

40 YEARS LATER

BALANCING BETWEEN CULTURES WITH CONTROL, WOMEN IN CONTROL, OUTREACH AND
HUMANITARIAN MENTORSHIP IN DIVERSE AND INCLUSIVE COMMUNITIES

Bozenna Pasik-Duncan, Ph.D., D.Sc.

IEEE CSS, SSIT, SC, WIC, WIE, WISE, AACC, IFAC, SIAM

University of Kansas

Departments of Mathematics

Lawrence, Kansas 66045, USA

Tel: +1 785 218 2971 – E-mail: bozenna@ku.edu

<http://www.math.ku.edu/ksacg/Bozenna.html>

BOZENNA PASIK-DUNCAN PH.D., D.SC.(HABILITATION)

Education:

- MS'70 - Mathematics & Computer Science, University of Warsaw, Poland
- Ph.D.'78 - Mathematics & Economics, Warsaw School of Economics (SGH), Poland
- D.Sc.'86 (habilitation doctorate) - Mathematical Statistics, Optimal Control, SGH

Moved to USA in 1984 - University of Kansas (KU) - research & teaching positions:

- Professor of Mathematics & Courtesy Professor of AE & EECS, Investigator of I2S & MMICC; Faculty Affiliate of CCB; Chancellor's Club Teaching Professor

In professional organizations - leadership positions include:

- Distinguished Member of IEEE CSS, IEEE Life Fellow, IFAC Fellow & AWM Fellow
- IEEE- HKN, Phi Beta Delta, International Honors Societies, Women's Hall of Fame
- Member of IEEE SSIT BOG & Chair of IEEE SSIT TC -Universal Access to Technology
- Past Global Chair of IEEE WIE & IEEE SSIT Representative in IEEE WIE
- Immediate Past Chair of IFAC Task Force on Diversity and Inclusion (D&I)
- Chair of IEEE Systems Council (SC) D&I & Member of IEEE SC WIE Committees
- Co-Founder & First Chair of IEEE CSS Women in Control (WIC) Committee
- Member of Award Boards of IFAC, AWM & CSS WIC Advisory Board
- Founder & Faculty Advisor of KU AWM & SIAM Student Chapters
- Founder & Coordinator of KU Mathematics Awareness Month Outreach Program
- Founder and Coordinator of AACC- IEEE CSS – IFAC Outreach Program
- Past VP of IEEE CSS; Past Chair of CSS Task Force on Globalization & IA Committee
- Past multiple terms Program Director of SIAM Systems Theory & Control AG
- Past VP of Polish Mathematical Society (PTM) & Chair of Award Committees of AWM, MAA, AMS, IFAC
- And many many more

