

APSSRA Shinozuka Memorial session

Memories of Prof. M. Shinozuka
- Stochastic FEM, Lifelines, and Remote Sensing -

October 7, 2020

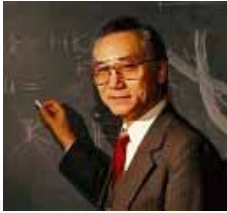
Fumio Yamazaki

Research Fellow, NIED, Japan.

Professor Emeritus, Chiba University, Japan.

History of Prof. M. Shinozuka

Year	Prof. Masanobu Shinozuka	Affiliation	Research topics
1930	1930.12.23 born in Tokyo		
1940			
1950	1953 BS, Kyoto University 1955 MS, Kyoto University	Kyoto Columbia	reliability theory
1960	1960 PhD, Columbia University 1969 Professor	Columbia	Monte Carlo simulation
1970		Columbia	system identification/control, stochastic dynamics
1980	1988 Princeton University	Columbia Princeton	lifeline stochastic FEM
1990	1990 Director, NCEER 1995 USC	Princeton USC	earthquake engineering advanced technologies (including remote sensing and GIS)
2000	2001 UC Irvine	USC UC Irvine	risk management monitoring of infrastructures
2010	2010. 12.23 80 th Birthday	Columbia	
2018	2018. 11. 5 passed away		



Masanobu Shinozuka

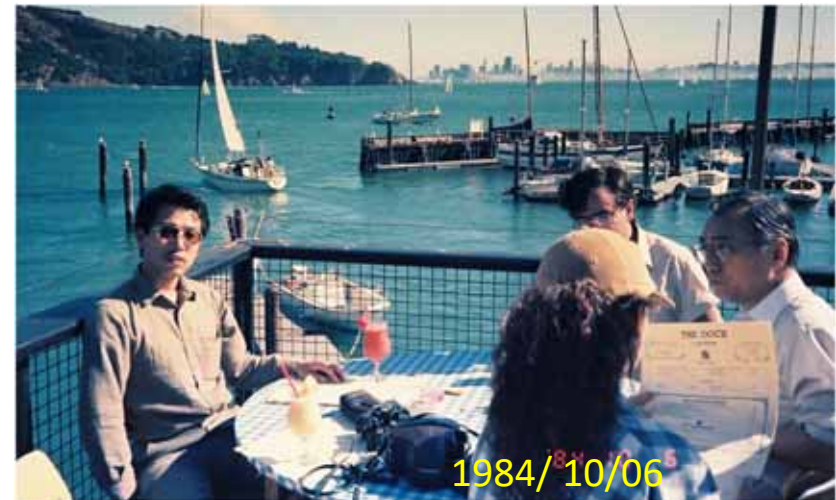
Professor of Civil Engineering and Engineering Mechanics, Columbia University
Continuum mechanics, stochastic processes, structural dynamics and control, earthquake and wind engineering

After Google Scholar

Citation: 30,043
h Index: 77
i10 Index: 323

Title	Citation	Year
A framework to quantitatively assess and enhance the seismic resilience of communities M Bruneau, SE Chang, RT Eguchi, GC Lee, TD O'Rourke, AM Reinhorn, ...Earthquake spectra 19 (4), 733-752	2909	2003
Digital simulation of random processes and its applications M Shinozuka, CM Jan Journal of sound and vibration 25 (1), 111-128	1845	1972
Statistical analysis of fragility curves M Shinozuka, MQ Feng, J Lee, T Naganuma Journal of engineering mechanics 126 (12), 1224-1231	1299	2000
Simulation of stochastic processes by spectral representation M Shinozuka, G Deodatis	1233	1991
Simulation of multivariate and multidimensional random processes M Shinozuka The Journal of the Acoustical Society of America 49 (1B), 357-368	737	1971
Basic analysis of structural safety M Shinozuka Journal of Structural Engineering 109 (3), 721-740	638	1983
Monte Carlo solution of structural dynamics M Shinozuka Computers & Structures 2 (5-6), 855-874	618	1972
Neumann expansion for stochastic finite element analysis F Yamazaki, M Shinozuka, G Dasgupta Journal of engineering mechanics 114 (8), 1335-1354	610	1988
Measuring improvements in the disaster resilience of communities SE Chang, M Shinozuka Earthquake spectra 20 (3), 739-755	528	2004
Nonlinear static procedure for fragility curve development M Shinozuka, MQ Feng, HK Kim, SH Kim Journal of engineering mechanics 126 (12), 1287-1295	477	2000
Simulation of multi-dimensional Gaussian stochastic fields by spectral representation M Shinozuka, G Deodatis	451	1996
Simulation of nonstationary random process M Shinozuka, Y Sato Journal of the Engineering Mechanics Division 93 (1), 11-40	429	1967
The analysis of structural safety .AM Freudenthal, JM Garrelts, M Shinozuka Columbia Univ New York Inst For The Study Of Fatigue And Reliability	415	1964
Digital generation of non-Gaussian stochastic fields F Yamazaki, M Shinozuka Journal of Engineering Mechanics 114 (7), 1183-1197	373	1988
Random fields and stochastic finite elements E Vanmarcke, M Shinozuka, S Nakagiri, GI Schueller, M Grigoriu Structural safety 3 (3-4), 143-166	369	1986
A vision-based system for remote sensing of bridge displacement JJ Lee, M Shinozuka Ndt & E International 39 (5), 425-431	354	2006
Structural-system identification. I: Theory R Ghanem, M Shinozuka Journal of Engineering Mechanics 121 (2), 255-264	345	1995
Response variability of stochastic finite element systems M Shinozuka, G Deodatis Journal of Engineering Mechanics 114 (3), 499-519	319	1988
Real-time displacement measurement of a flexible bridge using digital image processing techniques JJ Lee, M Shinozuka Experimental mechanics 46 (1), 105-114	276	2006

