ROBERT E. SYNOVEC **August 3, 2022**

UNIVERSITY OF WASHINGTON, Seattle WA, USA
College of Arts and Sciences

Basic Data:

Department: Chemistry Date of last promotion: 2001
Academic Rank: Professor
Birth Date: March 4, 1959

Educational Background:

Institution	Degree	Dates
Bethel College, St. Paul, MN	B.A., Chemistry (Summa Cum Laude)	1977-1981
Iowa State University, Ames, IA	Ph.D., Anal. Chem.	1981-1986

Ph.D. dissertation title: "Instrumental and Computational Techniques for Obtaining Analytical Data in High Performance Liquid Chromatography"

Employment Record:

1978-1981, Teaching Assistant, Chemistry and Mathematics, Bethel College, St. Paul, MN.
1981-1982, Teaching Assistant, Iowa State University, Ames, IA.
1982-1986, Research Assistant, Iowa State University, Ames, IA.
1986-1992, Assistant Professor of Chemistry, University of Washington, Seattle, WA.
1992-2001, Associate Professor of Chemistry, University of Washington, Seattle, WA.
2001-present, Professor of Chemistry, University of Washington, Seattle, WA

Other Professional Positions and Memberships:
1983-present, American Chemical Society (ACS)
2007-2011, Faculty Director, Center for Process Analytical Chemistry (CPAC), UW
2007-2020, Associate Chair, Graduate Education Program, Department of Chemistry, UW
1992-2018, Assistant Editor for *TALANTA*
2018-2020, Associate Editor for *TALANTA*
2019-present, Contributing Editor for *Trends in Analytical Chemistry (TrAC)*
2003-present, Editorial Board for *J. Chromatography A*
2004-present, Editorial Board for *Current Analytical Chemistry*
2010-present, member of the GC×GC Symposium Scientific Committee

Fellowships, Honors and Awards:

1984, Alpha Chi Sigma Graduate Research Award in Analytical Chemistry, ISU
1984, ACS Fellowship, ACS Division of Analytical Chemistry, ISU
1985-1986, Phillips Petroleum Fellowship in Analytical Chemistry, ISU
1986, Excellence in Graduate Research Award, Iowa State University (ISU)
1999, DuPont Educational Aid Grant, DuPont
1999, Visiting Faculty, Royal Golden Jubilee PhD Program, Chiang Mai University, Chiang Mai, Thailand
2000, Amersham Pharmacia Professor in Residence, Molecular Dynamics, Sunnyvale, CA
2009, L. S. Palmer Award, Minnesota Chromatography Forum, Minneapolis, MN
2013, GC×GC Scientific Achievement Award, 10th GC×GC Int. Symposium, Palm Springs, CA
2016, Marcel Golay Award, 40th ISCC Symposium, Riva del Garda, Italy

Brief Biographical Summary:

Robert E. Synovec is a Professor of Chemistry at the University of Washington (UW) in Seattle WA. He obtained his Ph.D. in 1986 from Iowa State University under the direction of Edward S. Yeung, and then joined the UW Faculty that year. He served as Associate Chair of the Chemistry Graduate Education Program from 2007-2020. Synovec has graduated 46 PhDs, 4 Thesis Masters, and 10 Non-Thesis Masters students, with 10 Post Docs and over 60 Undergraduate Researchers. His group pioneers the development of novel analytical instrumentation and methodology based upon chemical separation science, coupled with chemometric data analysis. The group investigates the basic principles of separation science, detection, and data analysis at both a fundamental and problem-solving level. He has over 280 publications, and over 620 research presentations which includes over 260 invited lectures and invited presentations. Synovec served as an Assistant Editor of *TALANTA* from 1992 to 2018, and more recently as an Associate Editor from May 2018 to February 2020. Synovec currently serves as a Contributing Editor for Trends in Analytical Chemistry (TrAC) starting in January 2018. Additionally, Synovec serves on the editorial boards for *J. Chromatography A* since January 2003 and *J. Chromatography Open* since January 2021. He co-chaired the International Symposium on Capillary Chromatography (ISCC) three times with Frank Svec: Portland, OR, May 2009, San Diego, CA, May 2011, and Palm Springs, CA, May 2013. Synovec serves on the GC×GC International Symposium scientific committee since 2010. In May 2013, Synovec was awarded the GC×GC Scientific Achievement Award at the 10th GC×GC International Symposium. This award has been instituted to recognize the pioneering contributions of key scientists in promoting GC×GC instrumentation, method development and/or applications. In May 2016, Synovec received the Marcel Golay Award at the 40th ISCC meeting in Riva del Garda, Italy, which is presented annually to a scientist in recognition of a lifetime of achievement in capillary chromatography.

