Oklahoma State University

School of Industrial Engineering and Management

College of
Engineering, Architecture and Technology

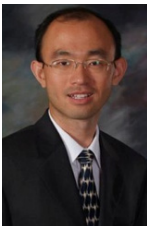
COWBOY CONNECTIONS

FALL 2019

Table of Contents

Message from School Head	2
IEM Mission, Vision & Goals	4
The Next Five Generations	5
Grand Opening	6
New Staff/Faculty Spotlight	7
Student Spotlight	8
Alumni Spotlight	12
Seminar Series	14
Industrial Advisory Board	16
Spring 2019 Graduates	18
Fall 2019 New Students	19
IAB Spotlight	20
IEM Awards	21
Faculty Accolades	24
Alumni Spotlight	26
Student Chapters	28
The Cowboy Academy	32
Research Grants	34
Journal Publications	35
Memories	38
Research	39
Fall 2019 Senior Design Teams	40
IEM Faculty and Staff	44

Dr. Sunderesh S. Heragu
School Head
Regents Professor and
Humphreys Chair



Dr. Tieming Liu
Graduate Program Director
Associate Professor

Dr. Camille DeYong
Undergraduate Program
Director
Associate Professor

Greetings!

IEM continues to push through major initiatives! Most recently, the renovation and refurbishing of the third floor of Engineering North (IEM's home) was completed and we had our grand opening on September 27th. Pistol Pete was there to help cut the ribbon (see the cover photo!). Fall graduation is upon us. Seventeen undergraduates, seventeen Master's students and two doctoral students will be walking the stage on December 13th and 14th.

We have a record number of students in the senior design class for Spring 2020 (32 students!). Thus, in this academic year, 2019-20, we will be graduating our largest class ever, more than twice as many students as were graduating just a few years ago.

Over a three-day period in late September, we had numerous activities surrounding the grand opening of the 3rd floor of EN. The Cowboy Academy of Industrial Engineering and Management (TCA) held its annual meeting. More than thirty of the 59 members were present at the meeting. Two others joined via video conference. The TCA is actively working on at least three fronts:

· Developing, funding, and rolling out a marketing plan: You may have seen short videos of our alumni and students on social media. If not, check our YouTube channel.

· Establishing a web portal for mentoring: A senior design team is working with TCA in scoping out such a portal so current students can be mentored by former students.

· Fundraising activities: TCA members have donated or helped raise $400,000 for the upgrades in EN 3rd floor!

Ten members were inducted into the Cowboy Academy on September 26th. This event, held at Meditations, was attended by current and Emeritus faculty, IAB members, and TCA members.

The Industrial Advisory Board (IAB) had its semiannual meeting on September 27th. All seventeen members were in attendance. The IAB has played an active role in mentoring senior design teams. They have also established a scholarship and helped name the Faculty Commons in the 3rd floor! The day concluded with the grand opening ceremony at 3:30 pm and donor recognition dinner at the ConocoPhillips Alumni Center. Alpha Pi Mu and Institute of Industrial and Systems Engineers helped organize a tailgate the next day.

Our alumni, students, staff, and faculty continue to receive awards – external to the university and internally as well. You will see examples of that throughout this newsletter. IEM has also been making significant alumni outreach over the years. To help you reconnect with them, we include a Q&A with a few alumni each newsletter. You will see that on pages 12 and 26 of this newsletter. If you would like to be showcased, please let me know by emailing iem@okstate.edu and we would be happy to feature you in an upcoming newsletter.

In addition to this newsletter, we have been sending out small email campaigns via Constant Contact each week. If you have not been receiving those emails and would like to do so, please text IEM to 22828.

The holidays are upon us and we take this opportunity to thank you for continuing to be actively engaged with your alma mater. We hope you have a great thanksgiving and a relaxing holiday season with family and friends.

We are nearing the end of our 2020 campaign and have not hit the goal of raising $20 million. We have increased the endowments to $8 million (including deferred gifts) and are in discussions to increase that amount by another 50%, but there is only a little more than a year to reach our target of $20 million. We hope IEM alumni will consider donating or making estate gifts to reach that goal. Recall that we are doing this for the next five generations, so that the benefits we have reaped over the past one hundred years are there for the next fifty, if not more.

Go Pokes!

Sunderesh S. Heragu
Regents Professor, Head and Humphreys Chair

To Receive IEM updates, please text IEM to 22828

IEM Mission, Vision, and Goals

Vision

IEM's vision is to place industrial engineers in a wide variety of industries including manufacturing, service, energy, healthcare, humanitarian and others, so that our society at large can benefit from systems that effectively use an optimal set of resources, efficiently produce goods or provide services and enrich the quality of life for all.

Mission

IEM's mission is to develop a diverse group of professionals and leaders in industrial engineering and management by being a leader in education, research, and outreach.

Educational Goals

IEM's educational goals are to educate and produce a new generation of diverse students who are proficient in theoretical, applied, and technology relevant concepts and practices that will have a global reach and global impact. IEM will continue to monitor and enhance the student recruiting, learning, retention, advising, mentoring, internship, and placement processes.

Research Goal

IEM's research goals are to engage in cutting edge research of global importance and to produce innovators as well as next generation engineering, education, and societal leaders.

Outreach Goals

IEM's outreach goals are to actively engage in community projects, economic development, and service for the greater good. The outreach goals also include enhancement of IEM's image within CEAT and OSU and the world at large.

The Next Five Generations

IEM has been fortunate to have had the resources and the support that have made it possible to recruit, educate, and produce leaders in our society. To benefit the next five generations, we launched a $20 million by 2020 campaign in December 2014 and have made good progress toward that goal. From $2.4 million in Fall 2013, our endowments (including deferred gifts) have risen to $8 million. The remaining $12 million must be raised in 1.5 years. The School of Industrial Engineering and Management looks to alumni and friends, like you, who make the next steps in our innovative future possible. We appreciate every donation, big or small, that supports our school. However, we have listed below several priorities for you to make the most impact.

Study Abroad Scholarship | $2,000 per student
Scholarships can be awarded to up to 12 students

Annual contribution to two IEM billboards | $15,000 per year

Sponsorship of IEM networking events | $25,000

Annual sponsorship of student travel | $40,000
IISE conferences, INFORMS conferences, commencement lunches, IAB-student luncheons and IEM reception at annual IISE meeting

Annual sponsorship of the weekly seminar series with a naming opportunity | $75,000

Endowing a professorship | $500,000

Endowing a chaired professorship | $1,000,000

Naming and endowing opportunity of IEM | $20,000,000

If you wish to donate, please send a check payable to the "Industrial Engineering and Management Excellence Fund" at Oklahoma State University, 354 Engineering North, Stillwater, OK 74078 or make a gift online by clicking the GIVE button at iem.okstate.edu.

For more information please contact
Bryce Killingsworth – Associate Development Director
Office: 405-385-5623
Cell: 405-385-3497
Email: bkillingsworth@osugiving.com

http://iem.okstate.edu/sites/default/files/TheNextFiveGenerations.pdf

IEM Grand Opening Celebration

Dr. Heragu, along with Pistol Pete, students, alumni, faculty, staff, and friends, cuts the ribbon for the Engineering North 3rd floor grand opening

Dean Tikalsky speaks to students, alumni, facutly, staff, and friends at the grand opening celebration

New Staff

Misty Werkman
Administrative Support Assistant

Misty was raised on a cattle ranch in western New Mexico. She traveled working industrial, oil and gas construction for a number of years which brought her to Oklahoma. She and her husband liked the area so they decided to stay a while. Misty's roots have always laid on the ranch she grew up on that her dad still manages today. She was riding a horse before she could walk. In her spare time, you will find her training horses, at a barrel race, a roping or working cattle.