FROM A POLISH SPACE TO THE LAND OF OZ

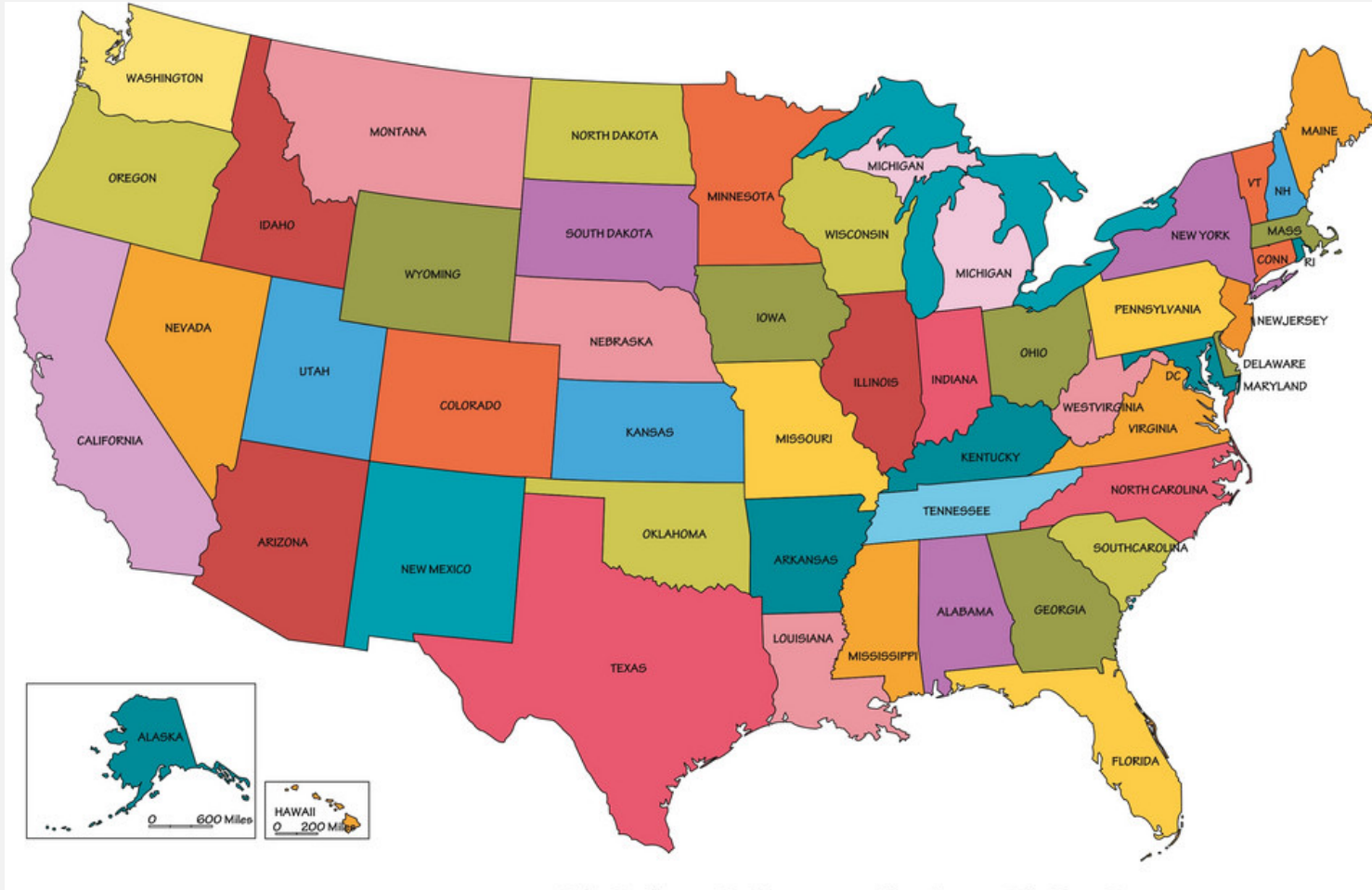
Moved in 1984 - 14 years at Warsaw School of Economics (SGH)

As First Spouse accommodated at Mathematics Department of
University of Kansas (KU) – 39 years

Balancing between two cultures as a tough challenge with amazing
opportunities

35 years of continued support from National Science Foundation
(NSF) – in recognition of research, teaching and broader impacts





- 2019 Kansas population: 2.913 million
- Statehood: 1861, 34th state
- Capital: Topeka
- State bird: western meadowlark
- State flower: sunflower

The University of Kansas



QUICK FACTS

Lawrence, Kansas

MAIN CAMPUS LOCATION

1865

FOUNDED



Jayhawk

MASCOT



*Crimson and the
Blue*

ALMA MATER (AND SCHOOL COLORS)

In 1866, the University of Kansas welcomed the first class of 55 students to an unfinished building on a treeless ridge called Mount Oread.

Today, our enrollment sits at 28,500. From that single building, we have grown to five campuses. The once barren landscape has grown into a wooded campus considered one of the most beautiful in the nation.

We embrace our role as the state's flagship university and a premier research institution, serving the state, nation, and world.

