B.F.スペンサー教授へのインタビュー

B.F.スペンサー

（ノートルダム大学）

スペンサー教授（ノートルダム大学）とのインタビューを掲載します。同教授は、2001 年の第 1 回地震工学研究発表討論会のさいに招待講演を行うなど、日本の多くの研究者の方々との親交を持っています。この記事は、スペンサー教授の来日機会を利用した面談、およびメール通信によるインタビューをもとに構成したものです。日本語訳にすると微妙なニュアンスの違い等も生じますので、英語のままとします。

スペンサー教授には、非常に多忙の中、大変好意的にこの企画に協力して戴きました。多くの時間を費やして、学生時代のこと、研究分野のこと、中国語のことなどを話してもらうことができました。この場を借りて、スペンサー教授に御礼申し上げます。

インタビュア：

西谷章（早稲田大学）

NISHITANI (N): Thank you for joining us, Dr. Spencer. You are the very first person for JAEE Newsletter interview program. Perhaps you are one of the most well-known foreign researchers among Japanese earthquake engineering research community. Speaking of our personal relationship, I first met you in Hawaii in 1993, when the first international workshop on structural control was held. Since then, we have had many opportunities to get together. Nearly ten years since that time. Time passes so quickly.

Let's get started. To begin with, I would like to ask you about your academic background. According to my understanding, you obtained the Ph.D. degree in Theoretical and Applied Mechanics (TAM) at University of Illinois at Urbana-Champaign (UIUC). There are only few similar departments in Japanese universities, I suppose. Could you speak to us about the field of theoretical and applied mechanics, in particular focusing on the relationship with earthquake or civil engineering?

SPENCER:

Engineering mechanics is the basic study of fluids and solids and how they react to applied forces. With roots in physics and mathematics, engineering mechanics provides the basis for all

of the mechanical sciences: civil engineering, materials science and engineering, mechanical engineering, and aerospace engineering. As such, having my M.S. and Ph.D. degrees in Theoretical and Applied Mechanics provided me with a very versatile background.

N: I know you were a very good student while you were in graduate school at the University of Illinois. When I visited Prof. Bergman at the Urbana-Champaign campus, I found your name in certain plaque listing the names of certain students. Why was your name on this plaque?

SPENCER:

I was an instructor teaching courses such as statics, dynamics, and mechanics of solids to undergraduate students for five of my eight semesters as a graduate student at the University of Illinois. The enrollment in these classes ranged from 47 to over 100 students. In recognition of my classroom performance, the Department made me the 1985 recipient of the J.O. Smith Award as the Outstanding Young Teacher in Engineering Mechanics and placed my name on this plaque.

N: What kind of research did you do in your doctoral thesis at the University of Illinois?

SPENCER:

My research as a graduate student focused on computational stochastic mechanics, and in particular on determining the reliability of a randomly excited hysteretic oscillator. The solution of a large class of physically motivated problems arising in stochastic dynamics is facilitated by appropriate modeling of the system such that its response process is Markovian. The reliability of an oscillator with hysteretic restoring force can be viewed as a first passage problem in random vibration, which can be posed as the solution of the backward Kolmogorov equation, the formal adjoint of the Fokker-Planck equation. For this problem, the backward Kolmogorov equation is an elliptic-parabolic initial-boundary value for which general solution is unavailable. My doctoral research addressed the computational solution of this partial differential equation using an upwinded finite element method and was published by Springer-Verlag in a monograph entitled Reliability of Randomly Excited Hysteretic Structures.

N: Your thesis supervisor was Prof. Larry Bergman, who is one of my very good friends as well. What was he like as the

supervisor? Do you think that you are the same kind of supervisor as he was? One thing that seems to Japanese very unusual regarding the relationship between doctoral students and thesis supervisors is that most of former Ph.D. students call their former supervisors by their first names, after getting the degree. Did you feel some hesitation when you first call Prof. Bergman "Larry"?

SPENCER:

Although not the case at all universities in the US, in our department at UIUC, all of the graduate students called the faculty by their first names. However, hearing other students call Larry by his first name was very strange. It took a few months to become accustomed to this practice.