"We lose ourselves in the things we love. We find ourselves there too." - Kristen Martz

Faculty Spotlight

Dr. Austin Buchanan
Assistant Professor

Austin Buchanan--a third-generation OSU alum--is an Assistant Professor of IEM at OSU. Prior to joining the faculty, he received his BS in IEM from OSU in 2011 and his PhD from Texas A&M in 2015. His research interests include operations research, integer programming, and network optimization. His research is currently funded by the National Science Foundation and has appeared in the journals *Mathematical Programming*, *INFORMS Journal on Computing*, and *Networks*, among others. He currently serves as Associate Editor for the journals *Networks* and *Optimization Letters* and is active in the INFORMS Optimization Society and in the Section on Telecommunications & Network Analytics.

"The lurking suspicion that something could be simplified is the world's richest source of rewarding challenges." -Edsger W. Dijkstra

Staff Update
Valerie Quirey has transitioned to the Graduate Programs Coordinator position. Congratulations Valerie!

Student Spotlight

Kathryn Fulton
Undergraduate Student

Kathryn Fulton is a 5th year IEM student graduating in December 2019. During her time at OSU, Kathryn has served on the executive team for Engineers without Borders and Tau Beta Pi. She has also directed and helped organize multiple shows within OSU's Greek community, including Freshman Follies, Varsity Revue, and Spring Sing. Additionally, she has been heavily involved in FOCUS (Fellowship of Catholic University Students) as a student leader on campus. In her free time, Kathryn enjoys taking music technology and production courses at OSU, playing music with friends, and songwriting. After graduation, Kathryn will be spending six months in Nashville to complete an apprenticeship with Love Good, a media company. Following that, she will be starting a full-time Logistics Engineering job with J.B. Hunt in Northwest Arkansas.

"Be who you were meant to be, and you will set the world on fire!" -St. Catherine of Siena

Jason Rush
Master's ETM Distance Education Student

Jason Rush is a graduate student in the MSETM program. He received his BS in petroleum engineering from the University of Texas at Austin. He currently lives in Houston, Texas with his wife and 15-month old son, working for ExxonMobil. His work has a rotational schedule of 28 days on, 28 days off to Sakhalin Island, Russia. Jason is a Fluids Advisor in the drilling department over the two offshore platforms, Berkut and Orlan. Previously he worked in Angola, Azerbaijan, Colombia, USA land and Deepwater Gulf of Mexico. He enjoys traveling, family time, mountain biking and board gaming on his days off. Jason says, "The knowledge I've gained in the MSETM program has given me the knowledge and confidence to start my own company in oilfield chemical distribution that I am working on during my free time."

"Have the end in mind and every day make sure you are working towards it." -Ryan Allis

Student Spotlight

Levi Edens
Master's ETM Distance Education Student

Levi Edens grew up most of his life in Northeastern Oklahoma in a little town called Miami. He graduated from Oklahoma State University in 2012 with his Bachelors in Biosystems Engineering and plans to graduate from the MSETM Program in the Fall of 2019. His main hobbies include traveling, golfing, hanging out with his girlfriend, and attending sporting events. He is a loyal Oklahoma State fan and tries to attend as many games as possible!

After his undergraduate studies, Levi went to work for Halliburton Energy Services in San Antonio, Texas. He worked as a Field Engineer, performing a variety of explosive perforation and radioactive well logging services. In 2016, Levi joined Dyno Nobel Inc. located in Carthage, MO. Dyno Nobel manufactures explosives and other specialized chemicals used in the energetics industry. Levi has held a variety of roles at Dyno Nobel in chemical process engineering, continuous improvement and currently works as the Production Manager of the Dynamite product line.

Levi plans to continue applying the skills he has acquired through the MSETM Program in his professional career. He is focused on continuously developing the people he leads as well as himself to drive his organization's success.

"The veracity of an answer is inversely proportional to its length" – Pascal Dennis

Student Spotlight

Abhimanyu Sah
Master's Student

Coming from a small town of Lumbini in southern Nepal, Abhimanyu Sah has always aspired to learn as much as he can. He completed his undergraduate degree in Mechanical Engineering from MNIT, India. After two years of working for the Ministry of Industry in Nepal as Energy Auditor, Abhimanyu got an opportunity to pursue graduate studies at Oklahoma State University in Industrial Engineering and Management. Getting into OSU has helped him learn different working models of industries in USA. Abhimanyu says, "I thank OSU for granting me an opportunity to be a Graduate Research Assistant where I get to visit many industries and perform energy assessments." In the future, he wants to become an entrepreneur who hopes to develop an optimized industrial work culture.

"I would like to take this opportunity to thank my parents, brother and my guru Dr. Hitesh Vora who have always helped me to excel in my career" says Ahbimanyu. On campus, Abhimanyu is involved in the Nepalese Student Association and serving as Sports Coordinator. His most memorable highlight in college was the Homecoming parade where the Nepalese Student Association showcased the Nepalese culture. For Abhimanyu, hobbies are more like a cliché' nowadays but in his spare time, he invests in stock markets and likes to play soccer.

"Success usually comes to those who are too busy to be looking for it." - Henry David Thoreau

Student Spotlight

Hamidreza Validi
Doctoral Student

Hamidreza Validi is Ph.D. student in the School of Industrial Engineering and Management at Oklahoma State University under the supervision of Dr. Austin Buchanan. Hamid received his B.S. and M.S. in Industrial Engineering from Ferdowsi University of Mashhad and Sharif University of Technology, respectively. He is broadly interested in combinatorial optimization, integer programming, and network optimization. Hamid's previous work has been published in *Networks* and *INFORMS Journal on Computing*. He has received John L. Imhoff Scholarship (IISE), E.J. Sierleja Memorial Fellowship (IISE), Distinguished Graduate Fellowship, and Phoenix Award for Outstanding Graduate Teaching Assistant. He taught IEM 3103 in Fall 2018 and Fall 2019.

"The more I spent time on Mathematics, the more excited I became." - Maryam Mirzakhani

Alumni Spotlight

Mitch Myers

Tell us a little bit about yourself.
I reside in Owasso, OK with my wife Christy and have four children – Blaine 23, Sutton 19, Brooke 16, Kennedy 15. I graduated in 1995 from OSU with a Bachelors in Industrial Engineering and Management. In 1999, I earned a Master's in Business Administration from OSU. For about 15 years, I served as Global Vice President of Operations of FW Murphy. In 2011, I purchased a manufacturing business, Thermal Specialties, LLC. Today, I own and manage four separate businesses; Thermal Specialties, Upside Interiors, Myers Property Investments, and Flexplan Administrators. My wife and I love to travel.

How has your IEM degree helped you?
My degree in IEM armed me with several key continuous improvement and critical thinking skills. More broadly, my degree helped me develop and solidify a scientific and logical approach to problem solving and developing efficient and reliable processes both in manufacturing and in administration.

What aspects of your OSU affiliation while you were a student stand out?
Oklahoma State is has a well-recognized IEM program which was important when establishing credibility early in my career. The OSU athletic program spirit has been a ton of fun.

What has motivated you to stay engaged with OSU, years after graduation?
I was blessed by the investment the OSU faculty made in my development. I have always been passionate about the value of education and it just comes natural to give back to the same institution that invested in me.

What do you think the future holds for the IEM student?
The future continues to be very bright for students who choose IEM. Every year, the technical requirements for industry jobs increases. The global economy presents many opportunities to improve process and system efficiency, improve reliability, and optimize the expanding tech based service sector.

List one or two highlights of your career.
One of the biggest highlights of my career was my work of building a manufacturing facility in Hangzhou, China, hiring the workforce, sourcing raw materials, and setting up the production work cells. Looking back, the exposure was amazing.
The second main highlight of my career was the decision to buy a manufacturing company. I am not a natural risk taker, but the years of work and development have been extremely rewarding.

Why is international exposure important for today's engineers? How would they benefit from availing of study abroad opportunities?
International exposure is such an important opportunity that todays IE's should pursue. The global economy makes international experience a very valuable asset to employers. If students afforded themselves of study abroad opportunities, they would be much more attractive to employers and be able to make a much bigger impact early in their career because of their pre-employment global experience.

