues, Editors: W.H. Bain, M.D. and A.M. Harper, M.D., Livingston Press, Edinburgh, 1968.

Chapter in: Microcomputers in Health Care, Ed. H.S. Eden, M.D., Moyes Med. Publishing Co., Park Ridge, N.J. 1984.

Chapter in: Auditory and Hearing Prosthetics Research, Ed. V.D. Larson, Grune & Stratton Publishing Co., 1979.

Chapter in: Comprehensive Management of the Spinal Cord Injured Patient, Ed. B. Lee, Saunders Publ. Co., Philadelphia, 1991.

Chapter on: An Active Medical Information System using Active Index and Artificial Neural Network, in: Advances in Medical Image Databases, (Editor: S. Wong), Kluwer Press, pp. 225-249, 1999 (authored by: Chang, S.K. Graupe, D., Hasegawa, K. and Kordylewski, H)

Chapter in: Handbook of Software Engineering and Knowledge Engineering, Ed.: S.K. Chang, (Vol. 1, Chapter 5), entitled: A Large Scale Neural Networks and Its Applications, by D. Graupe and H. Kordylewski), World Scientific Publishing Co., 2001, pp.487-505.

Chapter in: Biomedical Engineering Handbook (3rd Edition), Editor: JD Brozino, entitled: Transcutaneous FES for Ambulation: The Parastep System, CRC Taylor & Francis, Baton Rouge, London, N, 2006., pp. 31.1-31.20,

Editorship of Journals

1. Assoc. Editor, IEEE Trans. of Circuits and Systems, 1989-1992.
2. Editorial Advisory Board, Engineering Design, 1989-present.
3. Area Editor (Neural Networks), International Journal of Software Engineering and Knowledge Engineering, 1996-present.
4. Assoc. Editor, Neurological Research (with responsibility to neuroengineering), 1998-present.
5. Assoc. Editor, Psychline (Psychol & Neurol.), 1998-present.
6. Member of Editorial Board, Federation News, International Fed of Neurosurgery Societies, 1998-present.
7. Associate Editor, IEEE Trans. On Neural Systems and Rehabilitation Engineering, 2002-2004.
8. Member of the Advisory Board, European Jour. Translat. Myology, BAM (Basic & Applied Myology), 2007-present

Also: Guest Editor: Special Issue on Neurology and Neural Networks, (Neurol. Res., July 2001);
Guest Editor: Special Section on Functional Electrical Stimulation, (Neur. Res., Sept. 2002)



Journal Publications*

1. Simulation of the Dynamic Characteristics of a Superheater, Int. Jour. Mech. Sci., Vol. 5, pp. 13-40, 1963.
2. Computation of Steam Transients in Turbine and Piping Elements, Proc. Inst. Mech. E., Vol. 179, Pt. 3H, pp. 82-91, 1965, with A.S. Aldred.
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4. Dynamic Optimization of a Boiler, Proc. IEE, Vol. 112, pp. 445.
5. Adaptive Control by Predictive Identification and Optimization, Trans. IEEE, G-AC, pp. 191-194, April 1967, with G.R. Cassir.

6. Analysis of On-Line Identification and Control of Nuclear Reactor, Journ. Brit. Nuclear EnergySoc., Vol. AC-13, pp. 564-567, October 1968, with G.R. Cassir.
7. Reduction and Identification of Many-Variable Processes, Transaction of IEEE, Automatic Control, Vol. AC-13, pp. 564-567, October 1968, with G.R. Cassir.
8. A Predictive Approach to the Control of Processes without A priori Information, International Journal of Control, pp. 534-545, 1968, with G.R. Cassir.
9. Reduction of Optimization Parameters in Multivariable Processes without a Priori Information, Jour. Assoc. of Engrs. and Archs. of Israel, Vol. 26, pp. 82-85, 1968.
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14. Closed Loop Sub-Optimal Control of Linear Processes without Mode Switching, International Journal of Control, Vol. 15, pp. 577-586, 1972, with Y. Koren.
15. Derivation of Weighting Matrices Towards Satisfying Eigenvalue Requirements, Int. J. Cont., Vol. 16, pp. 881-890, 1972.
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17. Control of an Artificial Upper Limb in Several Degrees of Freedom, Bull. Prosthesis Res., vol. 10-18, pp. 25-39, 1973.
18. Identification of Predictor and Filter Parameters by ARMA Methods, International Journal of Control, Vo. 17, pp. 1021-1027, 1973, with D.J. Krause.
19. Identification and Prediction of a Class of Non-Gaussian Time Series via Transformation, Int. J. Sys. Sci., Vol. 4, pp. 441-447, 1973, with D.J. Krause.
20. On the Identification of Input-Output-Noise Models, Int. J. Sys. Sci., vol. 4, pp. 617-621, 1973, with D.J. Krause.