RESEARCH PROGRAM SUMMARY

The Synovec group is working in the areas of traditional analytical chemistry and bioanalytical chemistry, centered upon fundamental studies and applications of separation science. Primarily, we develop and apply gas chromatography (GC) based instrumentation, coupled with analytical methodology, chemical measurement science and multivariate data analysis (chemometrics). Overall, the group seeks to find a better fundamental understanding of the right balance of chemical separation and mathematical separation required to optimally glean the desired chemical information from analytical separation data. We complement our interest in developing and applying novel instrumentation and chemometrics with a deep interest in modeling the chromatographic separation processes based upon theory. Our theoretical modeling has provided fundamental insight and guidance for instrumental design improvements. Application of our separations technology in many exciting areas such as metabolomics, forensics, petroleum-based fuels, biofuels, and environmental systems are being explored.

In the area of GC, the fields of two-dimensional GC and chemometric data analysis are being integrated. Comprehensive two-dimensional GC instrumentation with time-of flight mass spectrometry detection (GC×GC-TOFMS) has been developed, improved upon, and applied, using two different modulation interfaces: flow-based and thermal-based. The GC×GC-TOFMS instrument provides an information-rich chemical fingerprint for complex samples, and the data is ideally suited for chemometric data analysis. Chemometrics plays a pivotal role in the analytical workflow for the translation of the raw data into useful information. We are exploring and developing advanced approaches for non-targeted discovery-based analysis of cross-sample comparisons of GC×GC–TOFMS data, coupled with robust deconvolution (decomposition), identification and quantification of meaningful analytes. Specifically, we have been developing Fisher-ratio (F-ratio) analysis, a statistically based data mining technique to discover analytes that distinguish sample classes based upon the experimental design. A recently developed tile-based F-ratio algorithm substantially improves chemical selectivity in the discovery process for the determination of an analyte “hit list.” In turn, important features discovered by the F-ratio analysis, the “hits”, are further analyzed using complementary chemometric methods. For this purpose, parallel factor analysis (PARAFAC) and a recently developed Signal-ratio algorithm have been shown to confidently analyze GC×GC–TOFMS data for many studies, readily providing analyte pure signal isolation, and analyte identification with quantification. For example, we are pioneering the development and implementation of the F-ratio software to find up- and down-regulated biomarker metabolites in metabolomics studies. Additionally, we are involved with forensic studies, where the goal is to find small concentration changes in chemical marker compounds that have significant forensic value.

The group has also developed comprehensive three-dimensional gas chromatography instrumentation (GC^3), which provides interesting opportunities to study selectivity advantages of three separation dimensions working in concert. The GC^3 research has been extended to include detection with TOFMS, producing a fourth order analytical instrument, opening new opportunities for chemometric analysis of complex data sets. Concurrently, work in the area of ultra-high-speed GC has been pioneered, with separations on the time scale of a chemical sensor (e.g., separations in the range of 50 ms to 500 ms). These ultra-high-speed GC separations are opening new opportunities in developing faster, more informative multi-dimensional GC instrumentation.

GRADUATE and UNDERGRADUATE RESEARCH STUDENTS, POST DOCS, COLLABORATORS and VISITING SCIENTISTS

Name	Thesis Topic (title if granted)	Date PhD Degree Granted
Curtiss N. Renn	High Temperature Microbore Liquid Chromatography Separation and Detection	Spring, 1991
Veeravagu Murugaiah	Properties and Applications of Hydrodynamically Generated Concentration Gradients	Spring, 1993
Leslie K. Moore	High Temperature Gradient Techniques for Microbore Liquid Chromatography	Summer, 1993
Daniel B. Taylor	Speciation of Copper in Jet Fuel by High Performance Liquid Chromatography	Summer, 1993
Lawrence R. Lima III	Separation and Detection of Chromophore Lacking Analytes	Summer, 1994
Timothy J. Bahowick	Techniques for Rapid Chromatographic Analysis of Partially-Resolved Peaks Using Sequentially-Injected Samples and Single-Channel Detection	Summer, 1995
Marc D. Foster	Liquid Chromatographic Separation and Sensing Principles with a Water Only Mobile Phase	Autumn, 1996
Nels A. Olson	Development of an Analyzer for Surface Active Species in Flow Injection and Liquid Chromatography Environments	Autumn, 1997
Carsten A. Bruckner	Rapid Chromatographic Analysis Using Novel Detection Systems and Chemometric Techniques	Spring, 1998
Bryan J. Prazen	Development of High Speed Hyphenated Chromatographic Analyzers and Second Order Data Analysis Techniques	Summer, 1998

