

Impact and Future of Reliability Engineering

DARRYLL J. PINES

APRIL 2, 2014
25TH ANNIVERSARY OF
CENTER ON RISK AND RELIABILITY



25
RE
RELIABILITY
ENGINEERING
1989-2014
25th Anniversary
Symposium

*Promise of a Discipline:
Reliability and Risk
in Theory and Practice*

April 2, 2014
8:30 a.m. - 5 p.m.
Samuel Riggs IV
Alumni Center
University of Maryland
College Park, MD



A. JAMES CLARK
SCHOOL OF ENGINEERING

Center for Risk and Reliability

The Center for Risk and Reliability (CRR) was formed in 1989 as the umbrella organization for many of the risk and reliability research and development activities at the UMD Clark School of Engineering. CRR research covers a wide range of subjects involving systems and processes, and include topics on predictive reliability modeling and simulation, physics of failure fundamentals, software reliability and human reliability analysis methods, advanced probabilistic inference methods, system-level health monitoring and prognostics, risk analysis theory and applications to complex systems such as space missions, civil aviation, nuclear power plants, petro-chemical installations, medical devices, information systems, and civil infrastructures. Over 20 core and adjunct faculty from various engineering departments of the Clark School of Engineering form the pool of experts at CRR. CRR is also home to numerous research laboratories with extensive state of the art equipment and high performance computers.

CRR is the research arm of the Reliability Engineering educational program, the largest and most comprehensive degree granting graduate program in the field of reliability and risk analysis of engineered systems and processes. The program offers MS, PhD, and Graduate Certificate in Reliability Engineering and Risk Analysis. All courses are available both through traditional on-campus and online delivery modes.



A. JAMES CLARK
SCHOOL OF ENGINEERING

Current Core Faculty



A. JAMES CLARK
SCHOOL OF ENGINEERING



Al-Sheikhly, Mohamad

Professor

Materials Science and Engineering
2309F Chemical and Nuclear Engineering Building
Phone: 301-405-5214 | mohamad@umd.edu



Desai, Jaydev

Professor

Mechanical Engineering
0160 Glenn L. Martin Hall
Phone: 301-405-4427 | jaydev@umd.edu



di Marzo, Marino

Professor

Fire Protection Engineering
3104B JM Patterson Building
Phone: 301-405-5257 | marino@umd.edu



Sandborn, Peter

Professor, Director of MTECH

Mechanical Engineering
2106A Glenn L. Martin Hall
Phone: 301-405-3167 | sandborn@umd.edu



Schmidt, Linda

Associate Professor

Mechanical Engineering
2104B Glenn L. Martin Hall
Phone: 301-405-0417 | lschmidt@umd.edu

Affiliate and Adjunct Faculty

Professor Neil Goldsman (ECE)

Professor Carol Smidts (ME, OSU)

Professor Joseph Bernstein (ECE, Israel)

Adjunct Faculty and Lecturers

Dr. Stuart Katzke (NIST)

Dr. Nathan Siu (NRC)

Dr. Norman Eisenberg (Independent
Consultant)

Dr. Mark Kaminiskiy (CRR-CEE)

Dr. Roy Schuyler (Independent Consultant)



A. JAMES CLARK
SCHOOL OF ENGINEERING

Microsoft Academic Ranking Reliability Engineering (based on publications)

1. City University of Hong Kong
2. Sandia National Laboratories
3. University of Southern California
4. National University of Singapore
5. University of California Berkeley
6. Politecnico di Milano
7. University of Electronic Science & Technol...
- 8. University of Maryland**
9. University of Manchester
10. Stanford University

2010 NRC Rankings

(Industrial Engineering, Operations Research, Reliability Engineering)

1. Stanford University-Management Science and Engineering, 1-2
2. Massachusetts Institute of Technology-Operations Research, 2-4
3. Georgia Institute of Technology-Main Campus-Industrial Engineering, 1-3
4. Northwestern University-Industrial Engineering and Management Sciences, 4-12
5. Carnegie Mellon University-Operations Res/Information Systems/Manufacturing and Operating Systems, 4-17
6. University of California-Berkeley-Industrial Engineering and Operations Research, 3-10
7. University of Michigan-Ann Arbor-Industrial Operations and Engineering 4-11
8. Cornell University-Operations Research 6-18
9. Carnegie Mellon University-Engineering and Public Policy 8-28
10. Purdue University-Main Campus-Industrial Engineering 6-22
11. Princeton University-Operations Research and Financial Engineering 11-29
12. University of Iowa-Industrial Engineering 11-37
13. University of Nebraska-Lincoln-Industrial and Management Systems Engineering 28-65
14. University of Wisconsin-Madison-Industrial Engineering 6-22
15. Virginia Polytechnic Institute and State University Industrial and Systems Engineering 5-28
16. University of Florida-Industrial and Systems Engineering 12-40
17. University at Buffalo-Industrial Engineering 27-53
18. University of Pennsylvania
19. Operations and Information Management 5-26
20. Arizona State University-Industrial Engineering 11-34
21. Pennsylvania State University-Main Campus-Industrial and Manufacturing Engineering 7-23
22. University of Pittsburgh-Pittsburgh Campus-Industrial Engineering 30-55
- 23. University of Maryland-College Park- Reliability Engineering 6-29**