EXCELLENCE IN SCHOLARSHIP LEADERSHIP AND COMMUNITY SERVICE

- The powerful integration of scholarship with leadership and community service.
- Scholarship in cross-disciplinary research and scholarship in teaching diverse groups of students - a way of thinking outside of the box and learning new perspectives, tools, and ideas as well as collaboration.
- Interdisciplinary leadership - the practice of mobilizing peers and students to tackle tough challenges and to thrive – a way of integrating scholarship in research, learning and teaching.
- Community service involves sharing passion and skills with others and celebrating broader impacts of scholarship and leadership.
- The five Cs: curiosity, creativity, connections, communication, and collaboration as my tools that drive success in research, teaching, leadership and community service.

THE POWER, BEAUTY, AND EXCITEMENT OF STOCHASTIC SYSTEMS AND CONTROL

- The Cross-Boundaries Nature of Stochastic Systems and the Collaborative Effort in Research, Teaching, and Learning
- The Human Brain as One of the Most Complicated Stochastic Systems
- The Brain as a Platform for Integrating Science, Technology, Engineering and Mathematics (STEM)

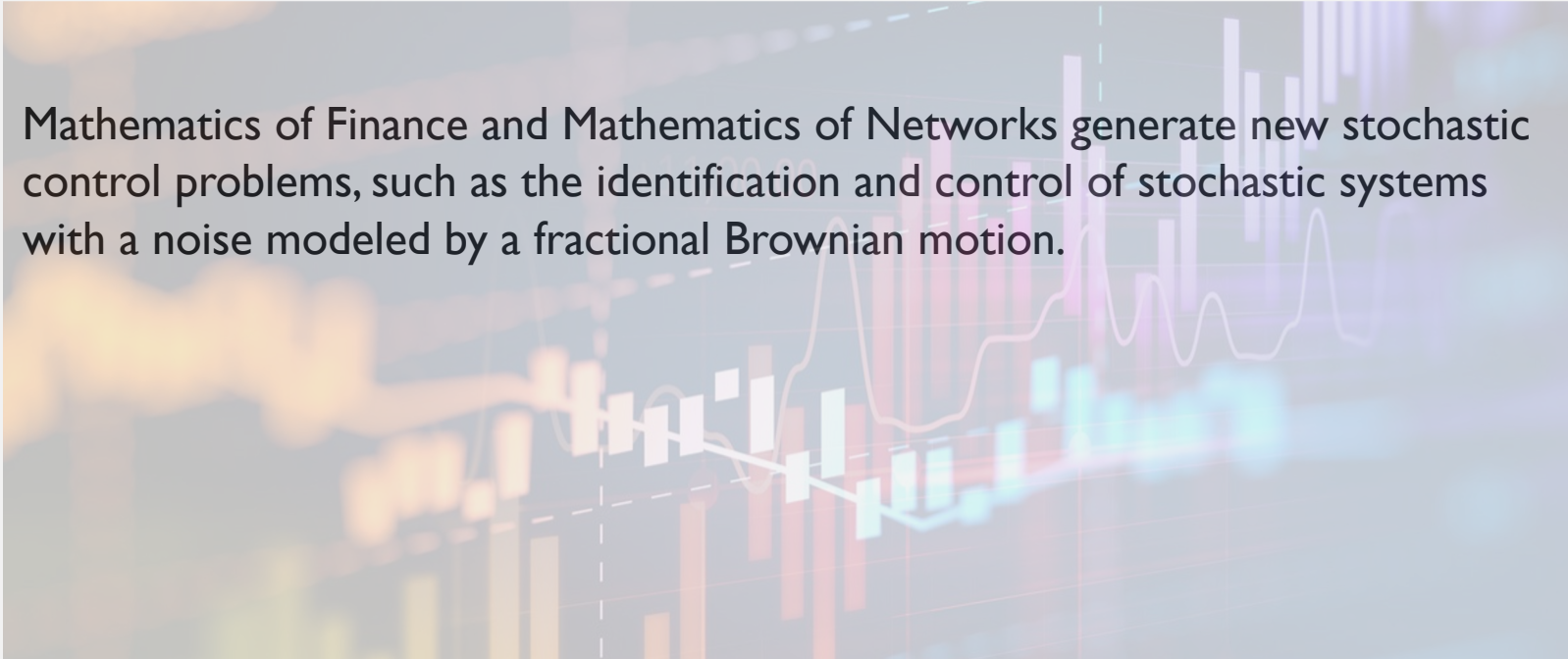
MULTIDISCIPLINARY AND INTERDISCIPLINARY APPROACHES

- Neurology, Neurosurgery, Neuropsychology
- Mathematics
- Engineering (Electrical, Biomedical)
- Computer Science
- Physics, Chemistry
- Biology, Physiology



REAL WORLD PROBLEMS GENERATE NEW MATHEMATICAL PROBLEMS

Mathematics of Finance and Mathematics of Networks generate new stochastic control problems, such as the identification and control of stochastic systems with a noise modeled by a fractional Brownian motion.



MAKING CONNECTIONS: BUILDING BRIDGES BETWEEN DIFFERENT FIELDS

- Modelling “noise” by a Fractional Brownian Motion and currently by Rosenblatt non-Gaussian process. Challenge and excitement of developing stochastic calculus for this non-Gaussian process.
- Fractional Brownian Motion and Stochastic Calculus and their Applications to Finance, Actuarial Sciences, Biology, Medicine, and Telecommunications.
- Development of Analytical and Numerical Methods Based on Stochastic Modelling has increased its Relevance in Finance, Biomedicine, and Telecommunications.

WHAT IS ADAPTIVE CONTROL

”In everyday language, to adapt means to change a behavior to conform to new circumstances. Intuitively, an adaptive controller is thus a controller that can modify its behavior in response to changes in the dynamics of the process and the character of the disturbances.”

Astrom and Wittenmark, Adaptive Control, 1995

- Many physical systems experience perturbations or have unmodeled dynamics in the systems.
