

## VITAE - Weldon A. Lodwick

### EDUCATION

Institution	Date	Degree	Major
Muskingum College	1963-1967	B.S.	Mathematics
University of Cincinnati	1967-1969	M.A.	Mathematics
Oregon State University	1973-1977	Ph.D. (1980)	Mathematics

**Thesis title:** "Two Numerical Methods for the Solution of Optimal Control Problems with Computed Error Bounds Using the Maximum Principle of Pontryagin"

**Supervisor:** Dr. Joel Davis

### PROFESSIONAL EXPERIENCE (last 35 years)

2017 – Present	Faculty Advisor to Faculty Assembly and the Provost of the University of Colorado Denver for Mediation and Professionalism
2015 – Present	Visiting Research Professor – University of Campinas, Mathematics Institute (IMECC), three sets of 3 month each.
2014 – Present	Professor Colaborador: Universidade Estadual Paulista-IBILCE São José do Rio Preto, São Paulo, Brazil
2012 calendar year	Visiting Professor Universidade Estadual de São Paulo, Departamento de Matemática Aplicada, São José do Rio Preto, São Paulo, Brazil
2011	Interim Chair, Physics Department, University of Colorado, Denver
2002 – Present	Full Professor of Mathematics, University of Colorado Denver
1991 - 1993	Visiting Associate Professor, Systems Analysis, Miami University, Oxford, Ohio
1989 – 2002	Associate Professor of Mathematics, University of Colorado Denver
1982 - 1989	Assistant Professor of Mathematics, University of Colorado Denver
1977 - 1982	Research Assistant and Assistant Professor, Department of Resource Development and co-director of the MSU/CRIES international project in Central America, Caribbean, and Syria, Michigan State University and Organization of American States

### AWARDS, HONORS, and SIGNIFICANT POSITIONS

- 2017 – present, faculty advisor to University of Colorado Denver, Faculty Assembly and University of Colorado Denver Provost to mediate and work with issues surrounding professionalism
- 2014 – Visiting Researcher (2015-2018): Universidade de Campinas – IMECC, Campinas, São Paulo, Brazil. Grant from CNPq.
- 2012 – Visiting Researcher: Universidade Estadual Paulista – IBILCE São José do Rio Preto, São Paulo, Brazil, Department of Computer Science, Statistics and Applied Mathematics. Grant from FAPESP no. 2011/13985-0
- 2011 – Interim chair, Department of Physics, University of Colorado, Denver
- 2011 – Present, Board Member, North American Fuzzy Information Processing Society (NAFIPS)
- 2010 – Present, Director, Center for Computational and Mathematical Biology, Department of Mathematical and Statistical Sciences, University of Colorado, Denver
- 2009 – Present, Research Fellow, Semeion Centro di Scienze della Comunicazione, Rome, Italy
- 2009 – University Distinguished Service Award (CU System of four campuses service award)
- 2008 – Visiting Professor (one month), Paul Sabatier University, Toulouse, France
- 2007 – 2018, Area Editor (fuzzy interval analysis and fuzzy differential equations) *Fuzzy Sets and System*
- 2005 – June 30, 2010 Chair of Faculty Senate Privilege and Tenure Committee, University Colorado System-wide Grievance and Dismissal Committee (three universities and four campuses), Vice Chair 2016-2017, Panel Chair

from 2016 – present.

2003 – Present, Board of Editors (Area Editor) for *Fuzzy Sets and System* and  
Chair of Optimization Under Uncertainty Special Interest Group of IFSA

2001 – 2011 Secretary and Director (publicly elected and re-elected) of South Englewood  
Sanitation District No. 1

2000 – Fulbright Research Fellowship (University of Coimbra, Portugal)

1994 – 1995 Outstanding Faculty – granted by students of the College of Engineering of the University of Colorado  
at Denver for teaching

1972 – Star Teacher, Burke County, Georgia

## ARTICLES PUBLISHED - refereed

### 2018

Lodwick, W. A., Jamison, K. D., “A constraint fuzzy interval analysis approach to fuzzy optimization,” *Information Sciences*, Vol. 426 (2018): 38-49.

Tiago M. da Costa, Yurilev Chalco Cano, Weldon A. Lodwick, Geraldo N. Silva, “A new approach to linear interval differential equations as a first step toward solving fuzzy differential”, *Fuzzy Sets and Systems*, Vol. 347, 15 September 2018, pp. 129-141.

Roman-Flores, H., Chalco-Cano, Y., Lodwick, W.A., ”Some integral inequalities for interval-valued functions,” *Computational and Applied Mathematics*, Vol. 35:2, May 2018, pp. 1306-1318.

de Salles Neto, L.L., Lavor, C., Lodwick, W.A., “A constraint interval approach to the generalized distance geometry problem,” *Optimization Letters*, 24 July, 2018 (first online appearance) pp. 1-10.

Esmi, E., Santo Pedro, F., Barros, L., Lodwick, W.A., “Frechet derivatives for linearly correlated function,” *Information Sciences*, Vol 435, April 2018, pp. 150-160.

Keyanpour, M., Tabar, M. Lodwick, W.A., “A solution algorithm for a system of interval linear equations based on the constraint interval point of view” *Reliable Computing*, February 8, 2018 (paper 189).

Tabar, M. , Keyanpour, M., Lodwick, W.A., “Solving interval linear programming problems using extended interval enclosure methods” *Soft Computing*, August 11, 2018 (first online appearance), pp. 1-11.

### 2017

Campos, J.R., Assuncao, E., Silva, G.N., Lodwick, W.A., Texeira, M.C.M., “Discrete-time interval optimal control problem,” *International Journal of Control*, (2018), online version December 8, 2017.

Costa, T., Bouwmeester, H , Lodwick, W., Lavor, C., “Calculating the possible conformations arising from uncertainty in the molecular distance geometry problem using constraint interval analysis, *Information Sciences*, 415–416 (2017) 41–52.

Leela-Apiradee, Worrawate, Weldon A. Lodwick, and Phantipa Thipwiwatpotjana. "An algorithm for solving two-sided interval systems of max-plus linear equations." *Information Sciences* 399 (2017): 183-200.

### 2016

Chalco-Cano, Y, Lodwick, W., Osuma-Gomez, R., Rufian-Lizana A., “The Karush-Tucker optimality conditions for fuzzy optimization problems,” *Fuzzy Optimization and Decision Making*, **15**:1, March 2016, pp. 57-73, DOI 10.1007/s10700-015-9213-9.

Romã-Flores, H., Chalco-Cano, Y., and Lodwick, W. A., “Some integral inequalities for interval-valued functions,” *Computational and Applied Mathematics*, November 16, 2016, pp. 1-13, DOI 10.1007/s40314-016-0396-7.