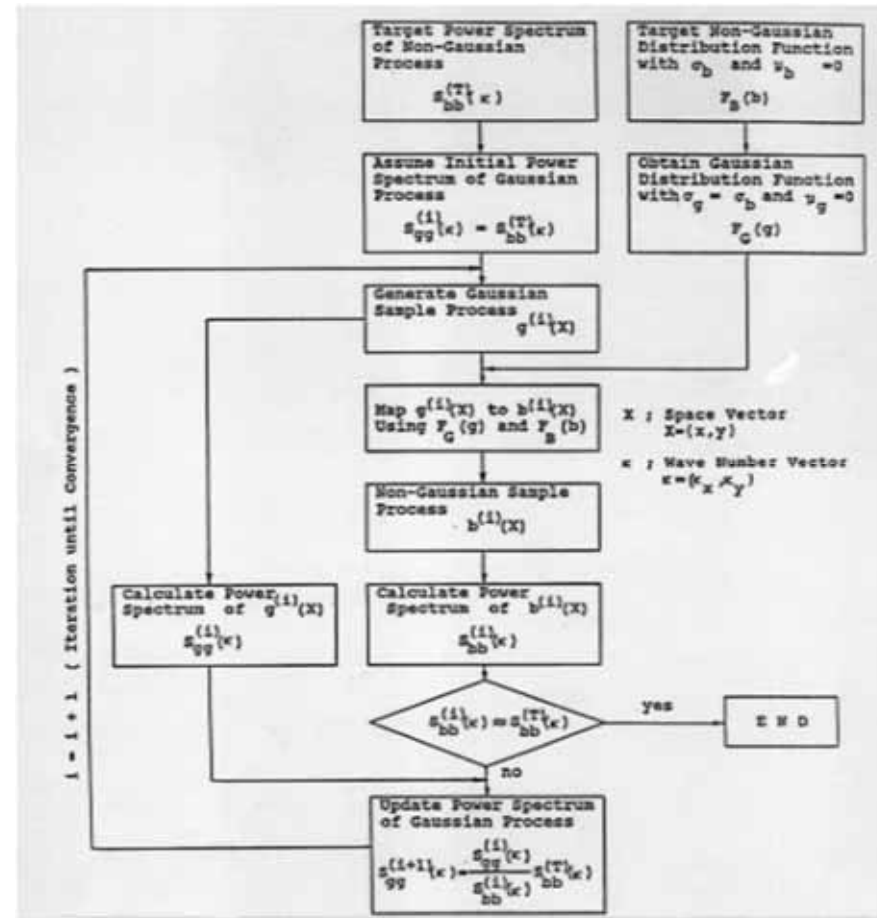
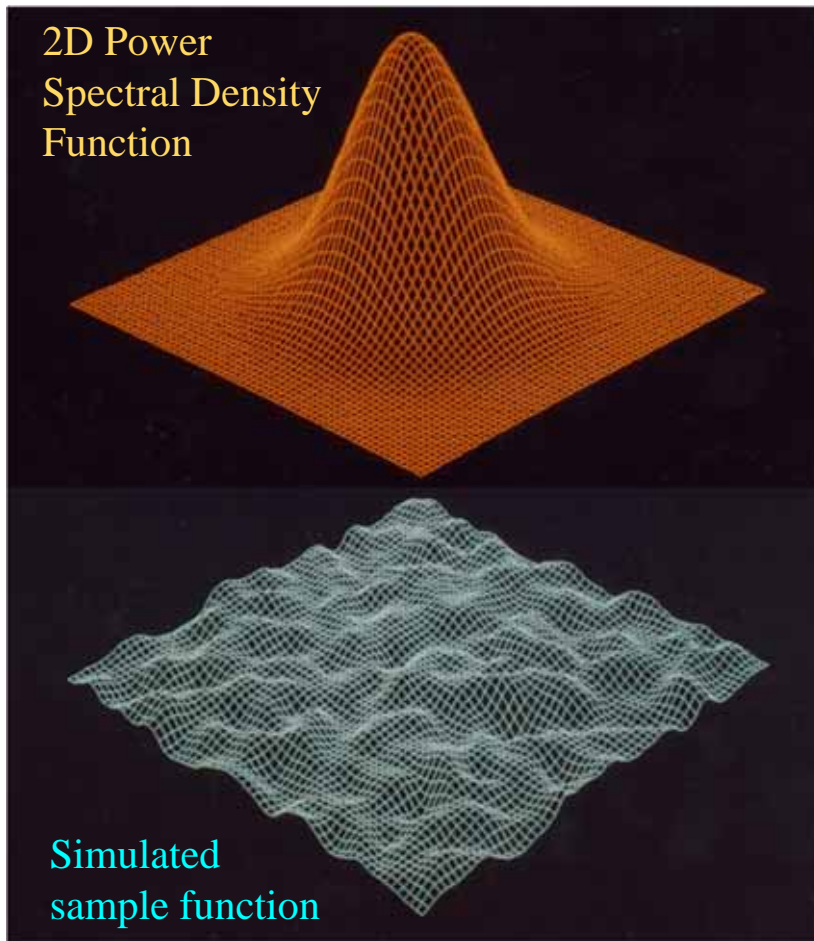
1984-1986 Columbia University



1984-1986 My research work at Columbia University

Yamazaki, F. and Shinozuka, M., **Digital Simulation of Non-Gaussian Stochastic Fields**, *Journal of Engineering Mechanics*, ASCE, Vol. 114, No. 7, 1988.