- These occurrences can often effectively be modeled by a noise perturbation.
- Examples show that noise may have a stabilizing or a destabilizing effect

Significance:

- Industrial models can often be described as controlled systems. Systems behavior depends on the parameters and the fact that the value of the parameters is unknown makes the system unknown. Some crucial information concerning the system is **NOT** available to the controller and this information should be learned during the system’s performance.
- The described problem is the problem of adaptive control.

ADAPTIVE CONTROL AND ITS SOLUTION

- Strong consistency of the family of estimates
- Self-optimality of an adaptive control that uses the family of estimates
- The general approach to adaptive control that is described here exhibits a splitting or separation of identification and adaptive control.
- **Powerful Interaction of Probability, Mathematical Statistics, SDE & Control**
- Self-tuning property
Asymptotically the adaptive control using the estimate of the unknown parameter is as good as the optimal control if we knew the system
- Self-optimizing property
The family of average costs converges to the optimal average costs, numerical computations for adaptive control
- **Powerful Interaction of Limit Theorems, Optimal Control & Computational Mathematics**

IMPORTANT ISSUES FOR IDENTIFICATION

- Estimators used:
 - Maximum likelihood
 - Least squares
 - Weighted least squares
- For some cases, the weighted least squares estimator is strongly consistent while the least squares estimator is not.
- Strong consistency of estimators
- Rate of convergence of estimators
- Asymptotic behavior of estimators
- **Mathematical Statistics Matters**

THE ROLE OF A PROFESSIONAL SCIENTIST AND ENGINEER IN A WIDE VARIETY OF COMMUNITIES AND SETTINGS

- IEEE TAC Special Issue on "Stochastic Control Methods in Financial Engineering"
- IEEE Control Systems Society Control Education
- AACC as Extraordinary Supporter & Sponsor for Outreach Activities in Control
- IFAC Control Education
- NSF Inaugural Pioneering Support for STEM Workshop for High School Students and Teachers at ACC'2000 in Chicago and follow up control activities around the world
In partnership of AACC, IEEE CSS, IFAC & SIAM
- Plain Talk Program for a wide range of the public with over 335 Outstanding Speakers

MOTIVATION AND PURPOSE

The longevity of the control field which spans STEM depends on its continuous success in attracting the most gifted young people to the profession and early exposure is a key to bringing control systems to middle and high school students and their teachers.