Jeanne M. Link	Mixed-Mode Chromatographic Separation and Whole Column Radiation Detection to Improve Sensitivity in Radiometabolite Analysis: Application to Carbon-11-Meta-Hydroxyephedrine in Plasma	Autumn, 1998
Toby E. Young	Water-Only Chemical Analysis Methodologies: Investigations of Water Liquid Chromatography, Subcritical Water Extraction, and Dynamic Surface Tension Detection	Autumn, 1998
M. Benton Free	Thermal Modulation of Microcalorimetric Sensors for Chemical Analysis	Autumn, 1999
Keith E. Miller	Dynamic Surface Tension Detector in Flow Injection Analysis and Liquid Chromatography	Spring, 2000
Carlos G. Fraga	GC × GC with Chemometric Pattern Recognition	Summer, 2000
Paul G. Vahey	Broadening the Applicability of Water Liquid Chromatography through Novel Methodologies and Micro-Fabrication	Autumn, 2000
Wes W. C. Quigley	The Analysis of Flowing Liquids Utilizing Drop-Based Instrumentation	Spring, 2002
Kevin J. Johnson	Stratagies for Chemometric Analysis of Gas Chromatographic Data	Spring, 2003
Colin D. Costin	Development of a Universal Microfluidic Detector for Applications in Separation Science and Process Monitoring	Autumn, 2003
Amanda E. (Moses) Sinha	Comprehensive Two-Dimensional Gas Chromatography Time-of-Flight Mass Spectrometry with Chemometric Analysis	Summer, 2004

Bethany A. Staggemeier	Dynamic Surface Tension Detection: Novel Applications to Continuous Flow Analysis and Interfacial Analysis	Autumn, 2004
Gwen M. L. Gross	The Development of Novel ChromatographicTools for Application in High-Speed and Multi-Dimensional Gas and Liquid Chromatography	Autumn, 2004
Janiece L. Hope	Comprehensive Gas Chromatography with Chemometric Data Analysis for Pattern Recognition and Signal Deconvolution of Complex Samples	Spring, 2005
Adam D. McBrady	Microfabricated Chromatographic Instrumentation for Micro Total Analysis Systems	Autumn, 2006
Karisa M. Pierce	Objectively Obtaining Information from Gas Chromatographic Separations Of Complex Samples using Novel Data Processing and Chemometric Techniques	Winter, 2007
Rachel E. Mohler	Discovery Based Yeast Metabolic Analysis using GC × GC – TOFMS and Chemometrics	Summer, 2007
Vanessa R. Reid	Novel Separation Technology for High-Speed GC: Theoretical and Experimental Approaches to Separation Optimization	Summer, 2008
Jamin C. Hoggard	Automation of Parallel Factor Analysis PARAFAC for Peak Resolution in GC × GC – TOFMS	Winter, 2008
Andrew W. Sulya	Annular Column Liquid Chromatography and other Enhancements in Instrumentation and Data Analysis for Conventional and Microbore High Performance Liquid Chromatography	Spring, 2009
Elizabeth M. Humston	Multi-Dimensional Separations and Data Analysis Technologies for the Elucidation Of Information from Complex Samples	Winter, 2009
Christopher W. Siegler	Development of Novel Multi-Dimensional Separation-Based Instrumentation and Data	Winter, 2011