Mpact-Rankings

2015 US News Mechanical Engineering Ranking

Stanford University	1
Massachusetts Institute of Technology	1
California Institute of Technology	3
University of California--Berkeley	3
Georgia Institute of Technology	5
University of Illinois--Urbana-Champaign	5
University of Michigan--Ann Arbor	5
Princeton University	8
Cornell University	8
Purdue University--West Lafayette	10
Carnegie Mellon University	10
University of Texas--Austin (Cockrell)	10
University of California--Los Angeles (Samueli)	13
Northwestern University (McCormick)	13
Johns Hopkins University (Whiting)	13
University of Minnesota--Twin Cities	16
University of Maryland--College Park (Clark)	17
Pennsylvania State University--University Park	17
Texas A&M University--College Station (Look)	17
Virginia Tech	17
University of California--San Diego (Jacobs)	21
University of Wisconsin--Madison	21
Rensselaer Polytechnic Institute	23
Ohio State University	23
University of Washington	23



A. JAMES CLARK
SCHOOL OF ENGINEERING

Impact-Prestige

Professional Society Fellows of Center

- Mohammed Modarres
 - Fellow, American Nuclear Society
- Ali Mosleh
 - Fellow, Society of Risk Analysis
- Bilal Ayuub
 - Fellow, ASEE
- Shapour Azarm
 - Fellow, ASME
- Greg Baecher,
 - Fellow, ASCE
- Arist Christou
 - Fellow, ASME
 - Fellow, APS

Faculty Service on Leading Journals

- Editorial Boards/Associate Editors
 - Reliability Engineering and System Safety Journal
 - Journal of Risk and Reliability.
 - International Journal on Performability Engineering
 - International Journal of Reliability and Safety (IJR)
 - SNAME's Journal of Ship Research, Ships and Offshore Structures Journal, Naval Engineers Journal (NEJ),



Mpact-NAE



For contributions to the development of Bayesian methods and computational tools in probabilistic risk assessment and reliability engineering.



For contributions to national defense and security through improved battlefield communication. Also *Inducted in May 2004 for innovative engineering and entrepreneurship in communications technologies.*



For the development, explication, and implementation of probabilistic- and reliability-based approaches to geotechnical and water-resources engineering.



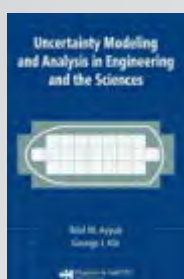
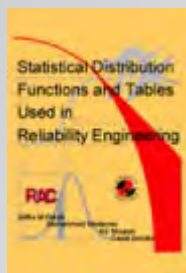
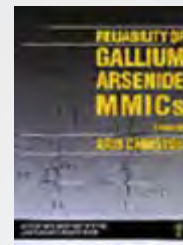
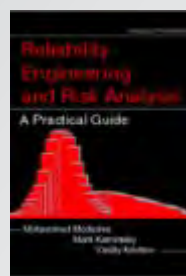
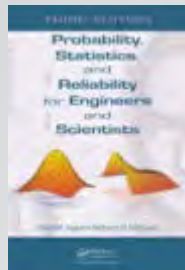
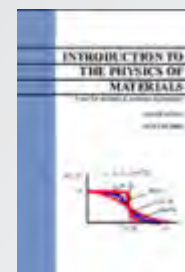
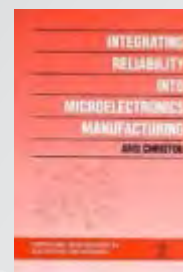
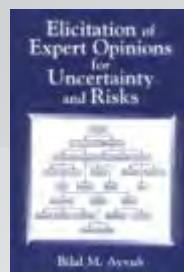
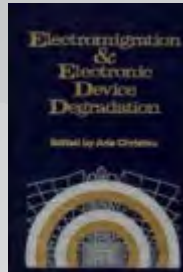
Mpact-Awards