### 2015

Buscema, M., Asadi-Zeydabadi, M., Lodwick, W. A., Breda, M., “The H0 function, a new index for detecting structural/topological complexity in undirected graphs,” *Physica A: Statistical Mechanics and its Applications*, December 2015, DOI: 10.1016/j.physa.2015.12.055.

Chalco-Cano, Y., Lodwick, W. A. and Condori-Equice, W, “On Ostrowski inequalities for interval-valued functions and applications”, *Soft Computing*, **19**, 3293-3300. DOI: 10.1007/s00500-014-1483-6

Costa, T., Chalco-Cano, Y., Lodwick, W. A., Silva, G., “Generalized interval vector spaces in interval optimization,” *Information Sciences*, **311**, pp. 74-85.

Costa, T., Lodwick, W. A., Chalco-Cano, Y., Silva, G., “A new approach for differentiability of interval-valued functions as a first step toward fuzzy differentiability,” Fuzzy Information Processing Society (NAFIPS) held jointly with 2015 5th World Conference on Soft Computing (WConSC), 2015 Annual Conference of the North American Proceedings of NAFIPS 2015, Redmond, Washington, August 17-19, 2015.

Inuiguchi, M., and Lodwick, W. A., “Foundational contributions of K. Asai and H. Tanaka to Fuzzy Optimization,” *Fuzzy Sets and Systems*, **274**, pp. 24-46. DOI: 10.1016/j.fss.2014.10.005.

Lodwick, W. A., and Dubois, D., “Interval linear systems as a necessary step in fuzzy linear systems,” *Fuzzy Sets and Systems* (online version October 20, 2015), **274**, pp. 227-251. DOI: 10.1016/j.fss.2015.03.018.

Massimi, V., Asadi-Zeydabady, M., Buscema, M., Dominici, D., Lodwick, W. A., and Simeoni, L., “The contribution of Artificial Adaptive System to limit the influence of systematic errors in the definition of the kinematic behavior of an extremely-slow landslide,” *Engineering Geology*, DOI: 10.1016/j.enggeo.2015.12.022.

#### 2014

Chalco-Cano, Y., Lodwick, W. A., and Bede, B. “Single level constraint interval arithmetic”, *Fuzzy Sets and Systems*, **257** December 16, 2014, Pages 146–168.

#### 2013

Lodwick, W. A. and Jamison, K. D., “Fuzzy Set and Possibility Theory in Optimization: L. Zadeh.s Contributions,” in *On Fuzziness? A Homage to L. Zadeh*, Rudolf, Enric Trillas, Settimo Termini and Claudio Moraga (eds.), Berlin, Heidelberg et al.: Springer-Verlag (Studies in Fuzziness and Soft Computing), 2013.

Lodwick, W. A., and Jenkins, O., “Constrained intervals and interval spaces,” *Soft Computing*, August 2013, **17**: 8, pp 1393-1402.

Boodgumarn, P., Thipwiwatpotjana, P., Lodwick, W.A., “When a probability interval is a random set,” *ScienceAsia* **39**, pp. 319-326, doi:10.2306/scienceasia1513-1874.2013.39.319.

Buscema M., Grossi, E., Bronstein, A., Lodwick, W. A., Asadi-Zeydabadi, M., Benzi, R., Newman, F., “A New Algorithm for Identifying Possible Source of the Epidemic With Application to the German Escherichia Coli Outbreak,” *International Journal of Geo-Information*, **2**:1, pp. 155-200, doi:10.3390/ijgi2010155

Buscema, Massimo, Sacco, Pier Luigi, and Lodwick, Weldon, “A systematic approach to discrete diffusion models for time and space extrapolation,” in *Intelligent Data Mining Applications Using Artificial Adaptive Systems* William Tastle (Editor). Springer-Verlag, 2013.

Chalco-Cano, Y, Lodwick, W., Rufian-Lizana A., “Optimality conditions of type KKT for optimization problem with interval-valued objective function via generalized derivative,” *Fuzzy Optimization and Decision Making*, **12**:1, March 2013, DOI 10.1007/s10700-013-9156-y.

Chalco-Cano, Y., Lodwick, W.A., Roman-Flores, H., “The Karush-Kuhn-Tucker optimality conditions for a class of fuzzy optimization problems using strongly generalized derivative,” Proceedings 2013 IFSA World Congress, pp. 203-208.

Inuiguchi, M., Lodwick, W. A., “The contributions of K. Asai and H. Tanaka in Fuzzy Optimization,” *Proceedings 2013 IFSA World Congress*, pp. 274-279.

Thipwiwatpotjana, P. and Lodwick, W. A., “A relationship between probability interval and random sets and its application to linear optimization with uncertainties,” *Fuzzy Sets and Systems*, **231**, November 2013, pp. 45-57.

Thipwiwatpotjana, P. and Lodwick, W. A., “Pessimistic, optimistic, and minimax regret approach for uncertain linear programs.” *Fuzzy Optimization and Decision Making*, published online November 15, 2013, DOI: 10.1007/s10700-013-9171-z, (2014) 13, pp. 151–171.

## 2012

Lodwick, W. A., “An Overview of Flexibility and Generalized Uncertainty in Optimization,” *Computational and Applied Mathematics*, **31:3**, pp. 1-21.

Buscema, M., Breda, M., Lodwick, W.A., “Training with input section and testing (TWIST) algorithm: a significant advance in pattern recognition performance of machine learning,” *Journal of Intelligent Learning Systems and Applications*, 2012, DOI: 10.4236/jilsa.2012.

## 2011

Chalco-Cano, Y., Lodwick, W., Bede, B., ‘Fuzzy differential equations and Zadeh's extension principle,” *Proceedings of the North American Fuzzy Information Processing Society*, NAFIPS 2011, El Paso, Texas.

Thipwiwatpotjana, P. and Lodwick, W. A., “The relationship between probability interval and random sets,” *Proceedings of the North American Fuzzy Information Processing Society*, NAFIPS 2011, El Paso, Texas.

## 2010

Lodwick, W. and Untiedt, Elizabeth, “Introduction to Fuzzy and Possibilistic Optimization” in Chapter 1: *Fuzzy Optimization: Recent Developments and Applications*, Weldon A. Lodwick and Janusz Kacprzyk (Editors), Springer-Verlag, New York, 2010.

Chalco-Cano, Y., Lodwick, W. A., “On difference of intervals and differentiability of interval-valued functions”, *Proceedings of the North American Fuzzy Information Processing Society*, NAFIPS 2010, Toronto, Canada, July 12-14, 2010.

## 2009

Lodwick, W., “The relation between interval, fuzzy, and possibilistic optimization,” *Modeling Decisions for Artificial Intelligence Conference Proceedings*, November 30 – December 2, 2009, Awaji Island, Japan.