Seminar Series

Spring 2019

Jan. 16: *Physical-Statistical Modeling and Optimization of Complex Systems—Healthcare and Manufacturing Applications*, Bing Yao, The Pennsylvania State University

Jan. 18: *Data Analytics and Optimization for Efficient and Sustainable Operation of Urban Mobility Systems*, Dr. Xinwu Qian, Purdue University

Jan 23: *Modeling and Improvement of Complex Systems with High-Dimensional Heterogeneous Data*, Mostafa Reisi Gahrooei, Georgia Tech University

Jan. 25: *Flow Capturing Problem with Length-Bounded Paths*, Dr. Okan Arslan, HEC Montreal

Jan. 28: I*nfectious Disease Control in Metapopulations with Limited Resources*, Dr. Burak Eksioglu, Clemson University

Jan. 29: *Optimization Models for Biopower System Optimization*, Dr. Sandra D. Eksioglu, Clemson University

Feb. 27: *Nonconvex Stochastic Optimization: From Conditional Gradient to Newton Method*, Dr. Saeed Ghadimi, Princeton University

Fall 2019

Sep 25: *Physical-Statistical Modeling and Optimization of Complex Systems—Healthcare and Manufacturing Applications*, *Dr.* Bing Yao, Oklahoma State University

Oct 9: *Smart Additive Manufacturing Using Advanced Sensing and Data Analytics*, Dr. Chenang Liu, Oklahoma State University

Oct 16: *Imposing Contiguity Constraints in Political Districting Models*, Hamidreza Validi, Oklahoma State University

Oct 30: *Control of False Discoveries in Grouped Hypothesis Testing for eQTL Data*, Dr. Pratyaydipta Rudra, Oklahoma State University

Nov 13: *Data Science for Wind Energy: Power Curve Modeling and Production Performance Analysis*, Dr. Yu Ding, Texas A & M University

Nov 15: *Criminal Justice in the United States: A Systems Perspective*, Dr. Gerald Evans, University of Louisville

Nov 20: *Stochastic Mirror Descent Methods for Multi-Agent Systems over Semidefinite Matrix Spaces and High-Dimensional Stochastic Optimization Problems*, Nahid Majlesinasab, Oklahoma State University

Industry Advisory Board

Greetings OSU IE&M Enthusiasts,

Our Fall meeting on September 26/27 was packed with some exciting firsts:
- We inaugurated the new 3rd floor conference room by having our first meeting in the new space.

- We high-fived Pistol Pete on the 3rd floor for the first time at the ribbon cutting ceremony for the new 3rd floor.

- Our Board was in full attendance and for the first time now includes representatives from 10 different states spread from California and Oregon all the way to South Carolina and Florida, and many states in between.

- We welcomed three new Board members for the first time: Ed Pohl (IE&M Head at the University of Arkansas), Frank Groenteman (Author, Entrepreneur, and Consultant at TMAC), and Zach Roberts (Director of Operations at JB Hunt) – Welcome to the team!

Another highlight was, as always, meeting with the senior design teams working on the following projects:
- Ameristar Fence: Develop distribution network optimization plan to reduce delivery lead time

- Arrow Engine: Increase efficiency of engine testing process

- OSU IEM Cowboy Academy: Develop an information system for a professional mentorship program

- NORDAM: Project involving accurate measurement in an industrial context

- Stillwater Designs (Kicker): Reduce Labor Cost per Unit of Tailgate Assembly product

If you have ideas for future senior design projects and/or internships for either undergraduate or graduate students, please reach out to:
-Mr. Allen Glenn – Senior Design Instructor – allen.glenn@okstate.edu
-Dr. Tieming Liu – Graduate Program Director – tieming.liu@okstate.edu

With warm regards,
The OSU IE&M Industrial Advisory Board

IAB Members

Brian Adams
Textron Aviation

Syam Anthony
Nike, Inc

Kevin Doeksen
American Airlines

Bill Dueease
The Coach Connection

Ashley Estes
Zeus Industrial Products

Michael Foss
Caterpillar

Jack Goertz
Tandems, Ltd

Frank Groenteman
TMAC

Steve Kiester
Bell Flight

Ed Pohl
University of Arkansas

Zach Roberts
J.B. Hunt Transport, Inc.

Stephanie Royce
Oklahoma State University

G. Satish
Connixt Inc.

Tom Saunders
Pioneer Natural Resources

Brenda Shumate
Williams Companies

Jack Watts
The Portola Company

Jon Womack
Third City Properties

Congratulations Graduates

We are proud of our Spring and Summer 2019 Graduates. We would like to congratulate the following IEM students fro their hard work and dedication in completing thier degree.We wish them the best of luck for their bright future!

BS IEM
Ahmed Almuhanna
Hanna Anthony
Megan Basenfelder
Andrew Browning
Justin Chan
Abbye Coan
Caleb Coats
Willis Cook
Cynithia Craig
Erica Crain
Eleanor Doyle
Kevin Fabian
Blake Fabian
Rania Farhani
Madeline Hawkins
Yeongun Hwang
Taylor Lambdin
Miguel Leal
Emily Marko
Michael Moylan
Logan Price
Emilie Ritz
Kalley Schwind
Noah Seltzer
Jordan Spencer
Jessica Tyler
Brittany Windsor

MS IEM
Arunprakash Elavarasan
Ishita Gupta
Jan Huertas De La Cruz
Sreja Malka
Paritosh Mehta
Pranav Muttha
Gaurav Nandangiri
Sourabh Nashte
Satthisskumar Udayakumar

MS ETM
Mike Altz
Cory Arnold
Jessica Blake
Mark Cizewski
Chris Clayon
Gabbrieal Cooley
Michael Dukes
Pat Fox
Turner Hall
Jake Hilderbrandt
Joe Krause
Derek Lang
Ariel Moss
Taylor Piccinich
Alyssa Reiss
Bryce Van Velson
Sean Wilferd
Qia Yang

PhD
Akash Gupta
Sadra Babaei
Yajun Lu

Welcome

We look forward to getting to know all of you and helping you on your way to becoming successful industrial engineers!

BS IEM
Salman Alfarhan
Yaqoub Alkandri
Ali AlMulla
Brady Amox
Cade Anderson
Landon Bakhsh
Carmen Beasley
Carson Beeler
Sarah Bishop
William Craig
Raegen Daigle
Britney Dunlap
Cole Durkee
Christopher Dyer
Tristen Fisher
Joseph Francis
Hope Goodwin
Jackson Green
Jayden Grilliette
Cameron Groenteman
Reece Hamar
Charles Hatfield
Kayla Hilger
Kyle Humphreys
Jared Jenkins
Chloe Jones
Jackson Linson
Caitlin Mantooth
Cooper Neff
Ian Penney
Cory Robbins
Mason Sharum
Kent Slater
Jeffrey Stockel
Charles Sturm
Gabriel Tiefenthaler
Caleb Triplett
Grace Voth
Nathan Whitehead
Drew Williams
Emma Wilson

MS IEM
Lei Qiao
Manh Nguyen
Md Mazharul Islam
Anshul Maheshwari
Shahu Chunade
Kushal Shah
Siddhiraj Kadam
Loksagar Rudraraju Subramanyam
Ayse Dogan
Swapnil Bhilavade
Nilesh Baraskar
Samrat Meher
Jayesh Yevale
Chaitali Borse
Aishwarya Kulkarni
Parisa Sahraeian
Vijay Kanase
Amit Sandbhor

MS ETM
Joel Goree
Patrick Alland
Courtney Baukal
Taylor Rodgers
Jonathan Girod
Daniel Nava
Christopher Wright
Joshua Reed
Reginal Glenn
Thomas Clark
Thomas Zerbe
Bradford Cary

PhD IEM
Zhangyue Shi
Yuxuan Li
Wuyang Qian

IAB Spotlight

Kevin Doeksen

Kevin graduated from OSU's IEM program in 1995 and then earned his MBA from Southern Methodist University in Dallas in 1997. Following graduation from SMU, Kevin was hired by American Airlines as a financial analyst in their DFW headquarters. Kevin has been with American now for 22 years in a variety of roles of increasing responsibility in Finance, Operations, Marketing and Customer Experience. He credits the base knowledge and concepts learned from OSU's IEM as a key foundation for success across this wide variety of roles. Currently, he is Managing Director, Service Recovery for American. In this role, Kevin leads American's efforts to minimize customer disruptions during irregular operations and retain loyalty of customers who experience a service failure. Prior to this position, Kevin led the American Eagle strategy and operations team – supporting 3,500 daily regional flights across American's network. Kevin lives in the Kessler Park neighborhood of Dallas, just south of downtown, with his twin sons, Henry and Andrew –age 6. He has served on the Industrial Advisory Board since 2017 and serves on the executive team in the role of Secretary.