The goal of these outreach efforts is to promote an increased awareness of the importance and cross-boundary nature of control and systems technology. The idea is that education is at all levels an inclusive process.

Over 20,000 K-12 students & over 335 passionate, and enthusiastic speakers had participated during 21 years of semiannual STEM outreach activities.



PLAIN TALK ON SYSTEMS AND CONTROL FOR A WIDE RANGE OF THE PUBLIC A SAMPLE

- The Power of Feedback
- Joys and Perils of Automation
- Control Education and the DARPA Grand Challenge
- The Next Phase of the Information Technology Revolution
- Controlling Air Traffic
- Understanding Phenomena through Real Physical Objects—Controlling Pendulum
- From the Brain to the Stock Market
- Epileptic Seizures: Quakes of the Brain

ENGAGING AN INSTITUTION

Every year for the last 30 years over 50% of faculty and students participate in KU MAM activities that include:

- Competitions for students 4-12th grade; over 80 schools throughout Kansas participate in this competition
- Workshops for fifth graders are organized by graduate and undergraduate students
- Colloquia for undergraduates and panel sessions with students, teachers & faculty
- Annual Proclamations by Governor of Kansas and city Mayor bring awareness to the Kansas and the Lawrence communities of the importance of STEM in everyday life.



VERTICAL AND HORIZONTAL TEACHING

- Vertical integration incorporates students and researchers at different levels in their teaching approach
- Involvement and engagement of K-12, undergraduate, graduate, and postdoctoral students
- Horizontal integration incorporates faculty from various disciplines in the teaching of a course

THE POWER OF INTEGRATING RESEARCH, TEACHING, AND LEARNING

- STEM education takes graduates everywhere
- Flexibility and Success in Obtaining Jobs
- Success in National Scholarships
- Quick Promotions
- Community Service & Broader Impacts of Research Highly Recognized



SCHOLARSHIP OF TEACHING

- Teaching, like other forms of scholarship, has been identified as an extended process that unfolds over time, a process with the elements of vision, design, interactions, outcomes and analysis.
- The classroom becomes a scientific laboratory.
- Teaching as an activity (experiment) over time .
- The visibility and viability of teaching problems that have been investigated as scholarship and not merely for the purpose of “fixing” them.
- The classroom as a stochastic system that requires adaptive control.
- Math 750 Course on Stochastic Adaptive Control attracts STEM+ Students.

SCHOLARSHIP OF TEACHING— INTERNATIONAL AND INTERDISCIPLINARY EXPERIENCE

- Teaching Experience—Balancing between different cultures
University of Warsaw
- Warsaw School of Economics
- Warsaw University of Technology
- University of Kansas
- Kansas K-12 Schools –

teaching as a volunteer “Probability & Linear Algebra” for 4 years 17 Honors Math Program students as best life-time experience in learning about American Education at the Elementary School Level and making life-time friends. Those students won every state competition in applications of mathematics.

FEEDBACK FROM STUDENTS

Former KU stochastic systems and control students were asked to give some recommendations to current students for considering careers in industry.

One student's response:

“Always be alert in your analysis of what you are doing—ask yourselves why things are the way they are—see if you can explain what you observe. Make sure that you consider how even the most abstract mathematics you do can be applied to real life problems.”