21. Identification of Kalman-Bucy Filters from Noisy Measurement Arrays, *Int. J. Sys. Sci.*, Vol. 4, pp. 739-756, 1973, with D.J. Krause and W.K. Cline.
22. Optimal Linear Control Subject to Sensitivity Constraints, *IEEE Trans. on Aut. Cont.*, Vol. 19, pp. 593-594, Oct. 1974.
23. Identification of ARMA Parameters of Time Series, *IEEE Trans. on Aut. Cont.*, Vol. 20, No. 1, pp. 104-107, Feb. 1975, with D.J. Krause and J.B. Moore.
24. Stochastic Analysis of EMG Signals via ARMA Methods, *IEEE Trans. on Sys., Man, and Cybernetics*, Vol. 5, No. 2, pp. 252-259, 1975, with W.K. Cline.
25. Derivation of ARMA Parameters and Orders from Pure AR Models, *Int. J. Cont.*, pp. 101-107, 1975, with W.K. Cline.
26. Performance Analysis of Linear Regulators with Non-Gaussian Markovian Disturbance, *Int. J. Sys. Sci.*, Vol. 6, pp. 653-664, 1975, with R. Shinnar and U.G. Cegla.
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32. Addendum to: A Unified Sequential Identification Structure Based on Convergence Considerations, *Automatica*, Vol. 12, No. 1, p. 541, 1976, with E. Fogel.
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43. Comment on A Unified Sequential Identification Structure, *Automatica*, Vol. 15, May 1979, with E. Fogel.
44. A Comparative Analysis of Various Least Squares Identification Algorithms Including Direct LS, Parcor, Lattice and Square-Root Algorithms, *Automatica*, Vol. 16, No. 1980, with V.K. Jain and J. Salahi.
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47. On LS Identification of Markov and Martingale Processes, *Int. J. Sys. Sci.*, Dec. 1980, with J. Grosspietsch and D. Graupe.
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50. Electromyographic Control of Functional Electrical Stimulation in Selected Paraplegics, *Orthopedics*, Vol. 7, pp. 1134-1138, 1984, K.H. Kohn, S. Basseas, and E. Naccarato.

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- 86.- Automated Epilepsy Detection via Multistage Nonlinear EEG Filtering and a LAMSTAR Neural Network, Neurological Research, (V.P. Nigam and D. Graupe) pp. 150-154, January 2004.
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10. Application of Regression Analysis to Reduction of Multivariable Control Problems and to Process Identification, Proc. NEC, Vol. 23, 1967 6th Symp. on Adaptive Processes, Chicago, pp. 20-25, 1967, with B.H. Swanik and G.R. Cassir.
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104. Neural Network Control of Functional Electrical Stimulation in Paraplegics, Proc. IEEE-ISCAS International Conf., London, 1995.
105. A Review of the Parastep FES System, 1st IFESS Conf., Cleveland, OH, 1996.
106. Large Memory Storage and Retrieval Networks, Proc. 29th IEEE Midwest Circ. and Sys. Symp., 1996, pp. 471-474.
107. Blind Adaptive Filtering in Speech Processing, Proc. IEEE Midwest Systems and Circuits Symp., 1996, pp. 799-802.
108. A Large-Memory Storage and Retrieval Neural Network for Browsing and Medical Diagnosis, Proc. 6th ANNIE Conf., St Louis, MO, 1996, pp. 711-716.
109. Neural Network for Control of Stimulation of Peripheral Motor Neurons to Allow Patient-Responsive Ambulation by Paraplegics, Proc. 6th ANNIE Conf., St. Louis, MO, 1996. [Best Paper Award].
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111. Advances in Transcutaneous FES for Ambulation by Paraplegics, Proc. 3rd IFESS Conf., Luzern, Switzerland, Sept. 1998.
112. Ambulation Performance of Complete Paraplegics Using the Parastep FNS System, Proc. Annual Conference of the Neurosurgical Society of the State of Buenos Aires, Miramar, Argentina, December 1998.
113. A Clinical and Performance Review of Ambulation of Complete Paraplegics Using the Parastep FNS System, Proc. of the Wayne State. Conf. on Advances in Neurosurgery, Detroit, February 1999.
114. A Transcutaneous Microprocessor-Based Stimulator for Independent Ambulation by Thoracic Level Paraplegics, Proc. 1999 ISTNii Congress on Instrumentation in Neurosurgery, Paper 061. p. 61. Las Vegas, April 29- May 2, 1999.
115. A Novel Large-Memory Neural Network as an Aid in Medical Diagnosis Applications, Proc. 3rd International BSI (Biomedical Signal Interpretation) Workshop, pp/ 366-369, Chicago, IL, June 1999.