	Analysis Strategies for Complex Samples	
Jeremy S. Nadeau	Advanced Preprocessing Methods for Optimization of Chemometric Algorithms for Gas Chromatography	Spring, 2011
Ryan B. Wilson	Novel Injection Techniques to Enable, Fast, High Peak Capacity Gas Chromatography Separations	Summer, 2012
Luke C. Marney	Metabolomics and the Development of Nontarget Discovery Analysis Methods for GC × GC – TOFMS	Summer 2013
Benjamin Kehimkar	Fundamental Studies of Rocket Propellant Fuel using GC × GC – TOFMS Instrumentation With Chemometric Data Analysis	Summer, 2014
Brian D. Fitz	Advances in Instrumentation and Data Analysis Techniques for Increasing Peak Capacity and Peak Capacity Production in One and Two Dimensional Gas Chromatography	Summer, 2015
Brendon A. Parsons	Development and Application of Improvements to the Tile-based Fisher Ratio Method and Fundamental Instrument Considerations for Non-targeted Analysis using Two-Dimensional Gas Chromatography	Summer, 2016
Nathanial E. Watson	Development of Instrumental and Computational Methods for Accessing Information in Multi-Dimensional Gas Chromatography with Mass Spectrometry	Winter, 2017
Brooke C. Reaser	Advanced Chemometric Techniques for the Analysis of Complex Samples using 1D and 2D Chromatography coupled with TOFMS	Winter, 2017
David K. Pinkerton	Fundamental Considerations in One and Two Dimensional Chromatography for Improved Chemometric Analysis	Spring, 2017
Christopher E. Freye	Development of Instrumental and Chemometric Techniques for the Analysis of Complex Samples Via Multi-Dimensional Gas Chromatography	Spring 2018

H. Daniel Bahaghighat	Development of Ultra-Fast Modulation for Application in Multi-Dimensional Gas Chromatography	Spring 2018
Derrick V. Gough	Development of New Modulation Methods Using the Pulse Valve Modulator in Multidimensional Gas Chromatography	Winter 2020
Kelsey L. Berrier	Advances in Feature Selection in One- and Two-Dimensional Gas Chromatography with Mass Spectrometry	Summer 2021
Sarah E. Prebihalo	Advance Chemometrics and Fundamental Considerations for Non-Targeted Analysis with Comprehensive Multidimensional Gas Chromatography coupled with Time-of-Flight Mass Spectrometry	Summer 2021
Paige E. Sudol	Investigation of Supervised and Unsupervised Discovery–Based Chemometric Tools to Expand the Scope of Multidimensional Gas Chromatography	Winter 2022
Timothy J. Trinklein		Current
Sonia Schöneich		Current
Grant S. Ochoa		Current
Caitlin N. Cain		Current
Lina Mikaliunaite		Current

MS Students Supervised (Thesis title noted):

Darrell O. Hancock	Concentration Gradient Detection by Near-Infrared Diode-Laser Interferometry **(Thesis)**	Summer, 1988
Ana Kristine Torgerson	The H-Sensor: An Absorbance-Based Microfluidic Sensor **(Thesis)**	Winter, 2006
Nathanial E. Watson	Techniques to Maximize Information in Multidimensional Chromatography and Mass Spectrometry **(Thesis)**	Spring, 2007
Yan Zhang	GC × GC – TOFMS of Metabolites	Spring, 2008

Mahmoud S. Al-Shaer	Process LC and NeSSI Applications	Summer, 2009
Jin H. Chen	Studies with GC	Summer, 2010
Irina Oelgiesser	Metabolomics and F-Ratio	Summer, 2012
Emilie A. Viglino	Forensic Analysis using GC × GC – TOFMS and Chemometrics	Autumn, 2012
Nicholas Moore	Development of GC × GC – HRTOFMS	Summer, 2017
Derrick V. Gough	Partial Modulation for Gas Chromatography **(Thesis)**	Spring, 2019
Warren P. Sadler	Studies of Cacao and Hops with GC-MS	Winter, 2020
Riley Rogan	Fundamental Study of the Agilent Invuto GC MSACST Program	Spring, 2021
Sunny Jiang	Analysis of Olefins using Bromination Chemistry and GC×GC-TOFMS MSACST Program	Spring, 2022
Joe Mohammad	Studies using the INTUVO GC MSACST Program	Spring, 2022
Robert Halvorsen		Current
Vlada Olkhovych		Current

Post Docs Supervised:

Bryan J. Prazen	May 1999-May 2005
Marc K. Boysworth	June 2001-May 2002
Louis Scampavia	January 2005 – June 2005
Karisa M. Pierce	March 2007 – June 2007
Thomas I. Dearing	April 2008 – September 2009
Jamin C. Hoggard	December 2008 – 2011 Research Staff Scientist 2011 – 2013

Elizabeth M. Humston	March 2010 – May 2011
Christopher W. Siegler	March 2011 – April 2011
Jeremy S. Nadeau	June 2011 – July 2011
Rachelle M. Burks	June 2011 – May 2012