"The only limit to our realization of tomorrow will be our doubts of today." - Franklin D. Roosevelt

Student and Faculty Awards

Dwight D. Gardner Scholarship
Lauren Lenaburg
Matthew Wilkinson

Gilbreth Memorial Fellowship
Mostafa Amini

Harold & Inge Marcus Scholarship
Elizabeth Bunting

IISE Fellows William Biles, Hamid Parsaei and Victor Zaloom Endowed Scholarship
Brittany Grubert

IISE Council of Fellows
Miranda Almen

John L Imhoff Scholarship
Hamidreza Validi

Presidents Scholarship
Evan Rackley

Department of Energy Industrial Assessment Center Student Award
Pragya Niraula

Rack Manufacturers Institute/John Nofsinger Honor Scholarship
Aaron Madden

Hanel Storage Systems Honor Scholarship
Elizabeth Bunting

Cassie Johnson, Lift Manufacturers Honor Scholarship
Cassie Johnson

2019 Forbes Under 30 Scholars
Erik Andino Mejia
Amrit Chugani
Anshul Maheshwari
Tori Richardson

2019 Mortar Board Top 20 Freshman
Ben Burchard

2019 Mortar Board Top 10 Freshman
Ryne Garrison

INFORMS QSR 2019 Data Challenge Award Finalist
Yuxuan Li
Zhangyue Shi

Showing in the Junior Faculty Industry Group at INFORMS
Dr. Austin Buchanan

Regents Distinguished Research Award
Dr. Sunderesh Heragu

IEM Gatherings

Mentoring session with students and Cowboy Academy members

IEM Gatherings

Lunch with students, faculty and the Industrial Advisory Board

Faculty Accolade

Regents Distinguished Research Award

Dr. Sunderesh Heragu

School Head, Regents Professor and Humphreys Chair

Dr. Heragu received the Regents Distinguished Research Award at the University Awards convocation on December 14th. The Regents Distinguished Research Award (RDRA) recognizes research excellence at Oklahoma State University. The term research includes all creative scholarly activities. Recipients of the award are selected based on the evidence of outstanding and meritorious achievements in research. The candidates must demonstrate a distinguished record of past and continuing excellence in research, and be clearly recognized nationally and internationally.

Dr. Heragu is a Regents Professor and Head of the School of Industrial Engineering and Management at Oklahoma State University where he holds the Donald and Cathey Humphreys Chair. Previously, he was the Duthie Chair in Engineering Logistics and Director of the Logistics and Distribution Institute (LoDI) at the University of Louisville. He has also served as Professor of at Rensselaer Polytechnic Institute, Assistant Professor in State University of New York, Plattsburgh, and held visiting appointments at: State University of New York, Buffalo; Technical University of Eindhoven, the Netherlands; University of Twente, the Netherlands; and IBM's Thomas J. Watson Research Center in Yorktown Heights, NY.

He is author of the 4th edition of *Facilities Design* and has authored or co-authored over two hundred fifty articles. He has served as Principal investigator or co-investigator on research projects totaling over $20 million funded by federal agencies such as the Department of Homeland Security, National Science Foundation, Defense Logistics Agency and private companies such as General Electric. Dr. Heragu is a Fellow of the *Institute of Industrial and Systems Engineers (IISE)*. He has received IISE's *David F. Baker Distinguished Research* award, *Award for Technical Innovation in Industrial Engineering*, two best paper awards from *IIE Transactions on Design and Manufacturing Award*. Both awards are recognized as Prestigious Awards by the National Academic of Engineering, Science, and Medicine.

US News Rankings

US News and World Report has recognized the outstanding quality of IEM and CEAT's programs.

The online graduate engineering programs in the College of Engineering, Architecture and Technology (CEAT), of which the MSETM is a major player, was ranked #13 among public universities (#16 overall) by US News and World Report.

US News also ranked IEM among the top 25 graduate programs in industrial/manufacturing/systems among public universities (#36 overall).

13 25

BRIDGING THE GAP BETWEEN ENGINEERING AND BUSINESS

- 100% online or on campus
- Military friendly
- Flexible curriculum
- Affordable and cost effective
- Ranked #16 among online programs (U.S. News and World Report)

Apply now! Applications accepted year-round.

Learn more at http://etm.okstate.edu

OSU

ENGINEERING AND TECHNOLOGY MANAGEMENT

College of Engineering, Architecture and Technology

Alumni Spotlight

Q & A With IEM Alumnus Dr. R. Logen Logendran

Tell us a little bit about yourself.

Following the receipt of my B.S. (Honors) degree in Mechanical Engineering from the University of Sri Lanka, I worked as a Mechanical Engineer in a corporation for one year, which allowed me to realize that my passion was more in research and development than in the practice of engineering. That led me to take up a position as Research Officer at a research institute for nearly two years. I then proceeded to the Asian Institute of Technology, Thailand, and earned an M.Eng. degree (with thesis) in Industrial Engineering and Management (IEM), followed by a Ph.D. from Oklahoma State University. Upon graduation I sought a faculty position at a university as I loved teaching, working with students on research problems of industrial-merit, and watching the students mature and grow. After spending a few years on the faculty of Industrial Engineering at Southern Illinois University at Edwardsville, I joined Oregon State University in the fall of 1989. After 30 years at Oregon State University in the School of Mechanical, Industrial, and Manufacturing Engineering, I retired in September 2019.

How has your IEM degree helped you?

Very broadly, the focus of IEM is to improve both the effectiveness and efficiency of complex systems. While I have worked on a variety of problems in scheduling over the years, I have made significant research contributions in two specific areas of manufacturing systems: Design of Cellular Manufacturing and Group Scheduling. The degrees that I earned in IEM have been instrumental in achieving my research objectives, both in terms of quality of the solutions obtained (effectiveness) and the time it took to obtain such solutions (efficiency).

What aspects of your OSU affiliation while you were a student stand out?

We were a collegial group of graduate students during the time I was at Oklahoma State (September 1981 - August 1984). The analytical courses taught by the faculty as a whole were very rigorous and, in turn, the expectations placed on the students were also high. This resulted in a collegial, yet healthy competition among the graduate students, which spurred small student group discussions outside the classroom for in-depth learning. I recall leading the discussions with my peer group, a week before the second mid-term test in a course that I took in the fall of 1981, titled “Advanced Engineering Economic Analysis,” taught by Dr. Carl Estes. He passed away some years ago, God bless his soul. By the time the test date came around, I felt like I knew everything by heart and aced the test. This isn’t anything out of the ordinary as I believe I reinforced my own learning and understanding of the course material by helping/instructing my peers.