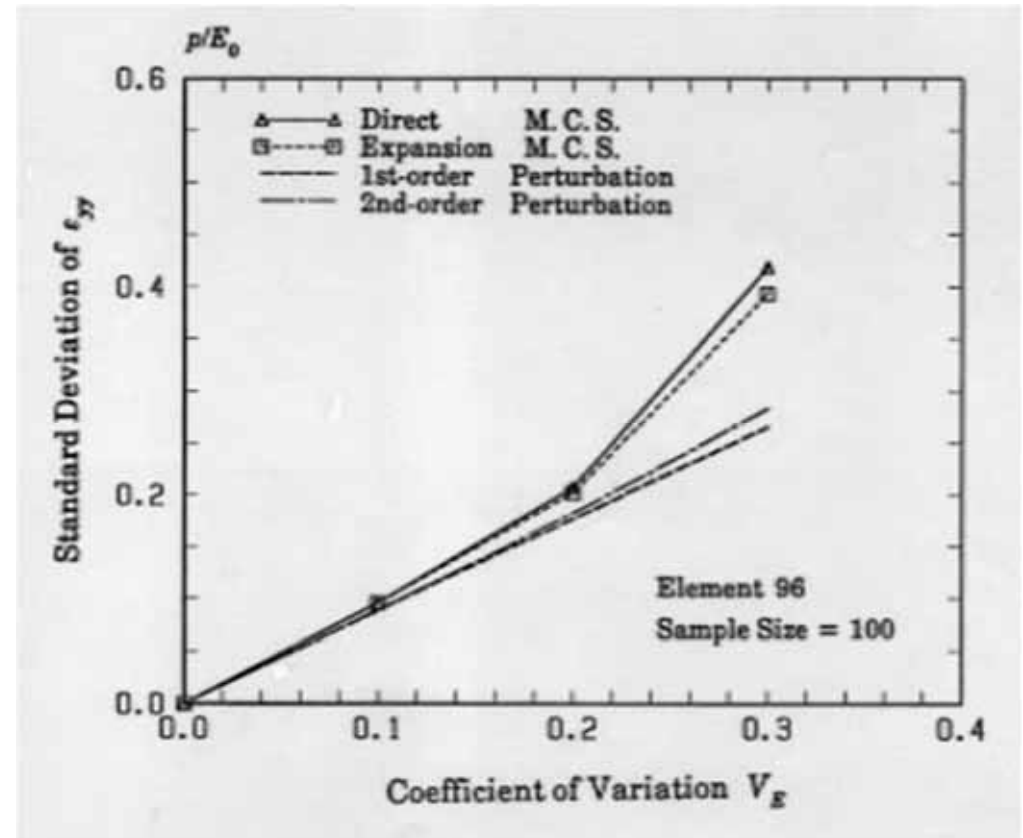
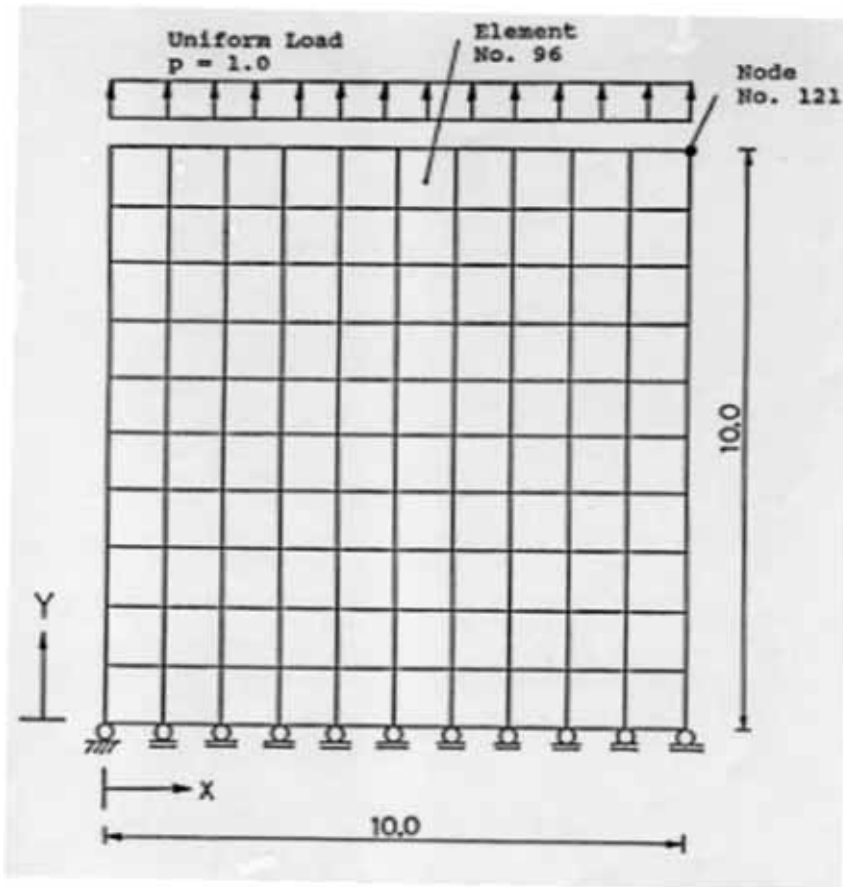
Citation by SCOPUS: 229
Google Scholar: 373



1984 - 1986 My Research work at Columbia University

Yamazaki, F., Shinozuka, M., and Dasgupta, G., **Neumann Expansion for Stochastic Finite Element Analysis**, *Journal of Engineering Mechanics*, ASCE, Vol. 114, No. 8, 1988.

Citation by SCOPUS: 389
Google Scholar: 610



1st International Conference on Computational Stochastic Mechanics
Celebration of Shono's 60-years Birthday Corfu, Greece, 1991.8