Lodwick, W. and Untiedt, E., “Fuzzy optimization,” in Meyers, R.A. (editor) **Encyclopedia of Complexity and Systems Science**, Soft Computing Section editor Janusz Kacprzyk, Springer Verlag, 2009.

Thipwiwatpotjana, Y. and Lodwick, W., “The use of interval-valued probability measures in fuzzy linear programming: A constraint set approach,” *IFSA-EUSFLAT 2009, Proceedings*, Lisbon, Portugal, July 20-24, 2009.

## 2008

Lodwick, W. and Jamison, D., “Interval-Valued Probability in the Analysis of Problems Containing a Mixture of Possibilistic, Probabilistic, and Interval Uncertainty,” *Fuzzy Sets and Systems*, **159:1**, 1 November 2008, pp.2845-2858

Lodwick, W., “Fundamentals of interval analysis and linkages to fuzzy set theory,” in **Handbook of Granular Computing**, Withold Pedrycz, Andrzej Skowron, and Vladik Kreinovich, John Wiley, Publishers, West Sussex, England, 2008, pp. 55-79.

Lodwick, W. , “Introduction to fuzzy surfaces” in Chapter 1: **Fuzzy Surfaces in Geographical Information**

**Systems**, Weldon A. Lodwick (editor), CRC Publishers, 2008.

#### 2007

Lodwick, W. and Jamison, K.D., "The Use of Interval-Valued Probability Measure in Optimization Under Uncertainty for Problems Containing a Mixture of Possibilistic, Probabilistic and Interval Uncertainty," in **Fundamentals of Fuzzy Logic and Soft Computing**, 12<sup>th</sup> International Fuzzy Systems Association World Congress, IFSA 2007, Cancun, Mexico, June 18-21, 2007 Proceedings, pages 361-370.

Untiedt, E. and Lodwick, W., "On selecting an algorithm for fuzzy optimization," in **Fundamentals of Fuzzy Logic and Soft Computing**, 12<sup>th</sup> International Fuzzy Systems Association World Congress, IFSA 2007, Cancun, Mexico, June 18-21, 2007 Proceedings, pages 371-380.

Lodwick, W. **Interval and Fuzzy Analysis: A Unified Approach**. *Advances in Imaging and Electronic Physics*, Vol. 148, pp. 76-192, Elsevier, 2007.

Lodwick, W. and Jamison, K.D., "Theory and semantics for fuzzy and possibilistic optimization," *Fuzzy Sets and Systems*, 158:17, pp. 1861-1871.

#### 2006

Lodwick, W. and Jamison, K.D., "Interval-valued probability in the analysis of problems containing a mixture of fuzzy, possibilistic and interval uncertainty", *Proceedings NAFIPS'06*, June 3-6, 2005, Montreal, Canada.

#### 2005

Lodwick, W. and Bachman, K., "Solving Large Scale Fuzzy Possibilistic Optimization Problems", *Fuzzy Optimization and Decision Making*, Volume 4, Number 4, pages 257-278, October 2005.

W.A. Lodwick, and K.D. Jamison, "Theory and semantics for fuzzy and possibilistic optimization," *Fuzzy Logic, Soft Computing and Computational Intelligence* (Eleventh International Fuzzy Systems Association World Congress), July 28-31, 2005, Beijing, China, Volume III, pp. 1805-1810.

Fonte, Cidalia and Lodwick, W., "Modeling the fuzzy spatial extent of geographical entities" in Cobb, M., Petry, F., and Robinson, V. (editors), **Fuzzy Modeling with Spatial Information for Geographical Problems**, Springer-Verlag, 2005.

#### 2004

Weldon A. Lodwick, K. David Jamison and Katherine A. Bachman, "Fuzzy and Possibilistic Optimization: Theory, Semantics and Algorithms for Solving Large Problems", *NAFIPS'2004 – Proceedings*, June, 2004. Fonte, Cidalia and Lodwick,

Fonte, C. and Weldon A., "Areas of Fuzzy Geographical Entities." *International Journal of Geographical Information Systems*, Volume 18 No. 2, March 2004, pp. 127-150.

#### 2003

Lodwick, W.A. and Jamison, K.D., "Estimating and Validating the Cumulative Distribution of a Function of Random Variables: Toward the Development of Distribution Arithmetic," *Reliable Computing*, 9:2, pp. 127-141.

Moore, R.E., and Lodwick, W.A., "Interval Analysis and Fuzzy Set Theory," *Fuzzy Sets and Systems*, 135:1, pp. 5-9.

Lodwick, W.A. and Santos, J., "Constructing Consistent Fuzzy Surfaces from Fuzzy Data," *Fuzzy Sets and Systems*, 135:2, pp. 259-277.

#### 2002

Jamison, K.D., and Lodwick, W.A., "The Construction of Consistent Possibility and Necessity Measures," *Fuzzy Sets and Systems*, 132:1, pp. 1-10.

Santos, J., Lodwick, W.A. and Neumaier, A., "A New Approach to Incorporate Uncertainty in Terrain Modeling," in **Lecture Notes in Computer Science Vol. 2478** by M. Egenhofer and D. Mark (editors), Springer-Verlag, 2002.

Russell, S., and Lodwick, W.A., "Fuzzy Game Theory and Internet Commerce: e-Strategy and Metarationality," *NAFIPS'2002 – Proceedings*, June, 2002.

### 2001

Lodwick, W.A., Neumaier, A. and Newman, F. D., "Optimization Under Uncertainty: Methods and Applications in Radiation Therapy," *Proceedings 10<sup>th</sup> IEEE International Conference on Fuzzy Systems 2001*, Volume 3, pp. 1219-1222.

Lodwick, W.A., Jamison, K. D. and Newman, F. D., "Extension of Interval Validation Methods to Fuzzy Set Theory," *NAFIPS'2001 – Proceedings*, edited by Larry Hall, July, 2001, pp. 1665-1670.

Jamison, K. D., Lodwick, W.A. and Newman, F. D., "Optimization Under Uncertainty Using Possibility and Necessity Distributions Consistent with Probability Distributions," *NAFIPS'2001-Proceedings*, edited by Larry Hall, July, 2001, pp. 1671-1676.

Jamison, K.D. and Lodwick, W.A., "Fuzzy Linear Programming Using Penalty Method," *Fuzzy Sets and Systems*, Vol. 119, 2001, pp. 97-110.

### 2000

Lodwick, W.A. and Jamison, K.D. and Russell, D., "A Comparison of Fuzzy, Stochastic and Deterministic Methods in Linear Programming," *19<sup>th</sup> International Conference of the North American Fuzzy Information Processing Society*, edited by Thomas Whalen, July 2000, pp. 321-325.