Dr. M. Palmer Terrell was my doctoral research advisor. He was a strict instructor and expected a high level of performance by students enrolled in his classes, which I loved. I may have taken this trait after him because during my 30 years as a professor at Oregon State, I too was considered a strict instructor with high expectations by both undergraduate and graduate students. In one of the early meetings, Dr. Terrell gave me an outline of what

was expected of my doctoral research and allowed me to select a topic of research myself. From that day forward, he gave me complete freedom to decide what I needed to do, with his approval of course, to bring my dissertation research to fruition. This prepared me well and gave me great confidence in my abilities when I completed my PhD in August 1984, and assumed a faculty position at Southern Illinois University at Edwardsville.

This last one is etched in my memory for good. Because of visa delays, I arrived in Stillwater, early in the morning on, September 2, 1981, a week after classes began. Dr. C. Patrick Koelling was the instructor for the graduate course titled "Foundations of Optimization," which met M, W: 2:00-3:20 pm. After a very long flight from Bangkok, Thailand to Oklahoma City with a stopover in Dallas, I needed a few extra hours of sleep. I woke up around noon, got ready, and went to take care of the late registration. By the time I got to Dr. Koelling's class I was late. Imagine a sleepy-eyed student walking into the class for the first time over 10 minutes late, during the fourth class meeting for the semester. I still remember the strange look from Dr. Koelling and the students in the class, wondering who I was and if I had mistakenly walked into the wrong class.

What has motivated you to stay engaged with OSU, years after graduation?

Throughout my career in academia, I would run into IEM faculty from Oklahoma State regularly at IISE and INFORMS conferences. Visiting with colleagues from Oklahoma State at these conferences, I have enjoyed keeping up with new developments in the School of IEM. I have also made annual donations to IEM for student scholarships. Four years ago there was an opportunity to make a significant donation to the School of IEM/College of Engineering to name a tile on a wall, for which my wife and I made the named donation. In 2016, I was inducted into the inaugural Cowboy Academy of IEM at Oklahoma State University. This has kept me well informed of some of the distinguished IEM alumni, who, in most cases, had graduated long after I left Oklahoma State. Following the recent remodel of the 3rd floor of Engineering North, there was an opportunity to make a significant donation to the School of IEM to name a space. My wife and I have made the donation to name an IEM Staff office.

List one or two highlights of your career.

I was elected Fellow of the Institute of Industrial and Systems Engineers (IISE) in 2009. My research has been funded by several organizations, including the National Science Foundation (NSF), Oregon Metals Initiative, and industry. With more than 140 publications, mostly with my masters and doctoral advisees and eight undergraduate students on several NSF Research Experiences for Undergraduates projects, including the Best Paper Award twice (in 2009 and 2012) for papers presented at international conferences and published in the conference proceedings, our work has served as a catalyst for academicians and practitioners alike to pursue further research on related problems.

Student Chapters

The Institute of Industrial and Systems Engineers

The Institute of Industrial and Systems Engineers has had an extremely successful Fall semester! Our organization is a global association committed to connecting students and professionals in the Industrial and Systems Engineering field. Everything we do is centered around creating stronger connections between students and faculty in the School of Industrial Engineering and Management as well as facilitating networking opportunities across the industry and our region. Our mission is to further our IEM undergraduate and graduate students' success in the academic and professional worlds.

This semester, our events have ranged from our annual IEM fall tailgate during the September 28th football game against Kansas State to hosting many information sessions with widely respected companies across all facets of the industry. We hosted Phillips 66, Credera Consulting, and PepsiCo for roundtable discussions and formal networking events. We are currently working on creating more IISE service opportunities, finalizing a cheap lunch opportunity for IEM students every few weeks, and promoting general membership in our club!

We would like to recognize the students who have worked so hard to make this organization so successful. The officers this academic year are:

- Lane Workman, President
- Matthew Wilkinson, Vice President
- Cole Luetkemeyer, Secretary
- Matt Burchard, Treasurer
- Brittany Grubert, Merchandise Chair
- Mallory Newell, Communications Chair
- Ben Burchard, Recruiting Chair
- Alexander Roubik, Events Chair
- Sam Koscelny, Fundraising Chair
- Amrit Chugani, Social Chair
- Brandon McKisick, Mentorship Chair
- Susan Weckler, CEAT Student Council Club Rep

Faculty Advisor: Dr. Chenang Liu

If you would like more information about IISE or want to become a member, please email Lane Workman at ltworkm@okstate.edu.

APICS

The APICS OSU student chapter aims to provide a training platform for new supply chain enthusiasts by creating a learning environment and building competencies on different supply chain operations and management topics. Our goal is to encourage certifications and provide networking opportunities such that it will create a bridge between academics and supply chain industrial work environment.

In collaboration with the Institute of Industrial and Systems Engineers (IISE), we organized a visit to Amazon Fulfillment Center to Oklahoma City to have insight about present day retrieval, sorting and dispatching processes in industries. We expect more industrial visits as we are in direct contact with APICS organization at OKC. We also encourage students who are looking for professional supply chain certifications like Certified in Production and Inventory Management (CPIM) and Certified Supply Chain Professional (CSCP). Apart from organizing events and certifications, we are constantly in touch with our alumni who are already working in supply chain domain so that we can build a networking opportunity.

We are currently looking for new students interested in the supply chain domain who can join our student chapter. In this way we hope to extend our horizon and build the supply chain community.

Faculty Advisor: Dr. Tieming Liu

Committee Members:

- Devarshi Tharwala, President
- Abhimanyu Sah, Secretary
- Seng Hooi Lim, Vice President-Education and Program Planning
- Viplav Patil, Vice President-Finance (Treasurer)

Student Chapters

INFORMS

The Institute for Operations Research and the Management Sciences (INFORMS) is the world's largest professional association dedicated to and promoting best practices and advances in operations research, management science, and analytics to improve operational processes, decision-making, and outcomes. The Oklahoma State University Student Chapter of INFORMS is a student-led campus organization focused on promoting student learning and professional advancement with fellow students and faculty within the field of operations research and management sciences. Our goal is to enable students to go beyond the bounds of coursework as they engage in research and extracurricular activities that lay the groundwork for their future as OR/MS professionals. Upcoming activities for Spring 2020 include:

1. Hosting the seminar series
2. Social gathering of graduate students
3. A workshop on Python

The INFORMS student chapter advisor is Dr. Juan Borrero and the Spring 2020 student officers are:

Hosseinali Salemi, President
Wuyang Qian, Vice President

If you have any questions or would like to connect with the student chapter, please feel free to email Hosseinali Salemi at hosseinali.salemi@okstate.edu. Also, do not forget to check out our Facebook page "INFORMS Student Chapter – Oklahoma State University" for more updates on events and chapter activities.

Alpha Pi Mu Industrial Engineering Honor Society

Alpha Pi Mu is excited to welcome 15 new members in Fall 2019!

1. Ahuja, Neeraj
2. Burchard, Matthew L.
3. Dixon, Derek Howard
4. Fallon, Jennifer
5. Goodin, Margaret
6. Hackler, Bailey
7. Humphrey, Sara
8. Lenaburg, Lauren A.
9. Lucas, James (Austin)
10. Luetkemeyer, Cole
11. McKisick, Brandon
12. Niraula, Pragya
13. Richardson, Victoria (Torie)
14. Sah, Abhimanyu
15. Wilkinson, Matthew

This semester was full of exciting events for the Alpha Pi Mu members. We started the semester with our yearly cookout to celebrate our new members. With the generous donations from the IEM Faculty, we were able to serve burgers and other food to over 15 students and professors. Alpha Pi Mu was thrilled to have Allen Schuermann, past national president of Alpha Pi Mu and Emeritus IEM Professor, join us at our cookout.

In November we had our fundraiser event at McAllister's, as well as our community service event which benefited Children's Weekend Food Sacks. Alpha Pi Mu members packed over 20,000 food sacks for children in need.

Alpha Pi Mu Cookout

Alpha Pi Mu Indctees

The Cowboy Academy

The Cowboy Academy Vision
For graduates to achieve their most valued and rewarding careers!