Significant Junior Faculty Awards/Recognition

1. Michel Cukier, NSF CAREER
2. Jeffrey Herrmann, Innovator of year
3. Monifa Vaughn-Cooke



Mpact-Book/Monograph Contributions



Mpact-Partnerships

CRR Research Partnerships

- Cooperative Research Agreements with government agencies:
 - US NRC
 - **US Navy /NAVAIR-NAWCAD**
 - NASA
 - EC Halden Research Center, Norway
 - EEC Joint Research Center, Italy
 - ETH Center for System Safety, Switzerland
 - Norwegian Institute of Technology
 - Paul Scherrer Research Institute, Switzerland
- Partnership with the industry:
 - ManTech
 - Reliability Information Analysis Center RIAC Partnership



Mpact-Education Innovations

Professional Education-OAEE

- Online Professional Masters Degree
- Graduate Certificate



since 1993 are as follows:

MS – 211

PhD – 97

Per OAEE's records, the Master of Engineering and Graduate Certificate in Engineering degrees awarded since 1994 and 2000 respectively are as follows:

M. Eng. Reliability On-Campus 46

M. Eng. Reliability Online 16

Total M. Eng. 62

GCEN Reliability On-Campus 10

GCEN Reliability Online 22

Total GCEN 32

- #1 Columbia University (Fu Foundation) New York, NY
- #2 University of California—Los Angeles (Samueli) Los Angeles, CA
- #3 University of Wisconsin—Madison Madison, WI
- #4 University of Southern California (Viterbi) Los Angeles, CA
- #5 Pennsylvania State University—World Campus College, PA
- #6 Purdue University—West Lafayette West Lafayette, IN
- #7 University of Michigan—Ann Arbor Ann Arbor, MI
- #7 Virginia Tech Blacksburg, VA
- #9 North Carolina State University Raleigh, NC
- #9 Texas A&M University—Kingsville (Dotterweich) Kingsville, TX
- #11 Arizona State University (Fulton) Tempe, AZ
- #12 Polytechnic Institute of New York University New York, NY
- #12 South Dakota School of Mines and Technology Rapid City, SD
- #14 Johns Hopkins University (Whiting) Baltimore, MD
- #14 **University of Maryland—College Park (Clark) College Park, MD**
- #16 California State University—Fullerton Fullerton, CA
- #17 Cornell University Ithaca, NY
- #17 Lawrence Technological University Southfield, MI
- #17 Missouri University of Science & Technology Rolla, MO
- #20 Texas Tech University (Whitacre) Lubbock, TX



A. JAMES CLARK
SCHOOL OF ENGINEERING

Impact - Placement of Meng, MS and PhDs

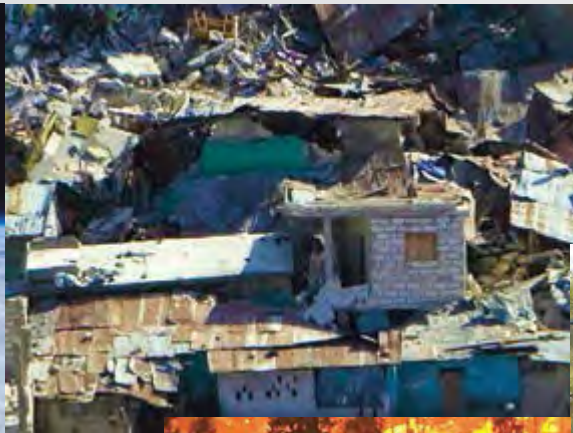
2006	Kristine Fretz	(currently with Johns Hopkins Applied Research Lab.)
2004	S. Chamberlain	(Currently, ITT - Industrial Products Group Reliability Specialist and Area Manager, ITT Industries)
2003	Chi Yeh	(Currently, Systems Engineering & Integration Branch, NASA, Glenn Research)
2001	F. Li	(Currently, Materials Research Scientist, Corning, Inc.)
2000	F. Joglar	(Currently, Manager, Fire Risk Group, SAIC)
2000	V. Krivtsov	(Currently, Ford Technical Leader for Reliability & Statistical Analysis, Ford Motor Company)
1998	H. Hadavi	(Energy Research Corp., Rockville, MD)
1998	J. O'Brien	(Currently Director of Office of Nuclear Safety, DOE)
1998	Y. Guan	(President and CEO, Advanced System Technology Management, Inc.)
1998	K. Ouliddren	(Currently, Staff Researcher, Nuclear Research Centre SCK-CEN, Mol, Belgium)
1997	T. Ni	(Currently, Deputy Dean, Shanghai University, China)
1997	A. Thunem	(Currently, Halden Reactor Project, Norway).
1994	Y-S. Hu	(Currently, Dean, Beijing Technology & Business University, and CEO of DML International Corp.)
1991	L. Hammersten	(Currently, Research Analyst, MITRE Corp.)
1990	L. Chen	VP at JP Morgan