February 1999, Taipei, Taiwan

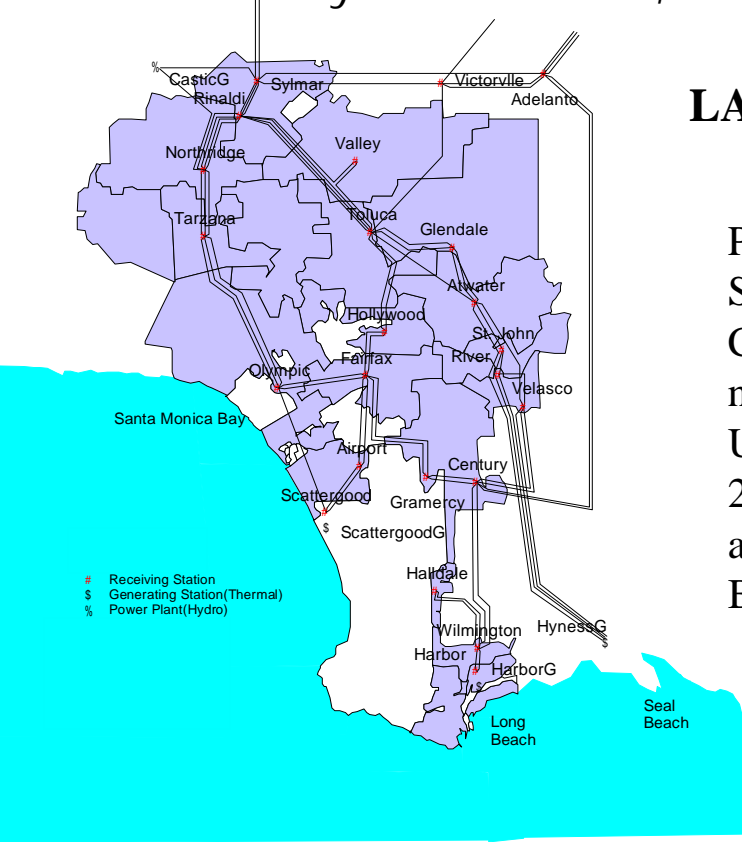
Lifeline and Prof. Shinozuka

Seismic Performance Analysis of Electric Power Systems

APEC Seminar on Earthquake Disaster Management of Energy Supply Systems

Chinese Taipei September 5 and 6, 2001

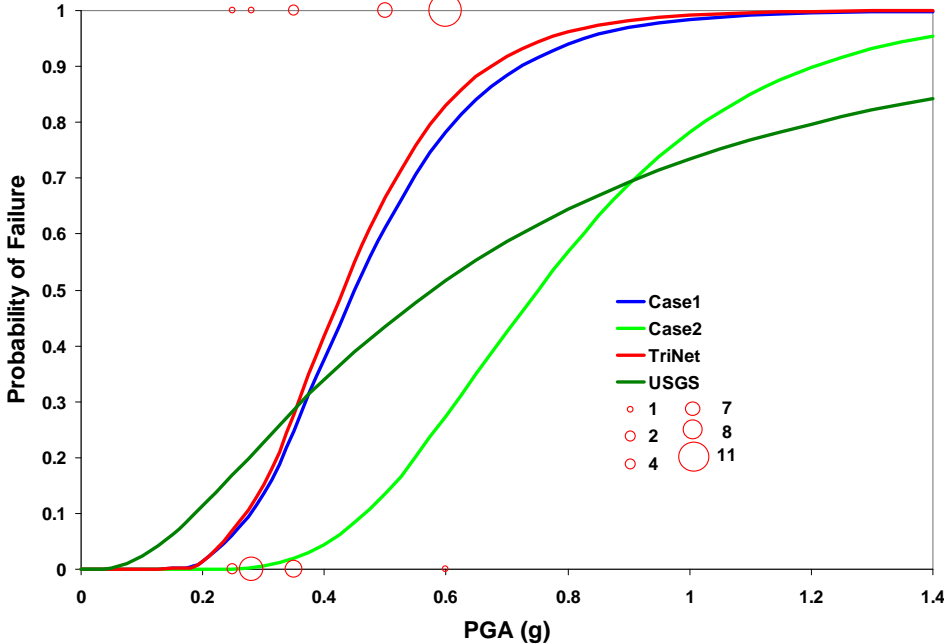
M. Shinozuka
University of California, Irvine



LADWP Service Areas

Part of Western Systems Coordinating Council's (WSCC's) network covering 14 US western states, 2 Canadian provinces and northern part of Baja California

Fragility Curves for Transformers

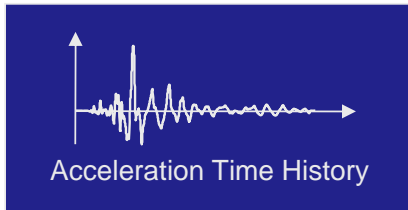


Effect of earthquake ground motions on fragility curves of highway bridge piers based on numerical simulation

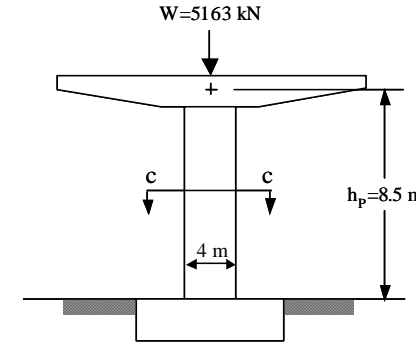
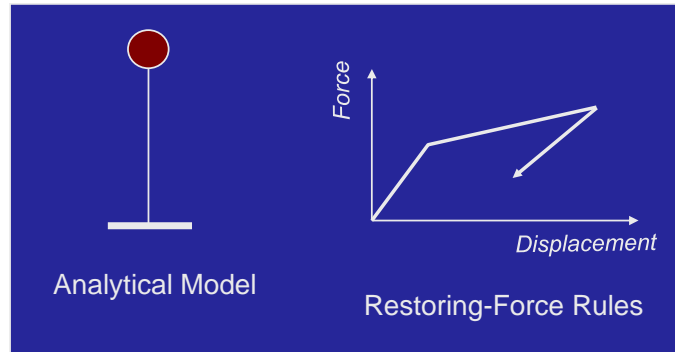
Karim and Yamazaki (2001) EESD

Google Scholar: 248

I. Ground Motion



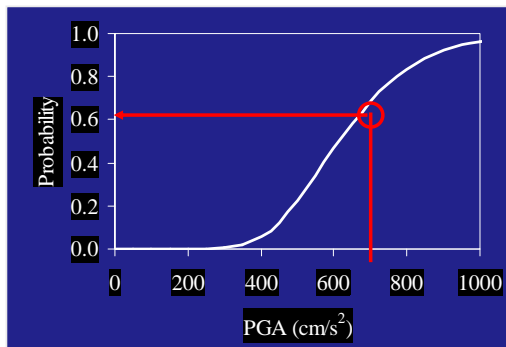
II. Dynamic Response Analysis



III. Damage Criteria

- A. Damage Classification
- B. Damage Indices (DI)