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117. A Wavelet Approach to Blind Adaptive Filtering, Proc. 43 rd IEEE Midwest Circuits and Systems Symp., E. Lansing, MI, Vol.43, pp. 1362-1365, August 2000. (D. Veselinovic and D. Graupe).
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119. Prediction of Fetal Wellbeing Using a Novel Neural Network, Proc. IASTED Signal Processing Conf., Heraklion, Greece, pp. 119-124, June 2002 (D. Scarpazza, M.H. Graupe, C.J. Hobel and D. Graupe).
120. A Neural Network Approach to Blind Separation of Unknown Mixed Channels, Proc. 12 th ANNIE Conf. (Artificial Neural Nets in Engg.), St. Louis, MO, pp. 689-694, Nov. 2002, (P. Suliga and D. Graupe)
121. A Novel Neural Network Application to Blind Adaptive Filtering of Unknown Noise from Speech, Proc. 12 th ANNIE (Artif. Neur. Net. In Engg.) Conf., St. Louis, MO, pp. 683-688, Nov. 2002 (D. Graupe and J. Abon).
122. Automated Detection of Epilepsy Using a LAMSTAR Neural Network, Proc. IASTED Internatl. Conf. On Biomedical Engineering, Salzburg, Austria, June 2003 (V.P. Nigam and D. Graupe).
123. A Motion Trajectory Based Video Retrieval System Using Parallel Adaptive Self Organizing Maps, Proc. International Joint Conf. on Neural Networks- IJCNN, (Wei Qu, Faisal I. Bashir, Dan Graupe, Ashfaq Khokhar, and Dan Schonfeld), 2005
124. Extraction of Fetal ECG from Maternal ECG, D Graupe, MH, Graupe, D, Zhong, Y, 26th Conf on Fetal Maternal Medicine, Amer. College Obstetrics & Gynecology, Miami Beach, Feb 2006 (ABSTRACT. Amer J Obstet. Gyn. March 2006).
125. Extracting Fetal from Maternal ECG for Early Diagnosis: Theoretical Problems and Solutions: BAF and ICA, Proc. 5th IASTED International Conf on Biomedical Engineering, pp. 352-356, Feb 2007.
126. Performance evaluation and patient training in FES for ambulation by complete thoracic level paraplegics, D Graupe and H Cerrel-Bazo, Padua Muscle Days: The Long Lasting Denervated Muscle, Padua, Italy, April 2007
127. Direct Back-Propagation control of unstable nonlinear systems with Unknown Parameter: Difficulties, strategies and results (D Graupe, E saric and M Smollak), Proc. IASTED International Conf on Control & Appl., Paper 568-006, pp. 158-162, Montreal, May, 2007.
128. Walking by Complete Thoracic-Level Paraplegics Via FES: Present Status and System Improvements, Proc. 12th IFESS Annual Conf., Philadelphia, PA, Session 3, Nov. 2007.

129. Control of Unstable Nonlinear and Nonstationary Systems Using LAMSTAR Neural Networks, Proc. 10th IASTED Internat. Conf. on Intelligent Systems and Control, Cambridge, MA, pp. 50-54, Nov. 2007 (D Graupe and M Smollack).