Another student from the Mayo Clinic:

“When I meet with investigators, they don't talk about math. They talk about genetics, anesthesiology, surgery, cancer, etc. It's important to be able to understand other subjects so that you can thoughtfully apply mathematics to them...The difference between classroom and job is the necessity to handle large data sets.”

THE ISSUE OF HOW TO TEACH AND TRAIN TO PROFESS

Communication and Writing in Science and Engineering

Engaging Students in the Voyage of Learning

“The voyage of discovery lies not in finding new landscapes, but in having new eyes.”—Marcel Proust



REFLECTIONS FROM THE CLASSROOM

“Taking this class really opened my eyes to math and science. We were taught until we knew what is going on...”

“We were taught how practical math is in life and how relevant it is for any field of study that we choose.”

“I learned from the material, learned from myself, and for it all, my life is better. A course with that kind of an impact and outcome is definitely life changing.”

THE POWER, BEAUTY AND EXCITEMENT OF C⁵

C⁵:

- Curiosity
- Creativity
- Connections
- Communication
- Collaboration

These five words drive the work in research, teaching and leadership.

MY BACKGROUND A WIDE VARIETY OF COMMUNITIES AND SETTINGS

- Poland and USA - Balancing Two Cultures: Polish and American
- Polish Mathematical Society and Warsaw School of Economics
- Lawrence Kansas and Lawrence Kansas Elementary School
- Society for Industrial Mathematics (SIAM) and SIAM Activity Group on Systems and Control
- Association for Women in Mathematics (AWM) and AWM Student Chapter at KU
- IEEE Control Systems Society (CSS) and Women in Control (WIC)
- IEEE and Women in Engineering (WIE)
- University of Kansas and Mathematics Awareness Month (MAM) Program at KU

New Challenges

Processing of information

Ability to work with complex systems and diverse groups

Ability to handle change

Ability to manage people

Ability to handle large data sets and use statistics

Practical Tips

Be flexible and open-minded

Be willing to take risks

Take advantage of opportunities Balance personal/professional life

Take care of mind, body and spirit daily

NETWORKING CAN MAKE A DIFFERENCE IN WOMEN'S LIVES – IEEE WIE

- Co-Founder of IEEE CSS Women in Control (WIC)
- 2017-2018 Global Chair of IEEE Women in Engineering (WIE)
- Founder/ Faculty Advisor of Association for Women in Mathematics (AWM) & Society for Industrial and Applied Mathematics (SIAM) Student Chapters at KU

GLOBAL CONNECTIONS

Professional societies can welcome women by being inclusive, supportive and making a difference in women's personal and professional lives, and in the world.

Several groups I am working with are:

- IEEE CSS Women in Control (WIC)
- IEEE Women in Engineering (WIE)
- IEEE SC WISE & IEEE SSIT WIE
- AWM & Women in SIAM
- AWS & AAUW
- Women in WB WePOWER SAR Network



NATIONAL AND LOCAL CONNECTIONS

The IEEE Women in Engineering (WIE) encourage women and girls to study and to have active careers in engineering and sciences.

The IEEE WIE is a very active organization whose purpose is:

- To promote a friendly environment for all women interested in STEM.
- To promote interest in engineering, leadership and community service.
- To inspire and engage women to pursue science and engineering and to advance women in a career development.



BUILDING BLOCKS

- Women can build exciting partnerships between women in industry, government and academia through leadership conferences, summits, and workshops and other activities with young professionals.
- Women can build a mentor/mentees program to advance women by finding sponsors and external funding.
- Women in Control are engaged in leadership and volunteering work in IEEE.