Regarding Larry's style as a supervisor, I believe that I speak for all of his former graduate students in saying that he is a truly excellent mentor. Although he never stated it, as opposed to the research itself being the "product" of his labors, I believe that Larry views the "product" as being his students. Of course, to effectively educate students, one must teach them how to conduct high quality research, but in my experience, the focus is on the student. I benefited tremendously from working with Larry at UIUC and have tried to emulate this style as a supervisor in my subsequent career as a faculty member at Notre Dame.

N: After receiving your doctoral degree, you joined the faculty of civil engineering at the University of Notre Dame. What made you go to the field of civil engineering? You could have chosen a field other than civil engineering.

SPENCER:

As you know, my undergraduate degree is in mechanical engineering. I also worked for the General Motors Corporation in Detroit for several summers learning about vehicle vibration problems. My graduate studies also focused on vibration problems, with an emphasis on randomly excited systems. Many disciplines conduct research on such topics. Indeed, upon graduation from the TAM department at UIUC, opportunities were available in aerospace, mechanical, and civil engineering. However, the most advanced research in the area of probabilistic mechanics was being conducted in civil engineering. At the same time, the research and educational opportunities offered at the Department of Civil Engineering at the University of Notre Dame seemed too attractive to pass up.

I think that I made the right decision to join the ranks of the civil engineers!

N: Speaking of your research career, as you mentioned minutes ago, your initial research was in computational stochastic mechanics. Subsequently you conducted research with regard to problems in fatigue and fracture reliability, active control of structures, and now magnetorheological (MR) damper-related semiactive control. What would you pick up as your best five or ten papers, if possible?

SPENCER:

I am not sure if the following papers are the "best", but they are the ones that I like the best.

Computational Stochastic Mechanics

B.F. Spencer, Jr., *Reliability of Randomly Excited Hysteretic Structures,* Lecture Notes in Engineering (series editors: C.A. Brebbia and S.A. Orszag), Vol. 21, Springer-Verlag, 1986.

B.F. Spencer, Jr. and L.A. Bergman, "On the Numerical Solution of the Fokker-Planck Equation for Nonlinear Stochastic Systems," *Nonlinear Dynamics,* Vol. 4, pp. 357-372, 1993.

Fatigue and Fracture Reliability

B.F. Spencer, Jr. and J. Tang, "A Markov Process Model for Fatigue Crack Growth," *Journal of Engineering Mechanics,* ASCE, Vol. 114, No. 12, pp.2134-2157, 1988.

Active Structural Control

B.F. Spencer, Jr., M.K. Sain, C.-H. Won, D.C. Kaspari Jr. and P.M. Sain, "Reliability-Based Measures Of Structural Control Robustness," *Structural Safety*, Vol. 15, pp. 111- 129, 1994.

S.J. Dyke, B.F. Spencer, Jr., P. Quast and M.K. Sain, "The Role of Control-Structure Interaction in Protective System Design," *Journal of Engineering Mechanics, ASCE,* Vol. 121, No. 2, pp. 322-338, 1995.

S.J. Dyke, B.F. Spencer, Jr., P. Quast, D.C. Kaspari, Jr., and M.K. Sain, "Implementation of an Active Mass Driver Using Acceleration Feedback Control," *Microcomputers in Civil Engineering: Special Issue on Active and Hybrid Structural Control*, Vol. 11, pp. 305-323, 1996.

Smart Damping (Semiactive Structural Control) using MR Fluid Technology

S.J. Dyke, B.F. Spencer, Jr., M.K. Sain and J.D. Carlson, "Modeling and Control of Magnetorheological Dampers for Seismic Response Reduction," *Smart Materials and Structures*, Vol. 5, pp. 565-575, 1996.

B.F. Spencer, Jr. S.J. Dyke, M.K. Sain and J.D. Carlson, "Phenomenological Model for Magnetorheological Dampers," *Journal of Engineering Mechanics, ASCE,* Vol. 123, No. 3, pp. 230-238, 1997.

