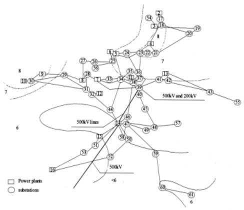
Seismic Safety Evaluation and Optimal Design of Electric Power Transmission Systems

Jun He, Naoyuki Ishida and Yan-Gang Zhao

Background and Objective

Experience from many previous earthquakes around the world such as 1995 Kobe earthquake (Japan) and 1989 Loma Prieta earthquake (U.S.A) have shown that the large earthquakes could cause severe damage to electric power transmission systems and result in further undesired hazards to the electricity service areas.

The present study provides a methodology for evaluation of seismic safety and life-cycle cost design of electric power transmission systems.



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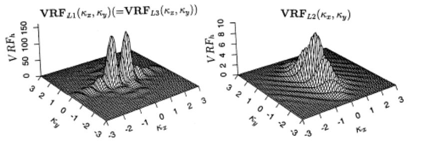
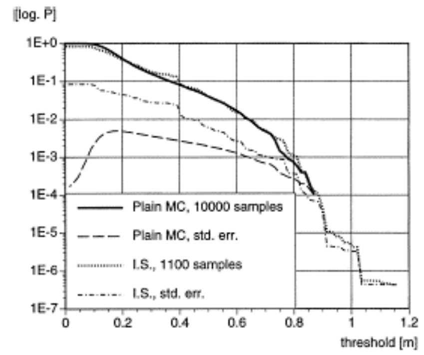
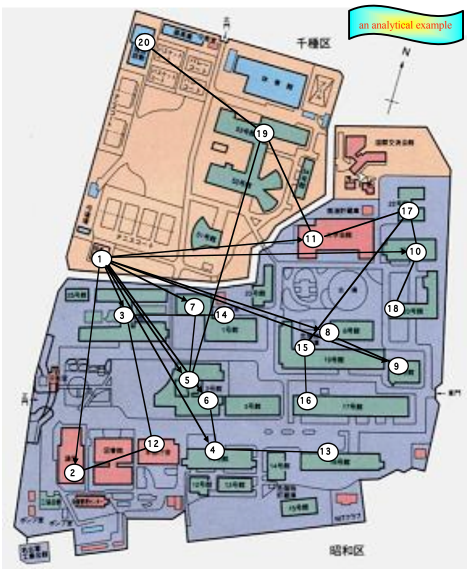
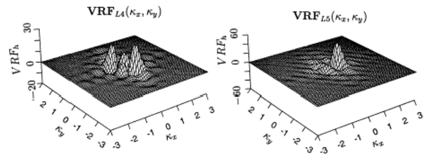
1. Seismic hazards analysis and ground acceleration evaluation;
2. Shaking table tests of critical electric structures;
3. Seismic safety analysis of electric power structures and systems;
4. Life-cycle cost analysis of large scale electric power systems;
5. Reliability-Based design of electric power systems;
6. Optimal design procedure of large scale electric power systems.

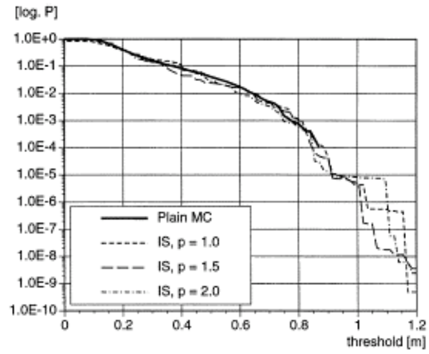




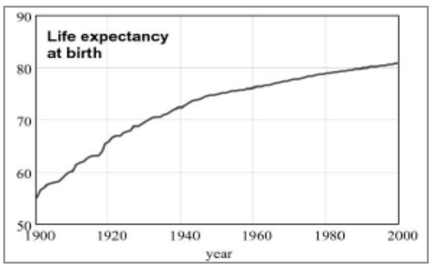
Passage probability



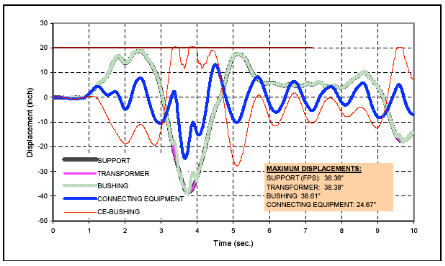




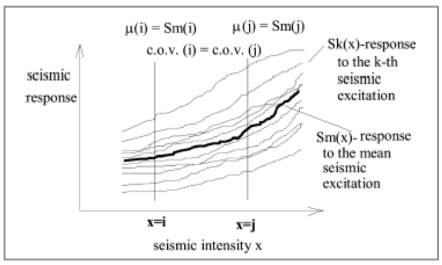
Passage probability



Life expectancy



Time history of displacement



Seismic responses

Table 1 Reliability result of various cases

node	case1	case2	case3	case4	case5	case6	case7	case8
12	0.802	0.802	0.808	0.802	0.802	0.802	0.802	0.802
13	0.729	0.787	0.729	0.729	0.729	0.799	0.729	0.800
14	0.729	0.729	0.729	0.729	0.729	0.729	0.729	0.729
15	0.722	0.786	0.793	0.793	0.800	0.797	0.801	0.800
16	0.650	0.780	0.793	0.794	0.808	0.803	0.810	0.808

Conclusion Remarks

1. A recursive decomposition method for identification of disjoint- minpaths (exclusive safe modes) and disjoint-mincuts, and reliability analysis of electric power transmission systems are proposed in the study.
2. A recursive formula for conditional fractals is proposed to evaluate the joint probability of exclusive safe modes and the reliability of the systems.
3. Numerical examples show that the proposed method is sophisticated and efficient in the seismic reliability analysis of electric power systems.
4. Life-cycle cost analysis and optimal design should be done in future.