IV. Fragility Curves

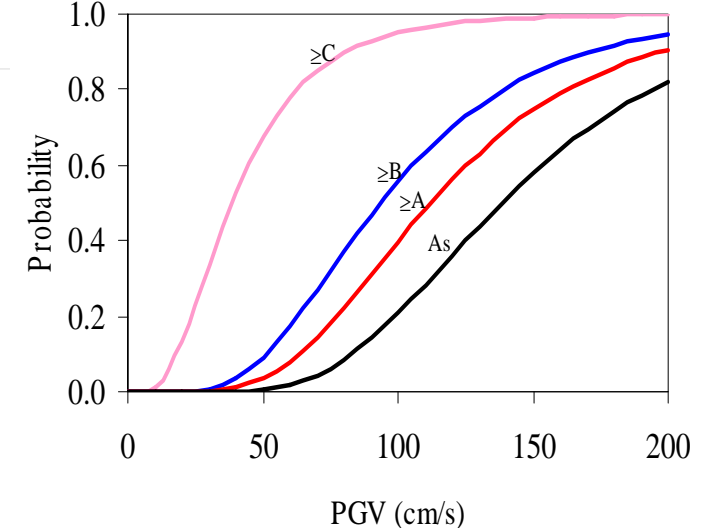


$$DI = \frac{\mu_d + \beta \cdot \mu_h}{\mu_u}$$

Park and Ang, 1985

$$P_R = \Phi \left[\frac{\ln X - \lambda}{\zeta} \right]$$

Fragility curves for a 1964 pier with respect to PGV



Prof. Shinozuka visited E-Defense construction site in Miki, Hyogo, Japan 2000. 7.13

Many US-Japan projects after 1994 Northridge and 1995 Kobe EQs



U.S.-Japan Cooperative Research in Urban Earthquake Disaster Mitigation 15-16 August 2001, Seattle, Washington

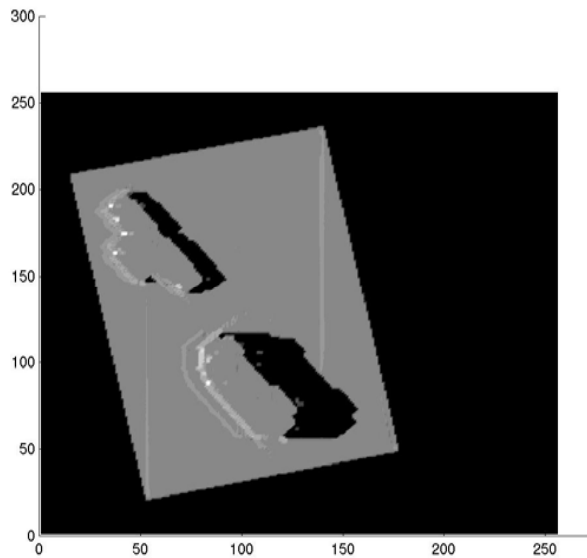
Many US-Japan projects after 1994 Northridge and 1995 Kobe EQs