The Cowboy Academy has been very active in 2019. President Bill Dueease and the balance of the TCA Board worked hard in the early part of the year finalizing the administrative functions of the Academy. The membership committee selected a outstanding group of nominees for induction into the Academy. The Academy selected and celebrated these new members at a recognition dinner in late September. The membership has 59 honorees who have made significant contribution in their careers and are looking to give back to the IEM Program.

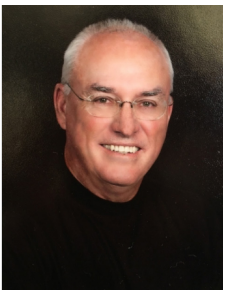
Alumni Dave Boyer, who serves as the Chair of the Marketing Committee, has led the committee in concert with a Marketing firm, Crossroads Communications to develop several videos designed to educate and attract prospective students. The videos have appeared on Facebook and will soon be published on other social media mechanisms. Other committees have been working hard to refine their respective missions and recruit members. As of the Fall Meeting, all committees have a Chair and a full compliment of committee members. Continued work will progress for the Marketing, Center of Excellence, Financial Support, and Career Opportunities committees. This will be a year of progress!

Board Members
Tom Britton
Denny Carreker
Bill Dueease
Laura Easley
Jack Goertz
Jeff Greer
John Harrington
Neil McCollom
Mitch Myers
Rick Webb
Stacie Wrobbel

Officers
Mitch Myers, *President*
Stacy Wrobbel, *Secretary*
Tom Britton, *Treasurer*

Current Members
Jaxon Axtell
Tony Bacher
Paul Baker
Michael Bartlett
Terrance Beaumariage
Leland Blank
David Boyer
Shay Braun
Thomas Britton
Denny Carreker
Kenneth Case
Samuel Combs
Megan Crozier
Jerry Dechert
Johann Demmel
Bill Dueease
Laura Raiman DuPont
Laura Easley
Brian Eaton
John English
Wolter Fabrycky
Phil Farrington
Kerry Gannaway
Jack Goertz
Jeff Greer
Frank Groenteman
John Harrington
Dave Hartmann
Gary Hogsett
Don Humphreys
Stuart Keeton
Behrokh Khoshnevis
William Kolarik
David Kyle
John Lewis
Rasaratnam Logendran
Gary Maxwell
Neal McCollom
Mitch Myers
David Nittler
Ron Orr
Kent Powers
David Pratt
Jack ReVelle
Stephanie Royce
Allen Schuermann
Brenda Shumate
Ting Nee Su
Leva Swim
Lyndon Taylor
Silvanus Udoka
Gregory Watson
Randy Watson
Jack Watts
Rick Webb
Lawrence Whitman
Marion Williams
Eric Woodroof
Stacie Wrobbel

2019 Cowboy Academy Inductees


Paul Baker

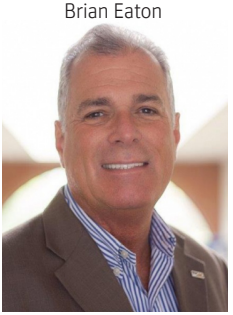

Megan Crozier

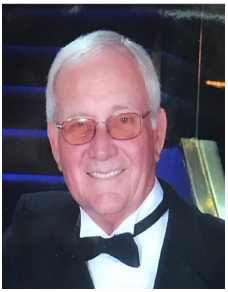

Jerry Dechert


Brian Eaton


Phil Farrington


Kerry Gannaway


Frank Groenteman


David Nittler


Brenda Shumate


Gregory Watson

Research Grants

Active in 2018 - 2020

D. Brunson, **B. Balasundaram**, M. Borunda, C. Fennell, P. Hoyt, MRI: Acquisition of Shared High Performance Compute Cluster for Multidisciplinary Computational and Data-Intensive Research, National Science Foundation, 10/1/2015 - 9/30/2018, $951,570.

B. Balasundaram, A. Buchanan, and S.S. Heragu, Optimization-Based Aggregate Master Planning Tools for Bay Valley Foods, LLC, Bay Valley Foods, LLC, 10/1/2017–9/30/2018, $250,599..

J. Borrero and L. Lozano, Modeling Worst-case Defender-Attacker Problems as Robust Linear Programs with Mixed-Integer Uncertainty Sets, Office of Naval Research, 05/01/19 - 02/30/22, $300,000.

A. Buchanan, Imposing Connectivity Constraints in Large-Scale Network Problems, National Science Foundation, 6/15/2017 – 5/31/2020, $258,586.

S.S. Heragu and R. Wilson (PIs), The Conoco Phillips/OSU Data Analytics Collaboration, ConocoPhillips, 7/1/19 - 6/30/22 $670,000.

M. Kamath, F. Yousefian, and S. Frazier, "Phase III: Flow Visualization and Risk Assessment of Hazardous Material Movement in Oklahoma", Oklahoma Department of Emergency Management, 10/1/2017–9/31/2018, $119,985.

M. Kamath, F. Yousefian, and S. Frazier, "Flow Visualization and Risk Assessment of Hazardous Material Movement in Oklahoma," Oklahoma Department of Emergency Management, 10/1/2019 - 9/31/2020, $112,158.

M. Kamath, F. Yousefian, and S. Frazier, Using HazMat Flow Analyzer and Risk Assessment Tools to Support Emerency Resource Planning and HazMat Training Activities in Oklahoma, Oklahoma Department of Emergency Management, 10/1/2018 - 9/31/2019, $131,620.

M. Kamath, F. Yousefian, and S. Frazier, Development of a GIS Application for Analyzing HazMat Flows in Oklahoma, Oklahoma Department of Emergency Management, 10/1/2018 - 9/31/2019, $131,620.

W. Kolarik, Industrial Assessment Center Program, U.S. Department of Energy, 9/1/2016 - 9/31/2021, $1,500,000.

T. Liu, W. Paiva and Ye Liang. "Validating a clinical decision support algorithm developed with big data to diagnose, state, prevent, and monitor a patient's diabetic retinopathy," OCAST, 8/1/2018 - 7/31/2020, $90,000.

T. Liu and C. Zhao, Studying the Impacts of Freight Consolidation and Truck Sharing on Freight Mobility, Transportation Consortium of South Central States (TranSET), 5/1/2017 - 10/31/2018, $55,000.

Journal Publications

Papers published or accepted in 2018-2020

Z. Miao and **B. Balasundaram**. An ellipsoidal bounding scheme for the quasi-clique number of a graph. I*NFORMS Journal on Computing*. Accepted for publication.

F. Nasirian, F. M. Pajouh, and **B. Balasundaram**. Detecting a most closeness-central clique in complex networks. *European Journal of Operational Research*. Accepted for publication.

J. Ma and **B. Balasundaram**. On the chance-constrained minimum spanning k-core problem. *Journal of Global Optimization*, 74(4):783-801, 2019.

S. Sun, Z. Miao, B. Ratcliffe, P. Campbell, B. Pasch, Y. A. El-Kassaby, **B. Balasundaram**, and C. Chen. SNP variable selection by generalized graph domination. *PLOS ONE*, 14(1):1–18, 2019.

Y. Lu, E. Moradi, and **B. Balasundaram**. Correction to: Finding a maximum k-club using the k-clique formulation and canonical hypercube cuts. *Optimization Letters*, 12(8):1959–1969, 2018.

E. Moradi and **B. Balasundaram**. Finding a maximum k-club using the k-clique formulation and canonical hypercube cuts. *Optimization Letters*, 12(8):1947–1957, 2018.

J.S. Borrero, O.A. Prokopyev, P. Krokhmal, Optimization of Cascading Processes in Arbitrary Networks with Stochastic Interactions. I*EEE Transactions on Network Science and Engineering*. Accepted for Publication.

J.S. Borrero, O.A. Prokopyev, D. Saure, Sequential Interdiction with Incomplete Information and Learning. *Operations Research*, 67(1): 72-89, 2019.