130. Stochastic modelling of the neuronal activity in the thalamus of essential tremor patient, IEEE/EMBS 32nd Ann. International Conf IEEE, Buenos Aires, 2010 (Ishita Basu, Daniela Tuninetti, Daniel Graupe, Konstantin V Slavin)

Honors

1. Election as IEEE Fellow, 1984.
2. Election as IEEE LIFE FELLOW, 2003
3. Springer Visiting Chair of Engineering, Univ. of California - Berkeley, 1977
4. Election and Appointment as Bodine Chair Professor (First holder of Chair - lifetime appointment) & Distinguished Professor at Illinois Institute of Technology (elected in 1994).
5. Certificate of Commendation on Research into Electrical Stimulation of Paraplegics - Cand. Paralysis Assoc., 1992.
6. Michigan Legislature - Joint resolution of House and Senate honoring Research into Elect. Stim. of Paraplegics by D. Graupe, 1994.
7. Governor of Michigan - Commendation of Research into Elect. Stim. of Paraplegics, 1995.
8. American Association of Life Extension - same as #6, 1995.
9. Election as Senior Scholar of University of Illinois, 1988-91
10. Best Paper Award, 6th Annual ANNIE (Artificial Neural Networks in Engineering) Conference, St. Louis, MO, 1996.
11. Keynote Address at IASTED International Conference on Signal Processing & Pattern Recognition, Heraklion, Greece, June 2002.
12. Election to serve on the IEEE-ESBM Regional Conferences Committee, 2004
13. Election to serve on the Executive Committee of the Board of the International Society of Bioelectromagnetism (ISBEM), (2004-2008).

U.S. Patents

1. Method & Means for Adaptively Filtering Noise from Speech, US Pat # 4,025,721, issued 5/24/77
2. Multifunctional Control for Above-Elbow Prosthesis, US Pat # 4,030,141. issued 6/21/77
3. Method & Means for Scrambling & Descrambling of Speech, US Pat # 4,086,435. 4/25/78
4. Method & Means for Processing Audio Freq. Signals to Conceal Intelligibility, US Pat # 4,126,761, issued 11/21/78
5. Method & Means. for Adaptively Filtering Near Stationary Noise, US Pat # 4,185,168, issued 6/22/80
6. ARMA Filter & Means to Design Same,US Pat # 4,188,667, issued 2/12/80
7. Multifunctional Control of Upper-Limb Prosthesis, US Pat # 4,209,860, issued 7/1/80
8. Improved Limb Prosthesis, US Pat # 4,220,176, issued 11/8/80
9. Adaptive Filtering of Acoustic Feedback, US Pat # 4,783,818, issued 11/8/88
10. Functional Electrical Stimulation (FES) Sys., US Apt # 5,014,705, issued 5/14/91
11. Method & Means For A Novel FES Sys., US Past # 5,016,635, applied Nov. 29, 1988, issued 5/21/91
12. Method & Means For Stim. Quadriceps,US Pat # 5,070,873, issued 12/10/91
13. Improved FES Sys., US Pat # 5,081,989, issued 1/21/92
14. An Improved FES Sys. & Its Control, US Pat # 5,092,329, issued 3/3/92
15. Artificial-Intelligence-Based Noise Reduction Sys, US Pat # 5,097,510, issued 3/17/92
16. Active Noise Cancellation Sys., US Pat # 5,140,640, issued 8/18/92
17. A Nonlinear Stochastic-Deterministic Blind Adaptive Filter (BAF), US Pat# 5,721,694, issued 12/23/97
18. BAF Closed-Loop System, US Pat# 5,768,392, issued 2/24/98
19. Compression Of Speech, US Pat # 5,822,370, issued 10/13/98
20. A Large Memory Neural Network, US Pat # 5,920,852, issued 7/6/99

21. N-Stage Compression of Speech, US Patent # 6,032,113, issued: 2/29/00.
22. Extraction of Fetal Electrocardiograms from maternal Electrocardiograms (M. H. Graupe, D. Graupe, P L Suliga, Y Zhong), Filed on behalf of University of Illinois, US Pat. # 7,680,531, issued 2010
23. Blind Adaptive Filtering for Extraction of Fetal ECG (D Graupe, M H Graupe, Y Zhong, Y), filed on behalf of the University of Illinois, US Pat. # 7,747,316, issued Oct. 13, 2011
24. Separation of One or More Fetal Heart Signals from Abdominal Signals of Pregnant Female (D Graupe, M H Graupe, Y Zhong), filed on behalf of University of Illinois, US Pat. # 7,747,318, issued June 29. 2010
25. Improvements in Deep Brain Stimulation, (D Graupe), filed on Behalf of Univ. of Illinois, US Pat. # 8,260,516, issued Oct, 2, 2012
26. Treating Neurological Disorders, (D Graupe and D Tuninetti), filed on Behalf of Univ. of Illinois, US Pat. # 8,391,986, issued March 5, 2013

Also, several Foreign Patents (issued in U.K., Japan, Canada, Germany, Australia, etc.) based on the above U.S. Patents.