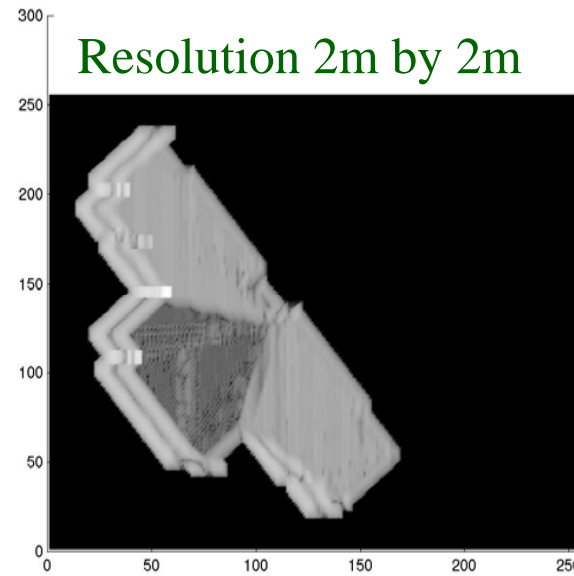
Remote Sensing and Prof. Shinozuka

SAR Simulation of Urban Areas

Shinozuka et al. 2000



USC-DRB & KAP buildings
before introducing damage



USC-DRB building
after introducing damage



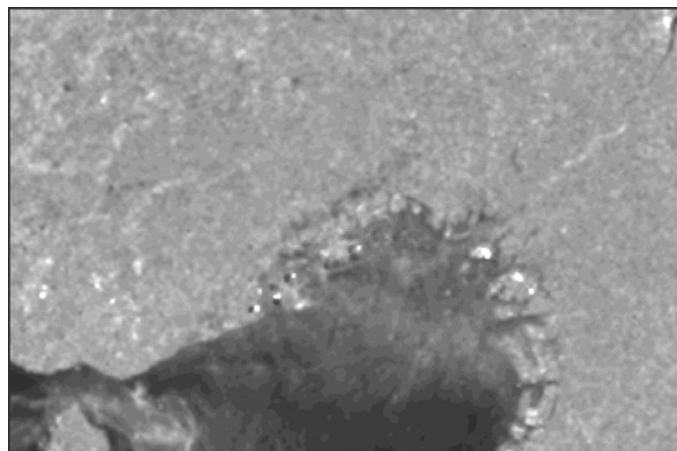
2000 MCEER-EDM Workshop
@ Newport Beach



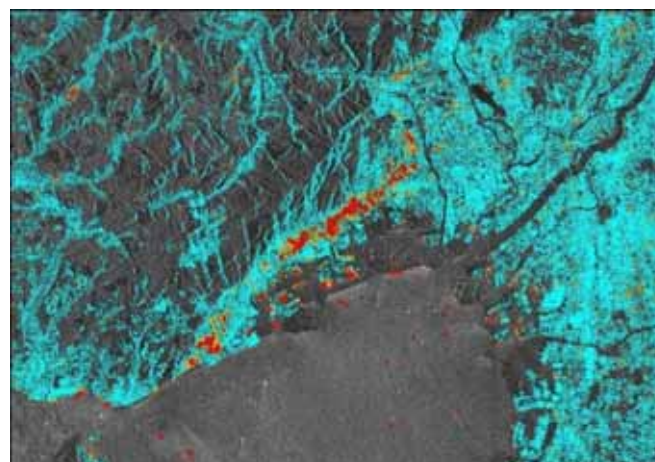
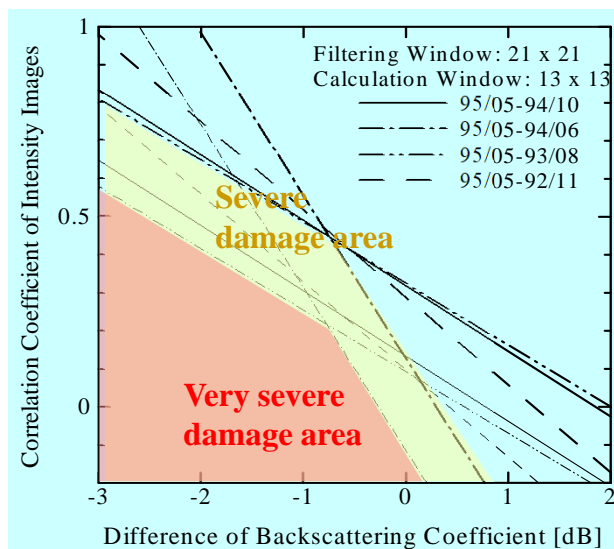
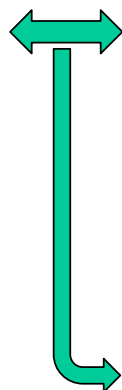
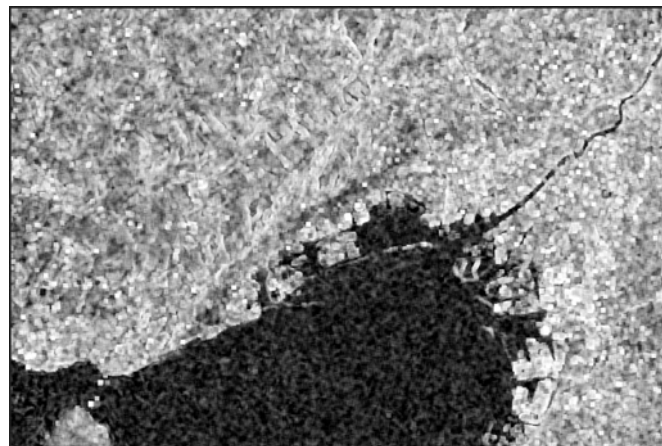
2003 1st Remote Sensing WS @UCI 13

Extraction of Damage Areas in 1995 Kobe EQ using ERS/SAR

✓ **Difference** of backscattering coefficient (1995/5/23 – 1994/6/3)



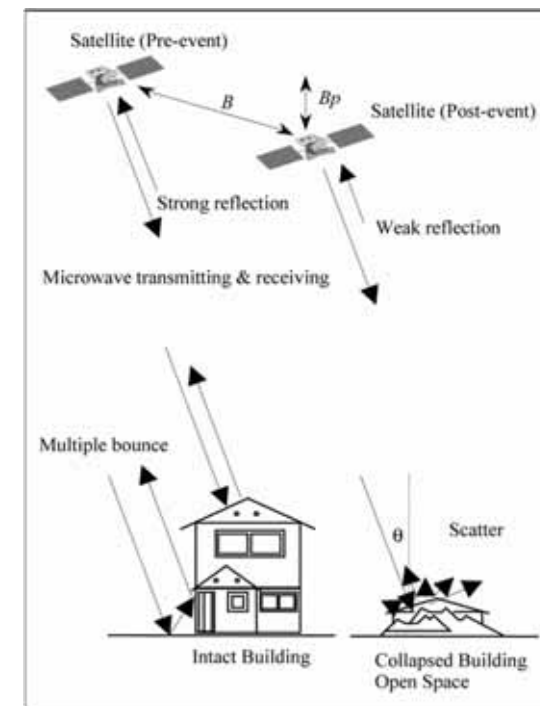
✓ **Correlation coefficient**



Red: Very severe damage area
Yellow: Severe damage area

Matsuoka and Yamazaki (2004) EQS

Google Scholar: 265



$$r = \frac{N \sum_{i=1}^N I_{a_i} I_{b_i} - \sum_{i=1}^N I_{a_i} \sum_{i=1}^N I_{b_i}}{\sqrt{\left(N \sum_{i=1}^N I_{a_i}^2 - \left(\sum_{i=1}^N I_{a_i} \right)^2 \right) \left(N \sum_{i=1}^N I_{b_i}^2 - \left(\sum_{i=1}^N I_{b_i} \right)^2 \right)}}$$

3rd International Workshop on Remote Sensing for Post-Disaster Response

September 12th, 2005 Chiba University, Japan

Keynote Lecture by M. Shnozuka

“Application of Remote Sensing Technology in Natural Hazard Assessment”



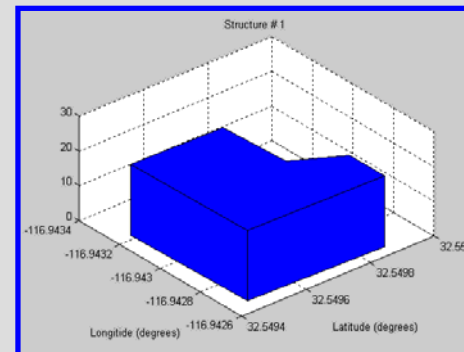
Keynote Speaker and
Karaoke Singer

MCEER's Remote Sensing Program

Masanobu Shinozuka
University of California, Irvine

Year 8 Accomplishments

1. Post-disaster damage & situation assessment
2. Field reconnaissance - damage data collection & visualization
3. Building inventory for loss estimation



3rd International Workshop on Remote Sensing and Disaster Response, Chiba, Japan, September 12-13, 2005

MULTIDISCIPLINARY CENTER FOR EARTHQUAKE ENGINEERING RESEARCH



International Symposium on Stochastic Analyses for Risk Management (SARM2010)