### 1999

Lodwick, W.A. and Russell, D., "The Use of Fuzzy Optimization Methods for Radiation Therapy of Tumors," *18<sup>th</sup> International Conference of the North American Fuzzy Information Processing Society*, edited by Rajesh N. Dave and Thomas Sudkamp, June 1999, pp.288-293.

Russell, S. and Lodwick, W.A., "Fuzzy Clustering in Data Mining for Telco Database Marketing Campaigns," *18<sup>th</sup> International Conference of the North American Fuzzy Information Processing Society*, edited by Rajesh N. Dave and Thomas Sudkamp, June 1999, pp. 720-726.

Jamison, K.D. and Lodwick, W.A., "Minimizing Unconstrained Fuzzy Functions," *Fuzzy Sets and Systems*, Vol. 103, No. 3, May 1999, pp. 457-467.

### 1998

Lodwick, W.A. and Jamison, K.D. " Fuzzy Optimization: Computational Methods and Applications to Radiation Therapy of Tumors," *EUFIT '98*, Vol. 3, Verlag Mainz, 1998, pp. 1888-1898.

Lodwick, W.A., S. McCourt, D. Newman, and S. Humphries, "Optimization Methods for Radiation Therapy Plans," in Borgers, Christof and Natterer, Frank (editors) **IMA Series in Applied Mathematics - Computational Radiology and Imaging: Therapy and Diagnosis**, Springer-Verlag, 1998.

### 1997

Lodwick W.A. and Jamison, K.D., "A Computational Method for Fuzzy Optimization," in Ayyub, Bilal and Gupta, Madan (editors), **Uncertainty Analysis in Engineering and Sciences: Fuzzy Logic, Statistics, and Neural Network Approach**, Kluwer Academic Publishers, 1997.

Lodwick, W.A., and Jamison, K.D., "Interval Methods and Fuzzy Optimization," *International Journal of Uncertainty, Fuzziness and Knowledge-Based Reasoning*, Vol. 5, No. 3, June, 1997, pp. 239-250.

### 1996

Corliss, G. and Lodwick, W.A., "Correct Computation of Solutions of Differential Algebraic Control Equations," *Zeitschrift fuer Angewandte Mathematik und Mechanik (ZAMM)* Special Volume: Numerical, Scientific Computing, Computer Science, 1996, Akademie Verlag, Berlin.

**1992**

Lodwick, W.A. and Levine, R., Chapter 3: "Sensitivity of Parameter and Loop Structures," pp. 43-86, Chapter 4: "Psychological Scaling and Filtering of Errors in Empirical Systems," pp. 87-118, Chapter 5: "Parameter Estimation and Assessing the Fit of Dynamic Models," pp. 119-150, in **Analysis of Dynamic Psychological Systems: Methods and Applications**, Volume 2, edited by, Ralph Levine and Hiram Fitzgerald, Plenum Press, 1992

Lodwick, W.A. "Preprocessing Nonlinear Functional Constraints with Application to the Pooling Problem," *ORSA Journal on Computing*, Vol. 4 No. 2, May, 1992, pp. 119-131.

**1990**

Lodwick, W.A., "A Generalized Convex Stochastic Dominance Algorithm," *IMA Journal of Mathematics in Business and Industry*, Vol. 2, No.3, Nov. 1990, pp. 225-246.

Lodwick, W., A. "Analysis of Structure in Fuzzy Linear Programs," *Fuzzy Sets and Systems*, Vol. 38, No. 1, October 1990, pp. 15-26.

Lodwick, W.A., W. Munson, and L. Svoboda, "Attribute Error and Sensitivity Analysis of Map Operations in Geographic Information Systems: Suitability Analysis" *The International Journal of Geographic Information Systems*, Vol. 4, No. 4, October 1990, pp. 413-428.

**1989**

Lodwick, W.A., "Constraint Propagation, Relational Arithmetic in AI Systems and Mathematical Programs," *Annals of OR, Special Issue: Linkages with Artificial Intelligence*, Vol. 21 (1989), pp. 143-148.

Lodwick, W.A., "Developing Confidence Limits on Errors of Suitability Analyses in Geographic Information Systems," in Goodchild, M. and Suchi, G. (eds), **Accuracy of Spatial Databases**, Taylor and D., London, United Kingdom, 1989, pp. 69-78.

**1988**

Lodwick, W.A., "The Use of Interval Analysis to Uncover Structures of Linear Systems," in Moore, R.E. (ed), **Proceedings of the International Workshop on Reliability and Computing**, Academic Press, 1988, pp. 341-353.

Lodwick, W.A., "Fuzzy Set Theoretic Approaches to Natural Language in Decision Support Systems," in Mitra, G. (ed), **Proceedings of the NATO ASI Conference on Mathematical Models for Decision Support**, Springer Verlag, 1988, pp. 575-584.

**1984**

Robison, L., Cochran, M. and Lodwick, W.A., "Improving the Efficiency of Stochastic Dominance Techniques using Convex Set Stochastic Dominance," *American Journal of Agricultural Economics*, Vol. 67, No. 2, 1984, pp. 289-295.

**BOOKS****Completed****2018**

Buscema, M., Lodwick, W. A., Breda, M., Guilia, M., Newman, F., Asadi, M. **Artificial Adaptive Systems in Data Understanding: Auto CM**. Springer-Verlag, 2018

**2017**

Lodwick, W. A., Thipwiwatpotjana, P. **Flexible and Generalized Uncertainty Optimization**, Springer-Verlag, January, 2017 (ISSN 978-3-319-51105-4). Second edition to be completed and in press 2019.

Lavor, C., Liberti, L., Lodwick, W., Costa, T. **An Introduction to Distance Geometry Applied to Molecular**

**Conformation.** Springer-Verlag, 2017.

## 2016

Barros, L. C., Bassanezi, R. C., Lodwick, W. A. *A First Course in Fuzzy Logic, Fuzzy Dynamical Systems and Biomathematics*, Springer-Verlag, September, 2016.

## 2008-2015

Lodwick, Weldon A. and Kacprzyk, Janusz, (editors). *Fuzzy Optimization: Recent Developments and Applications*, Springer-Verlag, New York, 2010.

Lodwick, Weldon A. (editor). *Fuzzy Surfaces in GIS and Geographical Analysis: Theory, Analytical Methods, Algorithms and Applications*, CRC Publishers, 2008.

## In Progress

Lodwick, W. A., Jamison, D. K. *Flexible and Generalized Uncertainty Optimization*, Springer-Verlag, March, 2018 submission (second edition – expanded)

Busema, M., Asadi, M., della Torre, F., Masini, G., Newman, F., Lodwick, W.A. *Topological Mapping* (expected submission, March 2019).