Undergraduate Research Students Supervised:

Perry Thornton (1987 – 1988)	Riboflavin Analysis in Vitamins
Tara Felix-Slinn (1988 – 1989)	Oxalate Determination in Blood Plasma by an Ion Chromatographic Method (1 publication)
Sara Downing (1989 – 1990)	Protein-ICG Chemistry and Analysis
Darren Dunphy (1990 – 1993)	Application of the Sequential Chromatogram Ratio Technique, and Development of a Surface Tension Detector for HPLC (3 publications)
Chris Stork (1992 – 1993)	Analysis of DNA by Flow Injection Analysis and Fluorescence Detection
Leonardo Lopez (1993 – 1994)	Application of Dynamic Surface Tension Detector
Katerina Hutterer (1994 – 1995) **NSF-REU student**	Analysis of Wine Components, Synthetic Cork
Mike Kobel (1994 – 1995)	Use of Surfactants in RP-HPLC
Scott Ecker (1995 – 1998)	Water-Only RP-HPLC (3 publications)
Dana M. Alloway (1996) **NSF-REU student**	Pressure-Based Dynamic Surface Tension Detector (1 publication)
Christine Devine (1997 – 1998)	Analysis of High Fructose Corn Syrup by Water Liquid Chromatography
Jon Watts (1997)	Dynamic Surface Tension Detection
Marianne Cavleti (1998 – 2002)	High Speed GC of Complex Samples (1 Publication)
Sean Green (1999) **NSF-REU student**	LC of Surfactants and Proteins with a Water Mobile Phase
Drew Santos (2000)	Ion Chromatography of Natural Water Samples: an Environmental Study

Marcelle Ulep (2000)	Ion Chromatography of Natural Water Samples: an Environmental Study
Joshua Rains (2000)	Ion Chromatography of Natural Water Samples: an Environmental Study
Ingrid R. Dimalouw (2000 – 2001)	HPLC and Surface Tension Detection of Proteins
Jane Kim (2001 – 2002) **NASA Space GRANT (SURP)**	HPLC and Surface Tension Detection of Proteins
Janiece (Flick) Hope (Summer 2001)	High Speed GC of Complex Samples (1 Publication as UG)
Rob Coleman (2003 – 2004)	GC and LC of Complex Samples
Jessica Smith (Summer 2003)	GC of Complex Samples with Data Analysis
Matthew M. Van Wingerden (Winter 2004 – Spring 2005 and Autumn 2006 – Spring 2007) **Mary Gates Endowment for Students Research Training Grant (twice)**	GC, GC × GC and Chemometrics for High Throughput Analysis (1 Publication)
Elizabeth Spencer-Green (Summer 2004) **NSF-REU student**, Bucknell U.	High Speed GC
Bokyong (Christine) Chun (2004 – 2005)	Applications of Microfluidic Diffusion Coefficient Sensor
Elizabeth-Clare M. Reed (2004 – 2005)	Studies of High-Speed GC
Lianna F. Wood (2004 – 2006)	GC and GC × GC of Complex Samples with Chemometrics (1 Publication)
Michael J. Barker (2006 – 2007)	GC – MS
Toby E. Guetschow (2007 – 2007)	GC – MS
Hyun Seo (Kevin) Ahn (2007 – 2008)	SPME – GC × GC, ChromaTOF Peak Table Study
Diana C. Brosten (2007 – 2008)	SPME – GC of fuels and yeast cell head-space
Gregory F. Brabeck (2008 – 2009)	Study of Cacao Beans using SPME sampling
Tyler J. Carter (2008 – 2009)	GC × GC using ionic liquid columns
Brian D. Fitz (2008 – 2010)	GC × GC using ionic liquid columns, high speed GC
Jason T. Reed (2010 – 2010)	High speed GC
Jessica K. Cao (2010 – 2011)	SPME – GC/MS study of Cacao Beans
Andrew D. Haass (2010 – 2011)	Studies with GC-qMS instrumentation