Tokyo Forum, December 23, 2010

80th Birthday of Prof. Shinozuka



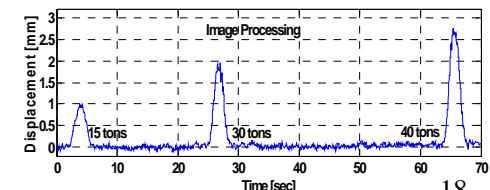
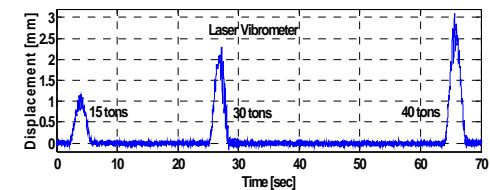
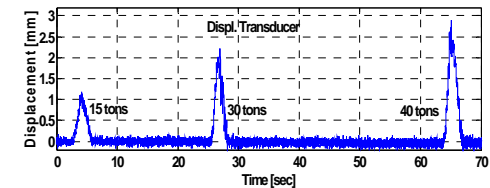
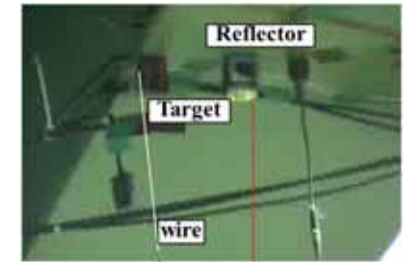
Emergence of Computational Stochastic Systems

Response Monitoring for System Modeling and Calibration



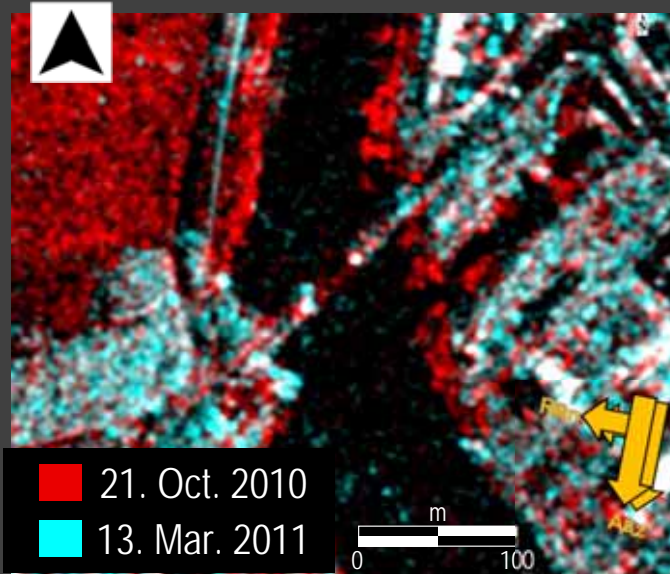
Masanobu Shinozuka
University of California, Irvine

International Symposium on Stochastic Analysis for Risk Management (SARM 1 2010)
Tokyo International Forum, Tokyo, Japan, December 23, 2010

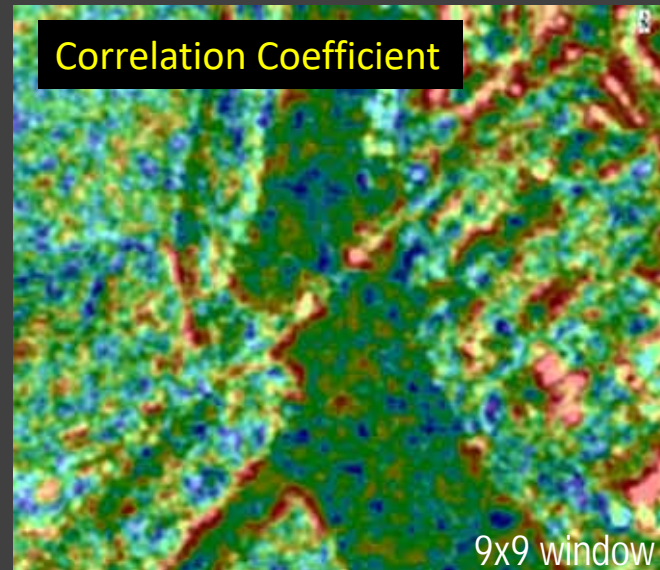
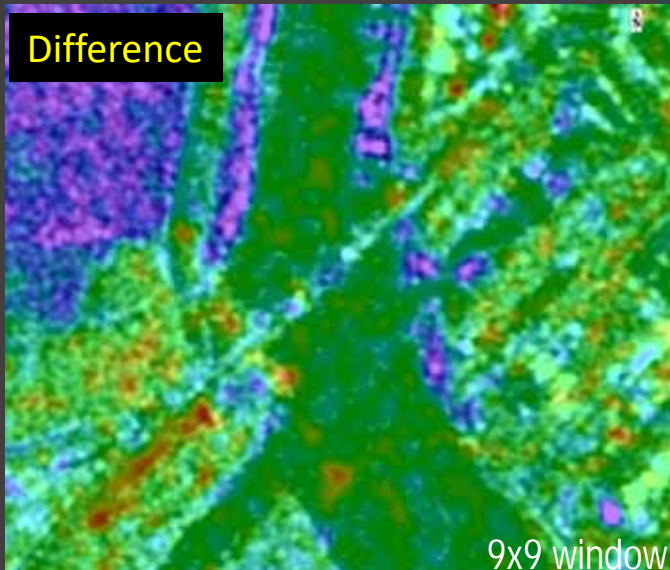


Detection of collapsed bridges from TerraSAR-X images

F. Yamazaki, K. Inoue, W. Liu (2016) SM & MS



Orbit Dir. : Desc.
Look Dir. : Right
Imaging Mode : StripMap
Pixel Res. : 1.25m/pix
Polarization : HH
Product Level : EEC