Lodwick, Weldon A. and Kacprzyk, Janusz. *A Primer of Flexible and Generalized Uncertainty Nonlinear Optimization*. Springer-Verlag (expected submission March 2020).

## ARTICLES

### 2018 – In progress

U. Leal, W.A. Lodwick, G.N. Siva, G. M. Huamum, “Continuous interval Optimization and optimal control under uncertainty” (written and in final revision before submission)

Chalco-Cano, Y., Maqui, G., Lodwick, W., Silva, G., “Necessary and sufficient conditions for interval optimization problems involving constraint interval arithmetic as a first step toward fuzzy optimization,” final revision for *Fuzzy Optimization and Decision Making*.

Lodwick, W.A., de Salles Neto, L. L., “The interval molecular Euclidean distance matrix completion problem” (final revisions prior to submission)

## SPECIAL ISSUES (journals)

Lodwick, Weldon A. and Oberguggenberger (editors), “Fuzzy Differential Equations,” *Fuzzy Sets and Systemes*, 2013.

Lodwick, Weldon A. and Inuiguchi, M. (editors), “Fuzzy and Possibilistic Optimization,” *Fuzzy Sets and Systems*, 2007.

Lodwick, Weldon A. and Jamison, K.D. (editors), “Interfaces between Fuzzy Set Theory and Interval Analysis,” *Fuzzy Sets and Systems*, **135**:1, April, 2003.

Lodwick, Weldon A. and Jamison, K.D. (editors), “Linkages Between Interval Mathematics and Fuzzy Set Theory,” *Reliable Computing*, 2002.

## PUBLICATIONS – un-refereed

Vladik Kreinovich, Daniel J. Berleant, Scott Ferson and Weldon A. Lodwick, “Combining Interval and Probabilistic Uncertainty: Foundations, Algorithms, Challenges -- An Overview,” Proceedings of the International Conference on Fuzzy Systems, Neural Networks, and Genetic Algorithms FNG'05, Tijuana, Mexico, October 13-14, 2005, pp. 1-10.



Jamison K. D. and Lodwick W. A., "Interval-Valued Probability Measures" July, 2004.

Jamison, K. D., Lodwick, W.A., and Kawai, M., "A Simple Closed Form estimate of the Cumulative Distribution Function a Monotone Function of a Random Variable," UCD/CCM Report No. 187, May, 2002.

Fonte, C., and Lodwick, W.A., "Modeling and Processing the Positional Uncertainty of Geographical Entities with Fuzzy Sets," UCD/CCM Report No. 176, August, 2001.

Corliss, G. and Lodwick, W.A., "The Role of Constraints in the Validated Solution of DAEs," Marquette University Technical Report No. 430 - March, 1996.

Lodwick, W.A. "Constrained Interval Arithmetic," UCD/CCM Report No. 138, February, 1999.

Lodwick, W.A. "Computing Minimal Admissible Sets in Decision Making Under Risk Using Convex Stochastic Dominance – Parts 1/2," UCD/RP 86-0101 and 86-0102, January 1986.

Lodwick, W.A. "A New Stochastic Dominance Criterion," UCD/RP 85-1201, December 1985.

Lodwick, W.A. "Interval Analysis and Optimal Control: Automatic Computation of Errors for Constrained and Unconstrained Problems," UCD/RP 85-1002, October, 1985.

Lodwick, W.A., "Two Interval Analytic Methods for Solving Unconstrained Optimal Control Problems Using Integral Equations with Automatically Computed Error Bounds," UCD/RP 85-1001, October 1985.

### **RESEARCH** (in progress)

Mizukoshi, M.T. and Lodwick, W.A. *Interval Differential Equations* (book – December 2020)

Mizukoshi, M.T. and Lodwick, W.A., (others) "Interval differential equations via differential algebraic equation," (article to be submitted December 2019)

Mizukoshi, M.T., dos Santos Ceconello, M., C., and Lodwick, W.A., "Interval non-linear differential equations stability analysis using constraint intervals," (article to be submitted December 2019)

Lodwick, W. A., "Reduction of uncertainty in molecular distance geometry analysis using constraint interval analysis" (article to be submitted by December 2019)

De Salles, Luiz L.; Lodwick, W.A., and Lavor, C., "Interval uncertainty and the Euclidean distance completion matrix problem," (article to be submitted March 2019).

De Sales, Luiz, Lavor, C., and Lodwick, W.A., (others), "The application of interval distance geometry problem algorithms to nuclear magnetic resonance experiments" (article to be submitted July 2019)

Mizukoshi, M.T., and Lodwick, W.A., "Interval linear differential equations stability analysis using constraint interval analysis" (article to be submitted December 2018)

Jamison, K.D. and Lodwick, W.A., "Interval-Valued Probability Measures: A formal method for consolidating information deficiency – Foundations," (article to be submitted December 2018).

### **TALKS AT PROFESSIONAL MEETINGS** (selected)

#### **2018**

Duy Tan Univesity, Danang, Vietnam, March 12, 2018, "Generalized uncertainty optimization: Tutorial"

Integrated Uncertainty in Knowledge Modelling and Decision Making (IUKM) 2018 - University of Hanoi, Hanoi, Vietnam, 2018 March 14, 2018– Tutorial, "A constraint function interval analysis approach to generalized uncertainty optimization", March 15, 2018, "Molecular distance geometry: The interval/fuzzy Euclidean distance matrix completion problem"

Chulalongkorn University, Bangkok, Thailand, March 19, 2018, "Generalized uncertainty optimization tutorial"

Chiang-Mai University, March 23, "A constraint interval approach to generalized uncertainty optimization"

NAFIPS 2018/CBSF V, Fortaleza, Ceará, Brazil, July 4-6, 2018, "Constraint interval function analysis – theory and application to generalized expectation in optimization"

International Conference on Industrial Mathematics, Foz de Iguaçu, July 23 – 27, 2018. “Thirty-five years of mathematics clinics at University of Colorado, Denver”

Universidade Federal de Goiás, Goiânia, Goiás, Brazil, November 20, 2018, “Interval-valued probability measures with application to dynamical systems”

Universidade Federal de São Paulo, São José dos Campos, SP, Brazil, August 15, 2018, “An introduction to generalized uncertainty optimization, November 13, “Interval-valued probability measures: A formal method for consolidating the languages of information deficiencies – Foundations”

Universidade Federal de São Paulo, São Paulo, SP, Brazil, sede central, November 22, 2019, “Personnel Problem Solving at the University of Colorado”

## 2017

Tenth Conference of the European Society for Fuzzy Logic and Technology (EUSFLAT 2017), keynote speaker, “A constraint fuzzy interval analysis approach to fuzzy optimization,” September 11-15, 2017, Warsaw, Poland.