Tina Lai (2011 – 2012)	High speed GC development
Lauren Alexander (2012 – 2013)	Metabolomics studies
Trinh K. Hoac (2011 – 2014)	Studies with diesel fuel samples and metabolomics
Brandyn C. Mannion (2011 – 2014)	High speed GC development
Carey Dixon (2013 – 2014)	Metabomomics studies
Khang To (2013 – 2014)	High speed GC development
Kyeong Min Yu (2013 – 2014)	High speed GC development
Kelli Stoneburner (2013 – 2014)	GC × GC and running integration
Christine Buffalow (2014 – 2015)	High speed GC with the LTM
Kia To (2014-2015)	High speed GC (1 publication)
Trin Hoac (2014-2015)	High speed GS (1 publication)
Lan Mu (2014 – 2016)	High temperature valve GC × GC (1 publication)
Ke Cui (Vicki) (2014 – 2016)	GC × GC × GC (1 publication)
Kendra Cochran (2014 – 2016)	LTM-GC
Anisha Uppugonduri (2016 – 2017)	PARAFAC studies
Dong H. Song (2018-2019)	GC with pulse valve modulation (1 publication)
Riley D. Rogan (2019-2020)	GC of cocoa
Arielle M. Bulmoja (2019-2020)	GC of metabolites
Cable G. Warren (2019-2021)	GC with pulse valve modulation (5 publications)
MacKenzie Marlahan (2019-2021)	GC of vaping products
Niza Matzick (2020-2022)	GC studies using the Intuvo GC

Visiting Scholars, Visiting Scientists, Visiting Graduate Students:

Emilia Bramanti	Institute for Chemical and Physical Processes (IPCF) – CNR, PISA Italy **(CNR Fellowship, Visiting Scientist, Summers: 1999, 2001, 2003, Spring 2006, Summer 2007, Summer 2008)**
Abdul Nabi	University of Balochistan, Quetta, Pakistan **Visiting Fulbright Fellow, January 2000-September2000**
Andy Weber	DOW Chemical Corporation, Freeport TX September 2000
Kate Gradpan	Chiang Mai University, Chiang Mai, Thailand Summer 1999, March 2004 **Royal Golden Jubilee PhD Program**
Mongkon Rayanakorn	Chiang Mai University, Chiang Mai, Thailand Summer 1999 **Royal Golden Jubilee PhD Program**
Jaroon Jakmunee	Chiang Mai University, Chiang Mai, Thailand March 2002 **Royal Golden Jubilee PhD Program**
Narong Lenghor	Chiang Mai University, Chiang Mai, Thailand 2002 – 2003 ***(Visiting Graduate Student)*** **Royal Golden Jubilee PhD Program**
Sumalee Tanikkul	Chiang Mai University, Chiang Mai, Thailand 2001 – 2003 ***(Visiting Graduate Student)*** **Royal Golden Jubilee PhD Program**
Yuthapong Udnan	Chiang Mai University, Chiang Mai, Thailand 2002 – 2003 ***(Visiting Graduate Student)*** **Royal Golden Jubilee PhD Program**
Rattikan (Jin) Chantiwas	Chiang Mai University, Chiang Mai, Thailand Summer 2004 (4 months) ***Visiting Scientist***
Supaporn Kradtap	Chiang Mai University, Chiang Mai, Thailand June 2004
Nisa Chawapun	Chiang Mai University, Chiang Mai, Thailand June 2004
Subhachai Jayasvasti	Chiang Mai University, Chiang Mai, Thailand June 2004

Sam Lucas	Battelle, Columbus, OH August 2002, May 2005
Erich Stozier	Battelle, Columbus OH June 2004, May 2005, December 2005
Terry Collier	3M, Engineering Systems Technology Center, St. Paul, MN July 2003
Gary Mallard	NIST, U.S. Dept. of Commerce, Gaithersburg, MD August 2004
Donald Young	Chevron-Texaco, Research and Technology, Richmond, CA May 2002, Nov. 2002, May 2003, Nov. 2003
Ulrich Bonne	Honeywell Laboratories, Plymouth, MN Nov. 2003, May 2004
Bob Wright	Pacific Northwest National Laboratory, Richland, WA Various visits 1998 - present
Jay Grate	Pacific Northwest National Laboratory, Richland, WA Various visits, 1999 – present
Elena Morosanova	Lomonosov Moscow State Univesity, Moscow, Russia Feb. – March, 2002
Jose Martinez Calatayud	Dept. of Analytical Chemistry, Facultad de Ciencias Quimicas, Universidad de Valencia, Valencia, Spain October 2003
Ricardo Santelli	Universidade Federal Fluminense, Instituto de Química, Rio de Janeiro, Brazil November 2004
Mark Merrick	LECO Corporation, St. Joseph MI August 2005
Carl Rechsteiner, Jr.	Chevron-Texaco, Research and Technology, Richmond, CA November 2004, May 2005, September 2005, November 2005
Wayne Rohrbaugh	Ashland Specialty Chemical Co., Columbus, OH November, 2004, May 2005
Ed Marti	Ashland Specialty Chemical Co., Columbus, OH May 2005
Daniel Dershowitz	Ashland Specialty Chemical Co., Columbus, OH May 2005, November 2005
Milton McDonnell	Honeywell, Morriston, NJ July 2005