J.L. Walteros, **A. Buchanan**. Why is maximum clique often easy in practice? *Operations Research*. Accepted for Publication. Honorable Mention in the 2019 JFIG Paper Competition.

H. Validi, **A. Buchanan**. The optimal design of low-latency virtual backbones. *INFORMS Journal on Computing*. Accepted for Publication.

H. Validi, **A. Buchanan**. A Note on “A linear-size zero-one programming model for the minimum spanning tree problem in planar graphs”. *Networks*, 73(1): 135-142, 2019.

A. Buchanan, Y. Wang, S. Butenko. Algorithms for node-weighted Steiner tree and maximum-weight connected subgraph. *Networks*, 72(2): 238-248, 2018.

O. Battaia, A. Dolgui, **S.S. Heragu,** S.M. Meerkov, and M. K. Tiwari, Design for manufacturing and assembly/disassembly: joint design of products and production systems, *International Journal of Production Research*, 56(24): 7181-7189, 2018.

Srivathsan, S. and **M. Kamath**, Understanding the Value of Upstream Inventory Information Sharing in Supply Chain Networks, *Applied Mathematical Modelling*, 54:393-412, 2018.

Ma, J., Y.T. Leung, and **M. Kamath**, 2019, Service System Design under Uncertainty: Insights from an M/G/1 model, *Service Science*. 11(1):40-56, 2019.

C. Liu, A. Law, D. Roberson, and Z, Kong, Image Analysis-based Closed Loop Quality Control for Additive Manufacturing with Fused Filament Fabrication, *Journal of Manufacturing Systems*. 51: 75-86, 2019

J. Liu, **C. Liu,** Y. Bai, P. Rao, Z. Kong, and C. Williams, Layer-wise Spatial Modeling of Porosity in Additive Manufacturing, *IISE Transactions*, 51(2):109-123, 2019.

C. Liu, A. Kapoor, J. VanOsdol,K. Ektate, Z. Kong, and A. Ranjan, A Spectral Fiedler Field-based Contrast Platform for Imaging of Nanoparticles in Colon Tumor, *Scientific Reports*, 8(11390):1-8, 2018.

S. Piri, D. Delen, **T. Liu,** A Synthetic Informative Minority Over-Sampling (SIMO) Algorithm Embedded into Support Vector Machine to Learn from Imbalanced Datasets. *Decision Support Systems*, 106: 15-29, 2018.

S. Piri, D. Delen, **T. Liu,** W. Paiva, Development of a New Metric to Identify Rare Patterns in Association Analysis: The Case of Analyzing Diabetic Comorbidities. E*xpert Systems with Applications*, 94: 112-125, 2018.

A. Gupta, **T. Liu**, S. Shepherd, W. Paiva. Using Statistical and Machine Learning Methods to Evaluate the Prognostic Accuracy of SIRS and qSOFA. *Healthcare Informatics Research.* 24(2): 139-147, 2018.

Y. Zhou, **T. Liu, C. Zhao**. Backup Capacity Coordination with Renewable Energy Certificates in a Regional Electricity Market. *IISE Transactions*, 50(8): 711– 719, 2018.

Y. Zhou, **T. Liu**, G. Cai, Impact of In-store Promotion and Spillover Effect on Private Label Introduction, *Service Science*. Accepted for Publication.

S. Babaei, C. Zhao, L. Fan, **T. Liu.** Incentive-Based Coordination Mechanism for Renewable and Conventional Energy Suppliers. *IEEE Transactions on Power Systems*, 34(3): 1761-1770: 2018.

A. Gupta, **T. Liu,** S. Shepherd. 2019. Clinical Decision Support System to Assess the Risk of Sepsis Using Tree Augmented Bayesian Networks and Electronic Medical Record Data. *Health Informatics Journal*. Published Online 13 Jun 2019.

B. Yao, H. Yang, and C. McLean, Robust Optimization of Dynamic Route Planning in Same-day Delivery Networks with One-time Observation of New Demand, *Networks*, 73(4): 434-452, 2018.

F. Imani, **B. Yao,** R. Chen, P. Rao, and H. Yang, Joint Multifractal and Lacunarity Analysis of Image Profiles for Manufacturing Quality Control, *ASME Journal of Manufacturing Science and Engineering*, 141 (4): 044501, 2018.

B. Yao and H. Yang, Constrained Markov Decision Process Modeling for Sequential Optimization of Additive Manufacturing Build Quality, *IEEE Access*, 6 (1): 54786-54794, 2018.

B. Yao, F. Imani, and H. Yang, Markov Decision Process for Image-guided Additive Manufacturing, *IEEE Robotics and Automation Letters*, 3(4): 2792-2798, 2018.

B. Yao, F. Imani, A. Sakpal, E. W. Reutzel and H. Yang, Multifractal Analysis of Image Profiles for the Characterization and Detection of Defects in Additive Manufacturing, *ASME Journal of Manufacturing Science and Engineering*, 140 (3): 031014, 2018.

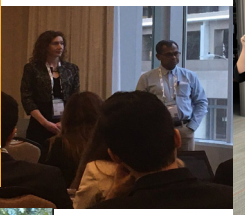
R. Zhu, **B. Yao,** F. Leonelli, and H. Yang, Optimal Sensor Placement for Space-time Potential Mapping and Data Fusion, *IEEE Sensors Letters*, 3 (1), 2018.

F. Yousefian, A. Nedich, and U.V. Shanbhag, On stochastic mirror-prox algorithms for stochastic Cartesian variational inequalities: randomized block coordinate and optimal averaging schemes, *Set-Valued and Variational Analysis*, 26 (4), 789-819, 2018.

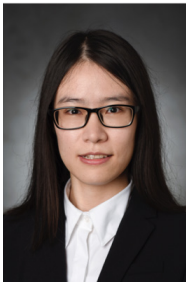
D. Newton, **F. Yousefian**, R. Pasupathy, Stochastic Gradient Descent: Recent Trends, *INFORMS Tutorials in Operations Research*, Published Online: 19 Oct 2018; 193-220.

N. Majlesinasab, **F. Yousefian,** A. Pourhabib, Self-tuned Stochastic Mirror Descent Methods for Smooth and Nonsmooth High-Dimensional Stochastic Optimization, *IEEE Transactions on Automatic Control*, 64 (10), 4377-4384, 2019.

Memories



SCHOOL OF
INDUSTRIAL ENGINEERING
AND MANAGEMENT



Physical-statistical Modeling and Regularization of High-dimensional Dynamical Systems

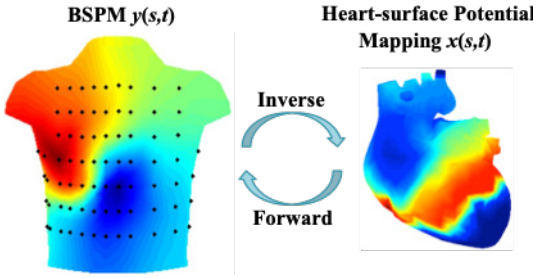
Dr. Bing Yao
Assistant Professor

From

1. Bing Yao and Hui Yang, "Physics-driven Spatiotemporal Regularization for High-dimensional Predictive Modeling", Scientific Reports 6, 2016
2. Bing Yao, Rui Zhu, and Hui Yang, "Characterizing the Location and Extent of Myocardial Infarctions with Inverse ECG Modeling and Spatiotemporal Regularization", IEEE Journal of Biomedical and Health Informatics, Vol. 22(5), 2017

Modern industries are increasingly investing in advanced sensing and imaging to facilitate the effective modeling, monitoring, and control of complex systems. For example, a body area sensor network helps capture multi-directional information pertinent to the heart electrical activity. Fig. 1 shows the spatiotemporal distribution of electric potentials y(s,t) acquired by the ECG sensor network, also called body surface potential mapping (BSPM) [1]. Such ECG time series enable medical scientists to investigate cardiac electrodynamics and further identify heart diseases by checking abnormalities in ECG waves [2]. For example, the patterns of ST depression/elevation, significant Q waves, or inverted T-waves in ECG cycles often indicate different styles of myocardial infarction.