University of Osaka, “A constraint fuzzy interval analysis approach to flexible (fuzzy) and generalized uncertainty (possibistic) optimization,” June 22, 2017.

## 2016

State University of São Paulo (UNESP), São José do Rio Preto, “The University of Colorado Denver, Department of Mathematics and Statistical Sciences Math Clinic Program” (November 21, 2016)

CBSF IV (Congresso Brasileiro de Sistemas Fuzzy), Mini-curso, “An Invitation to Flexible and Generalized Uncertainty Optimization” (November 16-19, three sessions).

Instituto de Alta Investigación, University of Tarapaca, “Distance Geometry and Constraint Interval Analysis” (November 7-11, 2016)

NAFIPS (North American Fuzzy Information Processing Society), University of El Paso, Texas, “

Scientific Computing, Computer Arithmetic and Verified Numerics, SCAN16, University of Uppsala, Sweden, (September 26-30, 2016), “The Molecular Distance Geometry Problem Under Interval Uncertainty” (Plenary Speaker)

CNMAC (Congresso Nacional de Matemática Aplicada e Computação), Gramado, Rio Grande do Sul, “Interval distance geometry problems” (September 5-9, 2016)

Federal University of Rio Grande do Sul (August 25), “Interesting applications of mathematics”

University of São Paulo - São Carlos, one-week workshop on distance geometry (July 4-9, 2016)

Federal University of São Carlos, Sorocaba, “Flexible and generalized uncertainty optimization and applications,” (June 9, 2016)

University of Campinas, Instituto de Matemática, Estatística, e Ciência de Computação, “Flexible and generalized uncertainty Optimization” (June 6, 2016)

## 2015

Lecture in distance geometry – July 29, 2015, IMECC-Unicamp (14:30-15:30), IMECC Lecture Series and Distance Geometry Seminar, “Incorporating uncertainty in the Molecular Distance Geometry Problem: An interval and constraint interval perspective”

June 8, 2015, Universidade Federal de Mato Grosso do Sul, Chapadão do Sul, MGS, Programa de Educação Tutorial, “Sistema Universitário de Pós-graduação nos EUA” Projeto de Extensão.

June 9, 2015, Universidade Federal de Goiás, Jataí, “Várias Aplicações da Matemática” (to undergraduate mathematics and statistics students and mathematics professors)

June 19, 2015, UNESP – Sorocaba, Ciências Ambientais, Ciclo de Seminários em Ciências Ambientais de 2015, “Introdução a Matemática Intervalar e Fuzzy com Aplicações – Boas Aplicações Requerem Boas Teorias: Tudo é Igual só Que é Diferente ou na Prática, a Teoria é Outra” (to undergraduate, graduate students, and professors of the Environmental Sciences Program)

July 15, 2015, University of Tarapaca, Chile – Arica, Departamento de Matematica, “Introduction to Interval and Fuzzy Mathematics with Applications” (undergraduates, graduates, and professors).

July 16, 2016, Universidad Nacional Jorge Basadre Grohmann, Facultad de Ciencias, Departamento Academico de Matemáticas y Estadística, Escuela Profesional de Matemática – Tacna, Perú, “Introduction to Interval and Fuzzy Mathematics with Applications”, (undergraduate, graduate, and professors)

**2014** - CBSF III (Congresso Brasileiro de Sistemas Fuzzy) and FLINS (Fuzzy Logic and Intelligent Technologies in Nuclear Science ), keynote speaker, “Solving Linear Systems with Interval Coefficients: A Unified Approach – Toward Solving Fuzzy Interval Systems”

UNESP – Departamento de Matemática Aplicada (September 3, 2014), “Interval linear systems”.

**2013** –2013 IFSA World Congress (invited special talk), “Professors Kiyoji Asai’s and Hideo Tanaka’s 1973-1983 Flexible and Generalized Uncertainty Optimization Approaches Revisited”

**2012** – Escola de Verao: Universidade Estadual Paulista, São José do Rio Preto, São Paulo (January 27, 2012)

Escola de Verao: Universidade Federal de Uberlandia, Uberlandia, Minas Gerais (February 15, 2012)

Sociedade Brasileira de Matemática Aplicada e Computacional – CNMAC, Aguas de Lindóia, São Paulo (September 17-21, 2012)

Congresso Brasileiro de Sistemas Fuzzy, Universidade Federal de Natal, Natal, Rio Grande do Norte (November 6-9, 2012), keynote speaker

**2011** – Dagstuhl Schloss, Germany, speaker (by invitation only conference)

ICIAM 2011, Vancouver, Canada, speaker

BioMathematics, Sofia, Bulgaria, keynote speaker

NAFIPS 2011, University of El Paso, Texas, speaker (three talks, two as co-author) and special session chair, “Theories of Uncertainties and Flexibility in Mathematical Analysis” (March 17 – 21, 2011)

**2010** – Congresso Brasileiro de Sistemas Fuzzy, UNESP, Sorocaba, November 2010, keynote speaker

NAFIPS 2010, “On difference of intervals and differentiability of interval-valued functions”, Yuri Chalco Cano and Weldon A. Lodwick, Toronto, Canada, July 12-14, 2010, special section chair.

SIMMAC XVII, University of Costa Rica, San Jose, Costa Rica, Short Course – Part 1: Interval, Fuzzy, and Possibilistic Optimization, (two hour presentation), Part 2: Radiation Therapy of Tumors, February 16-19, 2010.

**2009** – Plenary Speaker at the 6<sup>th</sup> Conference on Modeling Decisions for Artificial Intelligence, “The relation between interval, fuzzy, and possibilistic optimization,” November 30 – December 2, 2009, Awaji Island, Japan.

KENSAI Soft Computing Society, “State of the art in computing under uncertainty,” December 4, 2009, University of Osaka, Osaka, Japan.

IFSA 2009, Thipwivatpotjana, P. and Lodwick, W. A., “The use of interval-valued probability measures in fuzzy linear programming: A constraint set approach,” IFSA-EUSFLAT 2009, Proceedings, Lisbon, Portugal, July 20-24, 2001.

**2008** – IRIT (Toulouse, France), “Fuzzy interval analysis using constraint fuzzy arithmetic and gradual numbers with application to constraint logic programming, constraint propagation with interval labels,” May 6, 2008

NAFIPS'08, "Fuzzy interval analysis using constraint fuzzy arithmetic and gradual numbers," Rockefeller University, May 19-22, 2008.

New Trends in Industrial and Applied Mathematics: International Conference in the Memory of Professor A. M. Anile, invited speaker, "Being certain about uncertainty: Some ideas and extensions inspired by the research of Dr. Professor Marcello Anile", November 10-13, University of Catania, Catania, Italy.