Scott Ramos	Infometrix, Bothel, WA August 2005, March 2009
Brian Rohrback	Infometrix, Bothel, WA August 2005, March 2009
Cathy Zelenski	Midwest Research Institute, Kansas City, KS September 2005
John Van Scoy	Midwest Research Institute, Kansas City, KS September 2005
Chad Fisher	Midwest Research Institute, Kansas City, KS December 2005
Maribel Valero	Los Andes University, Merida, Venezuela Visiting Scholar, March-September 2006
Thomas Skov	Copenhagen University, Copenhagen, Denmark, March – May 2007. (Visiting Graduate Student)
Joshua Knowles	BBSRC David Phillips Fellow, School of Computer Science, The University of Manchester, UK, January – June 2009.
Nate Watson	Major, Course Director CH151/152, Department of Chemistry and Life Science, United States Military Academy (USMA), West Point, NY July 2009, Feb 2010
Beth Frinak	Postdoctoral Research Associate USMA Network Science Center, West Point, NY April 2010
Dan Burgard	Visiting Scholar University of Puget Sound, Tacoma, WA Summer 2011
Celina Monzon	Fulbright Scholar Argentina Nov 2019-Feb 2020

Collaborators (2000 – present):

Air Force Research Laboratory/RZSA, Edwards AFB: Matt Billingsley
Ashland Chemical Company: Dan Dershowitz, Wayne Rohrbaugh, Ed Marti
3M, Engineering Systems Technology Center: Terry Collier
Battelle, Columbus: Samuel Lucas, Erich Stozier
BiogenIdec: Maureen Lanan, Li Zang
Boeing: Bruce Davis, Paul Vahey, Oren Hadallar
Cargill: Colin Costin, Mike Blackburn
Chevron-Texaco, Research and Technology: Donald Young, Carl Rechsteiner, Jr.

Chiang Mai University, Department of Chemistry: Rattikan Chantiwas, Kate Grudpan, Jaroon Jakmunee, Narong Lenghor, Mongkon Rayanakorn, Sumalee Tanikkul, Yuthapong Udnan
Children's Hospital, Seattle: Rhona Jack
Copenhagen University: Rasmus Bro, Thomas Skov
DOW: Hernan Cortes, Andrew Weber
Eigenvector Research: Neal Gallagher, Barry Wise
Georgia Tech University, Mechanical Engineering Department: Peter Hesketh
Honeywell: Ulrich Bonne, Milton McDonnell, Adam Mc Brady
ICI: Jim Scrivens, Bill Campbell
Infometrix: Scott Ramos, Brain Rohrback
Insilicos: Erik Nilsson, Brian Pratt
Institute for Chemical and Physical Processes (IPCF) – CNR, PISA Italy: Chiara Allegrini, Francesca Beni, Emilia Bramanti, Fabrizio Ferri, Leonardo Lampugnani, Massimo Onor, Giorgio Raspi, Chandra Sortino, Maria Carla Spinetti
Johns Hopkins University, Whiting School of Engineering, Baltimore MD: Nicholas Keim
Kraft: Bob Magaletta, Carol Zrybko, Bruce Campbell
Lawrence Livermore National Laboratory: Olgica Bakajin, Michael Stadermann
Naval Research Laboratory, Chemical Dynamics and Diagnostics Branch: Kevin Johnson
New Mexico State University: Gary A. Eiceman, Satendra Prasad, Hartwig Schmidt
NIST, Boulder, CO: Tom Bruno
NIST, U.S. Dept. of Commerce, Gaithersburg, MD: Gary Mallard
Johns Hopkins University: Nicholas Keim, B. Hill-Lam, and J.C. Wilhelm
Pacific Northwest National Laboratory: Oleg Egorov, Carlos Fraga, Jay Grate, Kristin Jarman, David Nelson, Rhonda Skaggs, Jon Wahl, Bob Wright
Royal Institute of Technology, Dept. of Surface Chemistry, Stockholm, Sweden: Per Claesson
Seattle University, Department of Chemistry: Kristen Skogerboe
SRI International, Menlo Park, CA: Dave Flamm
Theo Chocolate, Seattle, WA: Andy McShea
United States Air Force Academy, Department of Chemistry: Carlos Fraga
United State Military Academy, West Point: Kenneth L. Cameron, Beth Frinak, J. Kenneth Wickiser
University of Balochistan, Department of Chemistry, Quetta, Pakistan: Abdul Nabi
University of Denver, Department of Chemistry and Biochemistry: Keith Miller
Univeristy of Texas, Arlington, Department of Chemistry: Dan Armstrong
University of Texas Southwestern Medical Center, Department of Biochemistry, Dallas, TX: Benjamin P. Tiu, Steven L. McKnight
University of Washington, Various Departments: Anatol Brodsky, Lloyd Burgess, Gary Christian, Bruce Kowalski, Brian Marquardt, Mel Koch, Mary Lidstrom, Jarda Ruzicka, Glenn VanBlaricom, Younan Xia, Elton (Ted) Young, Ken Dombek, Pete Rainey, Andrew Hoofnagle, Richard Palmiter, Thomas Montine, Sandra Juul, Rong Tian, Jonathan Himmelfarb
YKI, Institute for Surface Chemistry, Stockholm, Sweden: Bengt Kronberg