B.F. Spencer, Jr., S.J. Dyke, and H.S. Deoskar, "Benchmark Problems in Structural Control - Part I: Active Mass Driver System; Part II: Active Tendon System," *Earthquake Engineering and Structural Dynamics*, Vol. 27, pp. 1127-1147, 1998.

G. Yang, B.F. Spencer, Jr., J.C. Carlson and M.K. Sain, "Large-Scale MR Fluid Dampers: Modeling and Dynamic Performance Considerations," *Engineering Structures*, Vol. 24, pp. 309-323, 2002.

N: And what is your recent research interest?

SPENCER:

My research interests continue in the use of MR dampers for protection of civil infrastructure systems. A tremendous amount of progress has been made since we started working with the Lord Corporation on this research topic in 1994. Last year saw the first full-scale implementation of MR dampers for civil engineering applications achieved. Nihon-Kagaku-Miraikan, the Tokyo National Museum of Emerging Science and Innovation, has two 30-ton, MR Fluid dampers installed between the 3rd and 5th floors. The dampers were built by Sanwa Tekki using the Lord Corporation MR fluid. Currently being retrofitted with stay-cable dampers, the Dongting Lake Bridge in Hunan, China will constitute the first full-scale implementation of MR dampers for bridge structures. Two Lord SD-1005 (www.rheonetic.com) MR dampers are being installed on each cable to mitigate cable vibration. Seeing this research come to fruition has been extremely gratifying.

Most recently, my students and I have expanded our research to include structural health monitoring. Although structural

health monitoring and condition assessment for civil engineering structures is still a relatively young field, it holds great promise. Similarly, structural response control has revolutionized the way that buildings and bridges can respond to dynamics loads. Combining these two technologies together offers even more opportunities. We seek to develop an integrated system, including appropriate hardware, software, and networking components for acquisition and transmission of the data, as well as development of new diagnostic methods.

N: I heard that you are going to move to the civil engineering department at the University of Illinois at Urbana-Champaign in the coming August. How many years have you spent at University of Notre Dame? Please tell us about what the University of Notre Dame is like. For instance, how many students are there? How many faculty members? How many departments in the College of Engineering? How much are the tuition and fees? The University of Notre Dame is in South Bend, Indiana. What is South Bend like?

SPENCER:

Effective fall of 2002, I will join the faculty at the University of Illinois. The decision to leave Notre Dame was difficult, as you might imagine. My entire career, almost 17 years, has been spent at Notre Dame, and I've enjoyed nearly every moment. Founded in 1842, Notre Dame is a Catholic University offering undergraduate, graduate and professional programs to 11,000 students. Notre Dame's research programs cover a broad spectrum of disciplines and build upon her long-established reputation for excellence in undergraduate education. The aerodynamics of glider flight and the transmission of wireless messages were pioneered at the University, and the formulae for synthetic rubber were discovered at Notre Dame. The campus is truly beautiful, with two lakes on campus and the famous "Golden Dome". In 2000-01 Notre Dame's regular faculty numbered 736 full-time and 355 part-time. Founded in 1873, the College of Engineering has 105 teaching and research faculty members in five departments: Aerospace and Mechanical Engineering, Chemical Engineering, Civil Engineering and Geological Sciences, Computer Science and Engineering, and Electrical Engineering. There are approximately 1000 undergraduate and graduate students in the College. The undergraduate tuition, room and board for one academic year is approximately $31,000.

South Bend, with a metropolitan area of nearly 250,000, combines the lifestyle of a smaller community with the cultural and economic attractions found in much larger cities. Housing costs and the overall cost of living are quite low. South Bend's economic base is a stable mix of large and small industries with a highly developed retail, health care, and service economy. There are two "Fortune 500" companies in the area.

N: You should have a lot of memories regarding your life in University of Notre Dame. Could you say something about your most memorable experiences at the University of Notre Dame?

SPENCER:

My best memories of Notre Dame derive from working closely with so many excellent colleagues and students at the campus.