University of Innsbruck, Innsbruck Austria, invited speaker, "Analysis of propagation of uncertainty: Recycled and newer methods," November 25, 2008.

**2007** – IFSA'07 (Cancun, Mexico), "The Use of Interval-Valued Probability Measure in Optimization Under Uncertainty for Problems Containing a Mixture of Possibilistic, Probabilistic and Interval Uncertainty", June 18-21, 2007

Universidad de Tarapacá, Departamento de Matemática, Arica, Chile, "Interfaces between fuzzy set theory and interval analysis," July 31, August 1,, 2007.

COMCA XVII Congreso de Matemática Capricornio – Universidad de Atacama, Departamento de Matemática, Copiapó de 1 a 4 de Agosto, "A survey of theory, methods, and applications of optimization under fuzzy and possibilistic uncertainty," Special Section on Teoria Fuzzy.

**2006** – NAFIPS'06 (Montreal, Canada), "Interval-valued probability in the analysis of problems containing a mixture of fuzzy, possibilistic and interval uncertainty"

**2005** – IFSA'05, July 28-31, 2005, Beijing, China, "Semantics for fuzzy and possibilistic optimization theory".

Kensai Soft Computing Society, August 9, 2005, University of Osaka, Osaka, Japan, "Large-scale fuzzy, and possibilistic optimization: Theory, semantics and application to radiation therapy of tumors".

Kensai Soft Computing Society, August 9, 2005, University of Osaka, Osaka, Japan, "The fuzzy hypercube as a theoretical framework in determining criteria for intervening in elder financial abuse situations", with Dora G. Lodwick.

Berkeley Initiative on Soft Computing (a center of the Computer Science Department, University of California, Berkeley) – invited workshop, "A tutorial on the interfaces between fuzzy set theory and interval analysis", BISCSE'05 – November 2, 2005 (the conference was November 2-5, 2005).

Berleant, D. J., Ferson, S., Kreinovich, V., and Lodwick, W. A., "Combining interval and probabilistic uncertainty: Foundations, algorithms, challenges – An overview," 4<sup>th</sup> International Symposium on Imprecise Probabilities and Their Applications, Pittsburgh, Pennsylvania, 2005

**2004** – NAFIPS'04 Talk, Weldon A. Lodwick, K. David Jamison and Katherine A. Bachman, "Fuzzy and Possibilistic Optimization: Theory, Semantics and Algorithms for Solving Large Problems", **NAFIPS'2004 – Proceedings**, June, 2004.

## **2002**

Highlighted Talk, 2002 SIAM Workshop on Validated Computing, May 22-25, Toronto, Canada "Validation Methods and Fuzzy Set Theory."

## **2001**

10<sup>th</sup> IEEE Conference on Fuzzy Systems, Invited Speaker (Optimization and Decision Making) "Consistent Possibilistic Optimization in Radiation Therapy Problems," December, 2001, Melbourne, Australia.

NAFIPS'2001, "The Extension of Interval Validation Methods to Fuzzy Set Theory," July 2001, Vancouver, Canada.

## **2000**

Ruhr-University Bochum (Germany), Invited Talk, "Fuzzy Optimization – Theory, Methods and State of the Art," Institute of Management and Operations Research, November 10, 2000.

Katholieke Universiteit Nijmegen (Netherlands), Informal talk to graduate students and professor of the Department Computer Science, "Interval Analysis Methods and Complexity Reduction in Proof Assistants (Computerized Proofs)," November 8, 2000.

University of Catania (Italy), Two Invited Talks, "Incorporating Uncertainty into GIS," and "Optimization Under Uncertainty," October 24, 25, 2000.

University of Coimbra, Invited Talk, "Optimization Under Uncertainty with Applications to Radiation Therapy," October 4, 2000.

NAFIPS'2000, "A Comparison of Fuzzy, Stochastic and Deterministic Methods in Linear Programming," July 2000, Atlanta, Georgia.

#### **1999**

NAFIPS'1999, "The Use of Fuzzy Optimization Methods for Radiation Therapy of Tumors," June 10-12, 1999, New York City, NY.

#### **1998**

SIAM Annual Meeting – Minisymposium on Validated Solutions of Ordinary Differential Equations and Differential Algebraic Equations, "The Role of Constraints in Computing Validated Solutions to Differential Algebraic Equations."

#### **1997**

Institute for Mathematics and its Applications Conference on Computational Radiology and Imaging: Therapy and Diagnosis (invited speaker) – University of Minnesota, "Optimization Methods in Radiation Therapy of Tumors."

#### **1996**

University of Coimbra, Coimbra, Portugal, Department of Mathematics, "Error Propagation in Geographical Analyses as Implemented in a GIS."

University of Vienna, Vienna Austria, Department of Mathematics, "The Mathematics of Radiation Therapy of Tumors."

George Corliss (Marquette University) presenter, "The Role of Constraints in the Validated Solution of DAE's", International Conference on Interval Methods and Computer Aided Proofs in Science and Engineering, Wurtzburg, Germany.

#### **1995**

Arnold Neumaier (University of Vienna) presenter, "Validating Solutions of Differential-Algebraic Systems," Stanford University to a by invitation only retirement session for C.W. Gear.

SIAM Conference on Control, "Validation Methods for the Solution of Unconstrained Optimal Control Problems Using Differential-Algebraic Equations."

ICIAM Hamburg 95, "Correct Computation of Solutions of Differential Algebraic Control Equations," George Corliss presenter.

ISUMA-NAFIPS'95 (North American Information Processing Society) The 3rd International Symposium on Uncertainty Modeling and Analysis, Invited Talk, "Fuzzy and Interval Nonlinear Optimization: Theory and Computational Methods," September 15-20, 1995, College Park, Md.

#### **1993**

Conference on Numerical Result Verification, University of Southwest Louisiana, Lafayette, Louisiana (one talk and chaired one session), February 25 - March 1, 1993

#### **1992**

(By Invitation Only - German Government with NSF Travel grant) Schloss Dagstuhl Internationales Begegnungsund Forschungszentrum für Informatik Conference on Symbolic, Algebraic and Validated Numerical Computation Algebra, "Three Applications of Interval Methods for Computing Feasible Regions of Nonlinear Systems," Schloss Dagstuhl, W-6648 Wadern, Germany, August 3-7, 1992

#### **1991**

Invited speaker at the 11th Roundtable for the development of an Intelligent Mathematical Programming System, November, 1991

**1990**

Invited Speaker at the ORSA/TIMS Spring meeting to a special session of Operations Research Applied to the Petroleum Industry (May 1990, Las Vegas, Nevada).