BIBLIOGRAPHY

Publications:

An * indicates an INVITED publication. An # indicates co-first author. Each entry is a peer reviewed manuscript unless noted otherwise. Principal author is underlined.

1. "Quantitative Analysis Without Analyte Identification by Refractive Index Detection," R.E. Synovec, E.S. Yeung, *Anal. Chem.,* 1983, **54**, 1599-1603.

2. "Quantitative Gel-Permeation Chromatography Without Standards," R.E. Synovec, E.S. Yeung, *J. Chromatogr.*, 1984, **283**, 183-190.

3. "Correlation of Elution Orders in Different Liquid Chromatographic Systems Without Analyte Identification," R.E. Synovec, E.S. Yeung, *Anal. Chem.,* 1984, **56**, 1452-1457.

4.* "Characterization of Crude Oils using Liquid Chromatography Without Standards," R.E. Synovec, E.S. Yeung, in *Characterization of Heavy Crude Oils and Petroleum Residues,* B. Tissot, Ed., Editions Technip, Paris, 1984, pp-268-272. **Invited, peer reviewed conference proceeding.**

5. "Quantitation of Components in Crude Oils using Liquid Chromatography Without Identification," R.E. Synovec, E.S. Yeung, *J. Chromatogr. Sci.,* 1985, **23**, 214-221.

6. "Improvement of the Limit of Detection in Chromatography by an Integration Method," R.E. Synovec, E.S. Yeung, *Anal. Chem.,* 1985, **57**, 2162-2167. (Patent Awarded)

7. "A Laser-Based Circular Dichroism Detector for Conventional and Microbore Liquid Chromatography," R.E. Synovec, E.S. Yeung, *Anal. Chem.,* 1985, **57**, 2606-2610.

8. "Comparison of an Integration Procedure to Fourier Transform and Data Averaging Procedures in Chromatographic Data Analysis," R.E. Synovec, E.S. Yeung, *Anal. Chem.,* 1986, **58**, 2093-2095.

9. "Fluorescence Detected Circular Dichroism as a Detection Principle in High Performance Liquid Chromatography," R.E. Synovec, E.S. Yeung, *J. Chromatogr.,* 1986, **368**, 85-93.

10.* "Detectors for Liquid Chromatography," E.S. Yeung, R.E. Synovec, *Anal. Chem.,* 1986, **58**, 1237A-1256A. **Invited, peer reviewed A-page article**.

11.* "Laser-Based Circular Dichroism Detection of Molecules in Flowing Systems using High-Frequency Polarization Modulation," R.E. Synovec, E.S. Yeung, *AIP Conf. Proc.*, 1987, **160** (Adv. Laser Sci.-2), 615-617. **Invited, peer reviewed conference proceeding.**

12. "Effect of Ultrasonic Agitation in High Performance Size Exclusion Chromatography," R.E. Synovec, E.S. Yeung, *J. Chromatogr.,* 1987, **388**, 105-112.

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