Work on **Grand Challenge** Problems

Disaster Resilience

Risk and Reliability of Critical Infrastructure



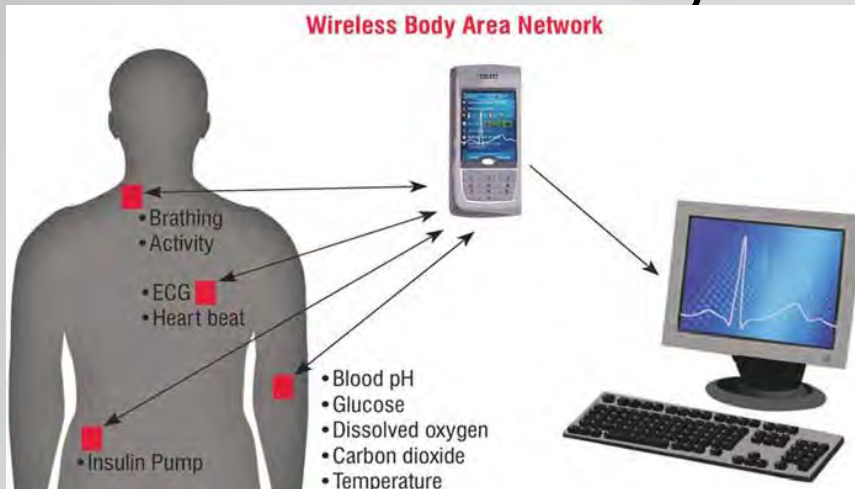
A. JAMES CLARK
SCHOOL OF ENGINEERING



Work on Grand **Challenge** Problems

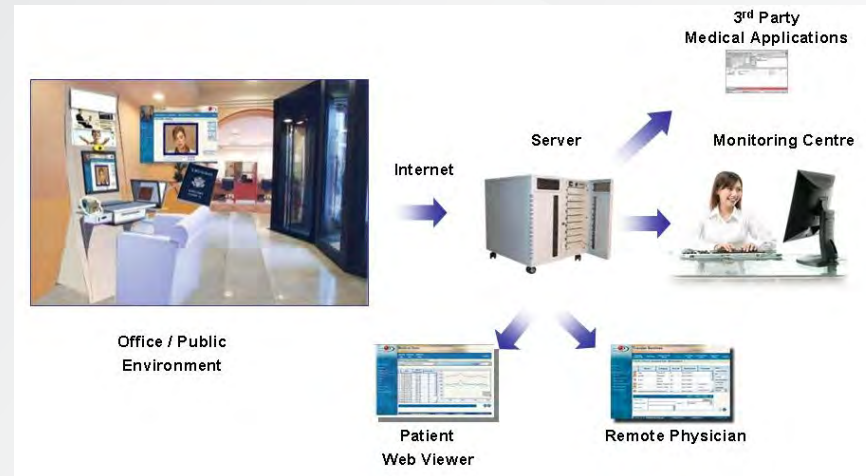
Global Public and Human Health

- Risk and Reliability of Devices and System



Radio Frequency (RF) or Wireless Devices

Insulin Pumps	Worn outside the body, these devices inject insulin into patients through an attached tube.
Cardiac Devices (Pacemakers and Defibrillators)	Medically implanted within the body, these can be read and adjusted wirelessly.
Neuro Stimulators	Implanted along neural paths, meaning the brain or spinal cord, these devices deliver electric stimulation to control various <u>neuro</u> -related abnormalities, such as epilepsy and Parkinson's disease.
Internal Infusion Pumps	Implanted inside the patient, these devices provide metered doses of medications ranging from therapeutic drugs to potent pain relievers (e.g., morphine).
Networked/Cabled (Ethernet) in Hospital/Medical Environments	
External Infusion Pumps	Within a medical environment, these devices provide metered doses of medications.
Radiological Machines	Used to deliver X-Rays or therapeutic radiological treatments information to doctors both inside and outside the medical facility.
Monitoring Devices	Used to monitor patients to provide information to workstations and central patient databases, such as heart monitors.



What of the Future?

New Faculty Hires in ME-Reliability Engineering:

- Monifa Vaughn-Cooke
- Offers out to at least 2 individuals

Facilities:

- Upgrades to Virtual Reality Cave under review to support future research thrusts

Education:

- Develop MOOC Course Series in Reliability Engineering



Some Perspectives from Dilbert