“Error Propagation and Sensitivity Analysis in Geographical Information Systems,” National Center for Geographical Information and Analysis and the Department of Geography, University of Santa Barbara (February 15-17, 1990).

**1989**

Intelligent Mathematical Programming Roundtable #6 – “Extensions of LP Reductions for the (Nonlinear) Pooling Problem,” University of Colorado, Denver, December 18, 1989.

**1988**

“Confidence Limits in Geographic Analysis - Suitability Analysis,” Specialist Meeting on Accuracy in Spatial Databases, National Center for Geographic Analysis, University of California, Santa Barbara, December 13-16, 1988.

“Finding Redundancies and Reduction in Fuzzy Linear Programming Problems,” The 13th International Symposium on Mathematical Programming, August 29-September 2, 1988, Tokyo, Japan (presented by H. Greenberg).

“Finding Redundancies and Infeasibilities in Linear Programs with Bounded Perturbed Coefficients,” 10th Symposium on Mathematical Programming with Data Perturbation, 26-27 May, 1988, The George Washington University, Washington, DC.

**1987**

“Fuzzy Set Theoretical Approaches to Natural Language Processing in Decision Support Systems,” NATO Advanced Study Institute, Val d'Isere, France, August, 1987.

“The CU-Denver Mathematics Clinic,” SIAM Conference on University-Industry Collaborations in the Mathematical Sciences, January 12-14, 1987, Claremont Colleges, Claremont, California.

**PROFESSIONAL ACTIVITIES**

**2014** – CBSF III, João Pessoa, Brazil, Keynote speaker (joint conference with FLINS 2014 - Fuzzy Logic and Intelligent Technologies in Nuclear Science), August 17-20, 2014.

**2013** – IFSA/NAFIPS 2013, Edmonton, Canada, Optimization special session co-chair and program committee

**2012** – CNMAC'12 and CBFS'12, program committee

**2011** – NAFIPS'11, El Paso, Texas, Optimization special session chair, program committee

**2009** – IFSA'09, Lisbon, Portugal, presented, Optimization special session co-chair

**2007** – IFSA'07, Cancun, Mexico, presented, Optimization special session co-chair (9 talks)  
Special Issue of *Fuzzy Sets and Systems* (guest editor)

**2006** – NAFIPS'06, presented

**2005** – NAFIPS'05, attended

IFSA'05, Beijing, China – presented, Optimization special session co-chair (8 talks)  
BISCSE'05, University of California, Berkeley – invited workshop presentation

**2004** NAFIPS'04, presentation

Associate Chair, Department of Mathematical Sciences, University of Colorado at Denver

**2003** NAFIPS'03, co-organizer of special session on interval analysis

**2002** – Organizing Committee, Scientific Committee, organizer of panels, and referee for a three-day symposium: 2002 SIAM Workshop on Validated Computing. I had the initial idea and the gathering of the group of people that

make up the organizing committee.

**Informal Workshop** – University of Coimbra, Coimbra Portugal, July 1-August 2, 2002.

NAFIPS'02, co-organizer of special session on interval analysis

**2000** – International Committee and Special Session Organizer (Fuzzy Optimization) for NAFIPS'2000.

## RELATED ACTIVITIES

**1967-1969:** I began a mathematics tutoring for at-risk African American high school students in Cincinnati, Ohio.

**1969-1973:** I obtained my teaching certificate, taught 8<sup>th</sup> -12<sup>th</sup> grade mathematics including advanced placement and remedial mathematics courses, rural Georgia.

**1969-1973:** I was actively involved with the local NEA becoming the first white president (under a ten year racial rotation) of the desegregated association for Burke County, Georgia. I did a lot of work on behalf of teachers from investigation of firings to lobbying at the state capitol to seeking improvements in public education for the county.

**1973:** Upward Bound Teacher, Payne College (one of the traditional Afro-American colleges), Augusta, Georgia.

**1973-1977:** Involved with a volunteer program at the Federal Penitentiary, Salem, Oregon to teach mathematics courses to inmates who received college credit of these courses.

**1977-1982:** I worked in Central America and Caribbean doing workshops and technology (geographical information systems, large economic models for analysis of resource trade-off issues). I also worked with Syrian officials to transfer computerized systems for agricultural census (statistical systems).

**1987-1988:** I was "on loan" (EPA Grant) to EPA Region 8 as a resident mathematician and help develop region 8's geographical information system and analysis laboratory.

## PHD STUDENTS

Ron VanIwaarden – 1996

David Jamison – 1998

Cidalia Fonte – 2003 (University of Coimbra, Coimbra, Portugal)

Jorge Santos – 2004 (University of Coimbra, Coimbra, Portugal)

Phantipa Thipwiwatpotjana (May of 2010)

Elizabeth Untiedt (May of 2010)

Oscar Jenkins (successfully defended thesis February of 2014, but did not complete revisions)

Tiago Mendonça da Costa, PhD, UNESP/São José do Rio Preto, Brazil, co-advisor (June 2014)

Ulcilea Alves Severino Leal, UNESP/São José do Rio Preto, Brazil, co-advisor (June 2015)

Alphonse Nde nebot (did not finish, enrolled in another university, masters completed June 2015, readmitted August 2016)

Jose Renato Campos, UNESP/Ilha Soltera, Brazil, co-advisor (expected completion December 2016)

**OTHER:** I speak Portuguese fluently and Spanish somewhat fluently.

## MATHEMATICS CLINICS TAUGHT

**Distance Geometry** – Fall 2015, Spring 2016

**Artificial Adaptive Systems Models** – Fall 2014

**Mathematical Models for Peace** – Fall 2004, Fall 2013

**UCHSC Department of Radiation Oncology-** Medical Image Processing and Radiation Therapy of Tumors (Fall semester, 2002, Fall 2008, Spring 2009, Spring 2010)

**Computerized Medical Systems** (Saint Louis, Missouri) - Radiation Therapy of Cancer Tumors (two semesters)

**United States Department of Agriculture, Plant Variety Protection Office** (Beltsville, Maryland) - Intelligent System for Plant Protection Applications (one semester)

**Martin Marietta Company** - Dynamical Systems and Neural Networks (two semesters)

**Water Models** – un-sponsored (one semester)

**Central Bank of Denver** - Portfolio Models (one semester)

**SERVICE - Major**

**Director and Secretary** (1997-2012), a publically/community elected position – South Englewood Sanitation District 1

**Chair** (2005-2009) **Vice-Chair** (2015-present) Faculty Senate Privilege and Tenure Committee – University of Colorado Faculty Senate Committee for Grievances and Dismissals (three university and four campus-wide committee) representing over 5,000 faculty members

**Interim Chair** – Physics Department (calendar year of 2011)