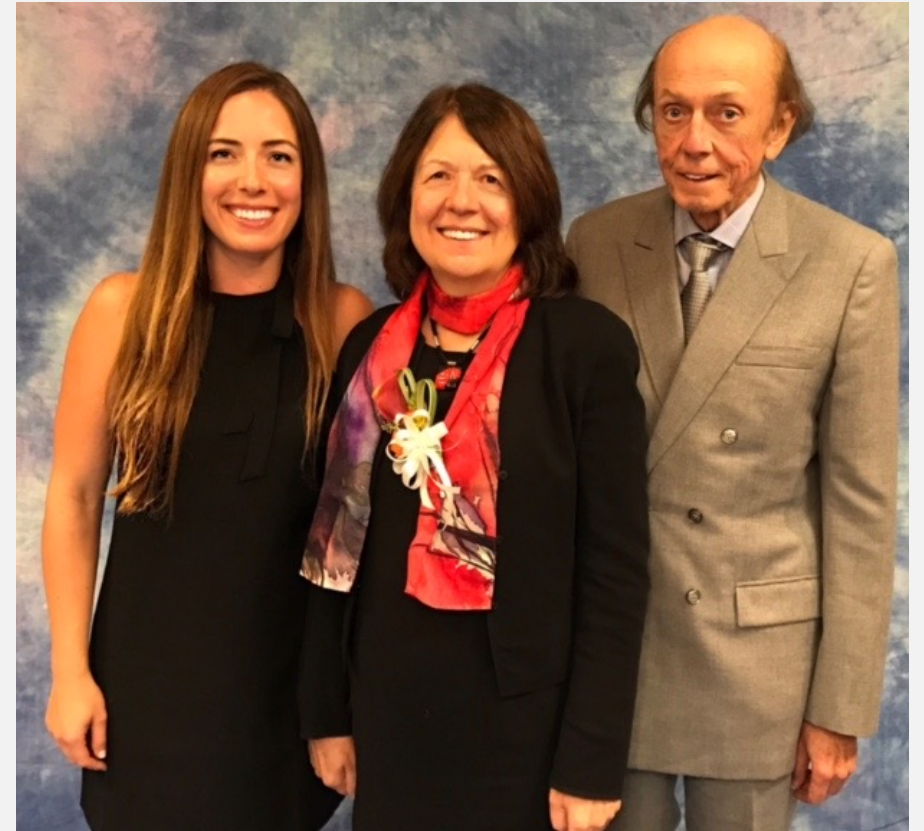


FAMILY CONNECTIONS

Women address issues of balancing career and family.

Building Communities makes a Difference

My family is my smallest STEM community



My family at IEEE EAB Awards Ceremony.
Dominique: BS in math, Ph.D. in EE, now Assistant Professor of Neurology at USC.
Tyrone: Ph.D. in EE, KU Professor of Mathematics and Courtesy Professor of EECS.

ROLE MODELS

I have been very fortunate to have great mentors. I am proud to call for nominations for the 2023 Bozenna Pasik-Duncan Humanitarian Mentorship Award. Nominations are open until the end of September.

- **Maria Sklodowska Curie – the only woman with 2 Nobel Prizes in Science**
- **My Mother and all Teachers in Poland – survivors of WWII**
- *** Polish Women in Mathematics & Science**
- Emily Taylor at KU & advice: “do things right”
- Women at KU Math Department
- Sally Frost Mason the only woman elected CLAS Dean at KU – a role model in DEI
- Deborah Lockhart NSF & AWM
- Women in Control in CSS, IFAC, SIAM & AWM
- Women in IEEE – role models in leadership
- Women in IEEE WIE & World Bank WePOWER
- Ramalatha Marimuthu & Women in India

Nominate your outstanding mentor!
<https://ieeereturningmothers.in/bozenna-pasik-duncan-humanitarian-mentorship-award/>

**THANK YOU TO HOLLY & WISE FOR THIS OPPORTUNITY TO SHARE
MY STORY, AND TO ALL ORGANIZATIONS, SGH, KU AND TO ALL
THOSE WHO MADE IMPORTANT CONTRIBUTIONS TO MY LIFE**

Big thanks go to my Family, Friends around the World, my Mentors,
Advisors, my life and career Sponsors, Students and Young Professionals
for their lifetime support, assistance, help and collaboration
and for making me feel always young, and “the happiest person on Earth”