N: May I go to the next subject, which is in regard to University of Illinois at Urbana-Champaign? What is the official name of the civil engineering department? In these days, many of civil engineering departments in the US appear to change the names such as the Department of Civil and Geotechnical Engineering, the Department of Civil and Environmental Engineering, and so on. Are there a few departments in the U.S. that have still maintained the conventional name of "Department of Civil Engineering?" How many faculty members are there in the civil engineering department at University of Illinois? Are there many professors doing researches about structural dynamics or control over there?

SPENCER:

Some universities, such as Washington University in St. Louis, still keep the name "Department of Civil Engineering." At the University of Illinois at Urbana-Champaign, the offical name of the department is the Department of Civil and Environmental Engineering. The Department was founded in 1871 and has 53 full time faculty members in the areas of environmental, structural, construction, transportation, hydraulic, and geotechnical engineering. The faculty's activity in structural dynamics and control iscurrently limited, but I am pleased to say that Prof. Nicholas P. Jones has accepted the position as Department Head, effective this fall. His background and expertise in wind engineering will be a welcome addition to the Department.

N: You will become the Newmark Professor of Civil Engineering there. What is the official title of this position? Most of

earthquake engineering related researchers know the name of "Newmark." How do you feel about being named to this position?

SPENCER:

The name of my position is the Nathan M. Newmark Professor of Civil Engineering. I am deeply honored to have been awarded this position, which carries the name of such an outstanding researcher and engineer.

N: We Japanese do not have such kind of professor system and are not familiar with it. So, we are wondering who and how to decide or choose, etc. Could you give us some information about the system like this?

SPENCER:

Some of the endowed professorships/chairs can be awarded to anyone in the university; however, the Newmark Professorship is only for a faculty member in the Department of Civil and Environmental Engineering. Generally speaking, a donor will give a certain amount of money to the University to establish an endowed professorship/chair. A committee is formed to evaluate potential candidates for these position and make recommendations to the University administration. At UIUC, the Provost makes the final decision regarding who will be awarded the endowed professorships/chairs. In addition to the title, most of these positions also provide a small research fund.

N: Recently I happened to know that you speak Chinese quite fluently. I know you have had a very nice relationship with Chinese structural control community. So, it would be convenient for you to speak Chinese language. That is quite understandable. But when I heard you speaking Chinese, to be frank, I was very much surprised. Your Chinese sounds like too good, even though I do not speak or understand any Chinese language at all. One of my Chinese friends said to me that your pronunciation of Chinese was extremely good. How did you learn to speak Chinese so fluently in such a short time?

SPENCER:

While on an airplane returning from Japan in 1998, I struck up a conversation with a man sitting next to me about the importance of children learning a second language, and commented that the choice of which language was not obvious for a native English speaker. He suggested that Mandarine Chinese was the obvious language, since it is spoken by 20% of the world's population. He also noted that if one can read

Chinese characters, then communication is also facilitated with Japanese and Korean people. While I did nothing at that time, the comments of this man stuck with me.

After a workshop I organized in Guangzhou, China in 1999, Larry Bergman and I took a short vacation to the ancient Chinese city of Xi'an. It happened that on the last day of the workshop, the USA had accidentally bombed the Chinese Embassy in Belgrade, Yugoslavia. During this time, the situation was rather tense, but because I had purchased a Chinese phrase book for this trip, we were able to get by without any big problems. This experience gave me the impetus to start studying Chinese. After deciding to learn the language, I was fortunate to be able to retain the wife of one of the postdocs in our department as a tutor. This, of course, pressured me to keep up with my lessons. I have found the entire experience to be not only rewarding and useful, but also a good way to relax in the evening. I hope that in the future I will have the time and opportunity to learn Japanese as well.

N: If you did not study Engineering, what kind of field would you choose to study? Or if you were reborn, would you choose the same or similar field? Or what kind of occupation would you like to choose other than university professor?

SPENCER:

Actually, I feel that being a university professor is one of the best jobs that one can have. You have the opportunity to work with bright young students and help them mature into independent engineers. You have the freedom to conduct research on whatever topic you wish. Your job is basically your hobby. One has the chance to travel and meet wonderful people such as yourself. I really don't think that I would choose another path, even if given the opportunity.

N: Thank you for taking your time. I appreciate very much. I believe you will get much more successful at your new university.