Advanced sensing and imaging bring a data-rich environment and provide an unprecedented opportunity to investigate and further optimize system dynamics for smart and personalized health. Realizing the full potential of sensing data depends greatly on advanced analytical and predictive methods, which is challenging due to the complex data structure. For example, the ECG time series is a projected view of the space-time cardiac dynamics, and the cardiac electrical activity is observed with noises and interference when propagating from the heart to the body. Medical scientists call for the estimation of electric potentials x(s,t) on the heart surface from BSPM y(s,t) so as to investigate cardiac pathological activities, which is also called the inverse ECG problem [3]. However, spatiotemporal-varying data and complex torso-heart geometries defy traditional regression modeling and regularization methods.



In general, high-dimensional predictive modeling poses several challenges including:

(1) Physics-based derivation of parameter matrix R: Traditional regression modeling estimates R based on the readily available data set of [x,y]. However, distributed sensing or imaging of spatiotemporal systems provides only the surface profiles y(s,t) such as BSPMs. It is difficult to directly measure heart-surface potential x(s,t). As such, inferring x(s,t) needs a better knowledge of parameter matrix R. Fortunately, physical laws define the mechanisms of electrical propagation from the heart to the body surface [4]. This, in turn, enables the derivation of parameter matrix R using physics-based principles.

(2) Ill-conditioned system: Systems involving high-dimensional data are commonly ill-conditioned. This is partly caused by unobserved x(s,t), and partly due to the fact that R is rank deficient. The condition number of R is also shown to be large [3,5]. Moreover, deriving R depends on deterministic physics-based principles and the numerical analysis of complex geometries but does not account for real-world uncertainties. As a result, high-dimensional prediction models cannot always match satisfactorily with data from real-world experiments.

(3) Spatiotemporal regularization: Ill-conditioned systems make the prediction more sensitive to noise factors and approximation errors. For example, measurement noises can potentially cause a small change in y(s,t), leading to a change in the solution. Because of the large value of cond(R), the pseudo-inverse solution may be unstable. As such, there is a need to develop new statistical approaches that leverage physics-based principles and observed data to account for uncertainties and tackle ill-conditioned problems. Although x(s,t) and y(s,t) are spatially distributed and dynamically evolving, they have spatial and temporal correlations. Very little has been done to develop new spatial regularization methods that handle approximation errors through spatial correlations on the complex geometry, as well as new temporal regularization methods to increase model robustness to noises in the time domain.

We develop a new spatiotemporal regularization model to tackle these research challenges and address ill-conditioned problems in high-dimensional predictive modeling. Our contributions are as follows:

(1) High-dimensional systems involve complex geometries, which challenge the derivation of parameter matrix R. We developed realistic models of torso-heart geometries, numerically discretized them with the boundary element method, and then utilized physical laws (i.e., divergence theorem and Green's theorem) to derive the parameter matrix.

(2) Because physics-based models are deterministic and do not account for real-world uncertainties, we developed a physical-statistical approach that integrates R with a spatiotemporal regularization (STRE) method to build the prediction model. This approach leverages data from actual experiments to improve spatial and temporal regularity of the solutions, thereby making the final prediction closer to reality.

(3) The proposed STRE model involves both temporal and spatial correlations of the high-dimensional data, which cannot be solved analytically. Iterative algorithms such as the multiplicative update method are commonly used. However, they are not generally applicable because the electric field involves both positive and negative potentials. We developed a new method of dipole multiplicative update, which is inspired by the dipole assumption in electrodynamic physics. This new idea overcomes the drawbacks of existing multiplicative update methods, and provides a generalized approach to solve spatiotemporal regularization problems.

We evaluate and validate the proposed STRE model in simulation as well as a real-world case study to map electric potentials from the body to the heart surface. Experimental results show that our method effectively tackles ill-conditioned problems, and demonstrates superior performance in identifying the location and extent of myocardial infarction on the heart surface. This research work provides a new and effective approach to noninvasively investigate disease-altered electric potentials from the body to the heart surface.

References:

[1] Y. Rudy and J. E. Burns, "Noninvasive Electrocardiographic Imaging", Annals of Noninvasive Electrocardiology, 4(3), 1999

[2] H. Yang, C. Kan, G. Liu, and Y. Chen, "Spatiotemporal Differentiation of Myocardial Infraction", IEEE Transaction on Automation Science and Engineering, 10 (4), 2013

[3] C. Ramanathan, R.N. Chanem, P. Jia, K. Ryu, and Y. Rudy, "Noninvasive Electrocardiographic Imaging for Cardiac Electrophysiology and Arrhythmia", Nature Medicine, 10(4), 2004

[4] R.C. Barr, M. Ramsey, and M.S. Spach, "Relating epicardial to Body Surface Potential Distributions by Means of Transfer Coefficients based on Geometry Measurements", IEEE Transactions on Biomedical Engineering, (1), 1977

[5] L. Wang, H. Zhang, K.C. Wong, H. Liu, and P. Shi, "Physiological-model-constrained noninvasive reconstruction of volumetric myocardial transmembrane potentials," IEEE Transactions on Biomedical Engineering, 57(2), 2010.

Fall 2019 Senior Design Teams

Graduating Industrial Engineering and Management (IEM) seniors conclude their academic studies with a capstone course called Senior Design, taken in their last semester. During this course, student teams work as outside 'consultants' on real-world problems for clients in the manufacturing and service sectors. The projects provide students the opportunity to apply the theories and tools they have learned to provide clients with innovative solutions to a problem.

Team NORDAM:

David Everly
Ashlynn Hughes
Nathan Green

Faculty Mentor:
Dr. Austin Buchanan

Stillwater Designs (Kicker) Team:

Molly Day
Kathryn Fulton
Alexander Pick

Faculty Mentor:
Dr. Terry Collins

Fall 2019 Senior Design Teams

Ameristar Team:

Omar Zain Abeden
Jackson Baker
Sarah Moore

Faculty Mentor:
Dr. Chenang Liu

Arrow Engine Team:

Mitchel Loiseau
Whitney Fillmore
Dylan Rowan

Faculty Mentor:
Dr. Bing Yao (not pictured)

Cowboy Academy Team:

Justin Hamilton
Omar Algannas
Aaron Madden

Faculty Mentor:
Dr. Camille DeYong

IEM Faculty

Dr. Baski Balasundaram
Wilson Bentley Chair and Associate Professor

Dr. Juan S. Borrero
Assistant Professor

Dr. Austin Buchanan
Assistant Professor

Dr. Terry Collins
Associate Professor

Dr. Camille DeYong
Associate Professor
Undergraduate Program Director

Dr. Jennifer Glenn
Teaching Assistant Professor

Dr. Tim Hardin
Teaching Assistant Professor

Dr. Sunderesh Heragu
Regents Professor and School Head
Donald and Cathey Humphreys Chair

Dr. Manjunath Kamath
Professor

Dr. Chenang Liu
Assistant Professor

Dr. Tieming Liu
Associate Professor
Graduate Program Director

Dr. Bing Yao
Assistant Professor

Dr. Farzad Yousefian
Assistant Professor

IEM Staff

Laura Brown
Senior Financial Assistant
Administrative Support Supervisor

Mya Jackson
Student Worker

Valerie Quirey
Graduate Programs Coordinator

Cara Sides
Student Worker

Matt Taylor
IEM Undergraduate Academic Advisor

Misty Werkman
Administrative Support Assistant II

School of Industrial Engineering and Managment
354 Engineering North
Oklahoma State University
Stillwater, OK 74078
405-744-6055 iem.okstate.edu


@IEM_Okstate


@OkStateIEM


@IEMOKstate