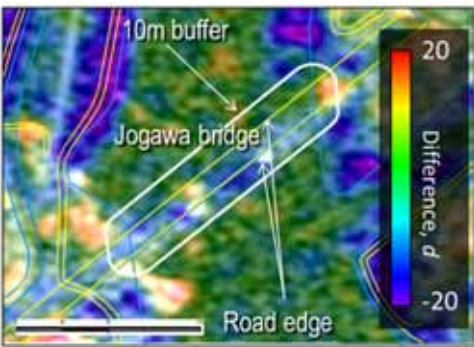


Jogawa Bridge
(126.0m)

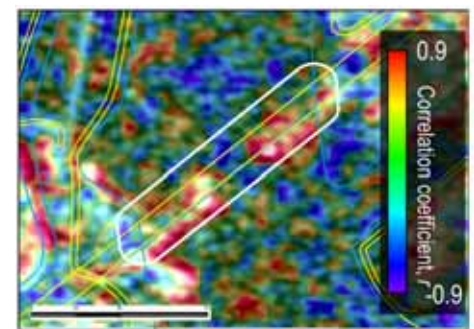
TSX data provided
by PASCO Co.

Extraction of collapsed bridges based on the relationship between the difference and correlation coefficient from SAR images

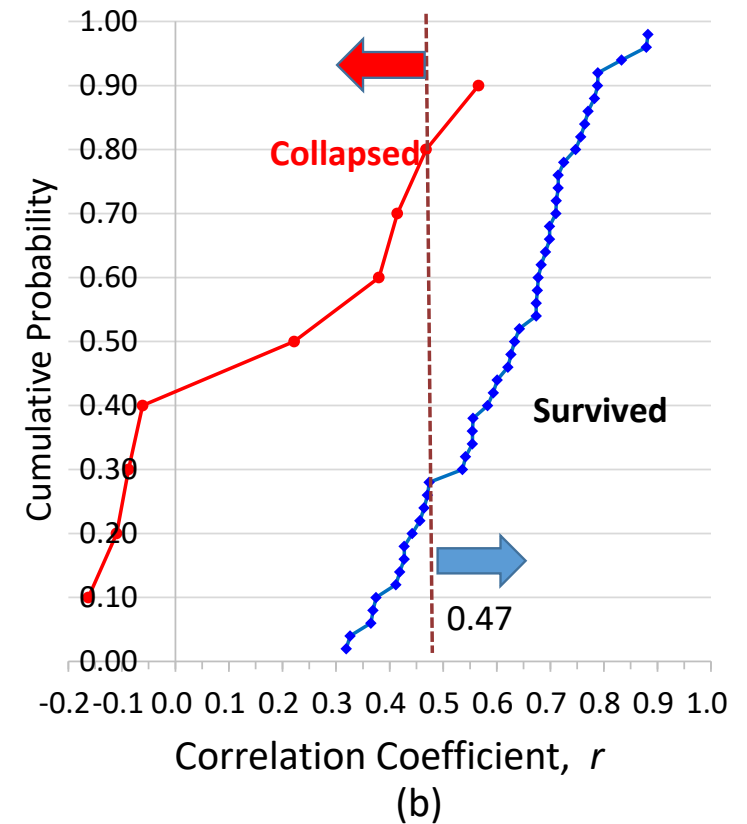
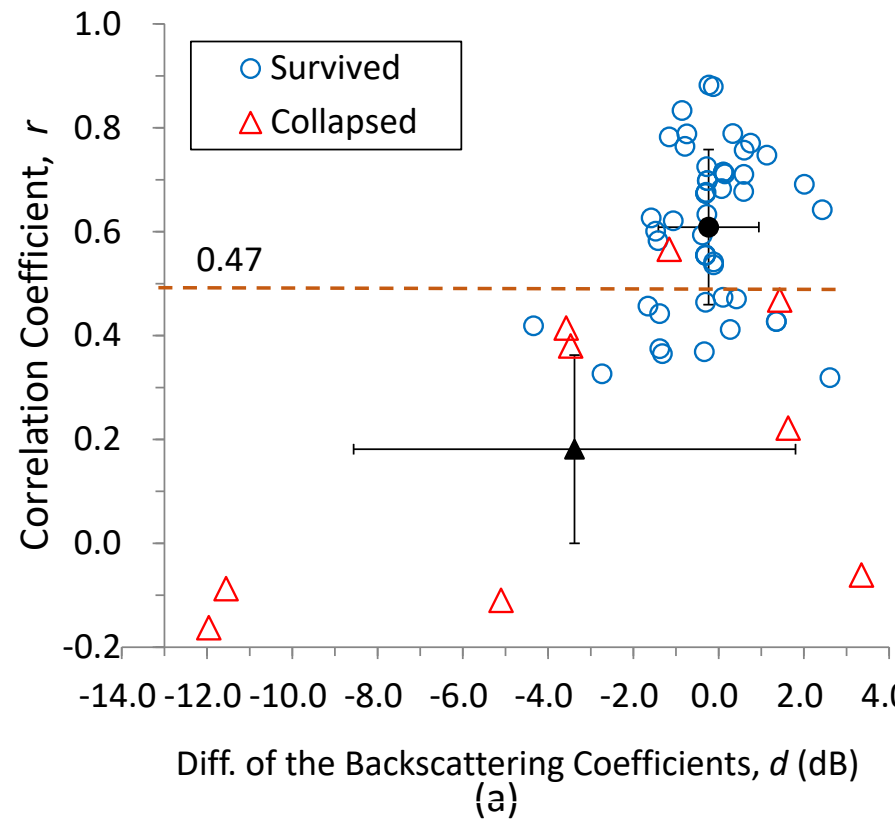
F. Yamazaki, K. Inoue, W. Liu (2016) SM&MS



Difference



Correlation Coefficient



F. Yamazaki, **K. Inoue**, W. Liu, Damage assessment of bridges using spatial characteristics of high-resolution satellite SAR intensity images, Stochastic Mechanics SM&MS 2016, vol. VI, No. 1, Capri, Italy, 2016.

Last Reunion with Prof. Shinozuka ICOSAR 2013 @New York City



Prof. Shinozuka:

We appreciate all your supports to guide us to academia.

You are my great mentor over 30 years.

We pray your soul may rest in peace.