

Preface

On November 3-5, 2005, 60 Japanese and American engineers from industry, academia, government labs, and other research institutions gathered for the Fifth Japan-America Frontiers of Engineering Symposium (JAFOE) at Hitachi Global Storage Technologies in San Jose, California. Convened by the U.S. National Academy of Engineering (NAE), Japan Science and Technology Agency (JST), and the Engineering Academy of Japan (EAJ), this exciting and unique meeting included presentations and discussions of leading-edge research and technical work in four sessions: Humanoid Robots, Pure Water Technologies, Semiconductor R&D, and Biotechnology: Detection and Destruction of Pathogens. The primary purpose of this book is to convey the content of the meeting through abstracts of the presentations and other meeting materials reprinted herein, as well as to inform the reader about the underpinning philosophy of the Frontiers of Engineering program.

Origins and Goals of the Activity

Since 1995, the U.S. National Academy of Engineering has held an annual U.S. Frontiers of Engineering symposium that brings together 100 outstanding, early-career engineers from U.S. companies, universities, and government labs to discuss pioneering research and technical work across a range of engineering fields. The goal of the symposium series is to introduce these engineers to each other, challenge them to think about developments and problems at the frontiers of areas different from their own, and thereby facilitate collaborative work, the transfer of new techniques and approaches across fields, and establishment of contacts among the next generation of engineering leaders. The program has expanded internationally, and there are now three bilateral programs — with Germany, Japan, and India.

The JAFOE activity aims to bring together outstanding, early-career Japanese and American engineers (ages 30-45) from industry, universities, and other research institutions to introduce their areas of engineering research and technical work, thereby facilitating an interdisciplinary transfer of knowledge and methodology that could eventually lead to the development of cooperative networks of young engineers from both countries. Conferences are held annually, alternately in Japan and the United States, with about 30 engineers from each country participating. An organizing committee comprised of Japanese and U.S. engineers develops the program for the event and assists in the selection of participants.

Content of the 2005 JAFOE Symposium

Dr. James Fujimoto, professor, Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, and Dr. Kazuhiro Sakurada, head, Research Center Japan, Nihon Schering K.K., co-chaired the organizing committee and the symposium. Two Japanese and two Americans gave presentations in each of the four sessions mentioned above. Presentations covered such specific topics as autonomous and interactive behaviors of humanoid robots, management of water supply systems in Asian countries, the challenges and opportunities of sustaining the silicon revolution, and DNA-directed formation of nano-scale wires and their use in a DNA identification system. Speakers had been asked to tailor their talks to a technically sophisticated but nonspecialist audience and to address such questions as: What are the frontiers in their field? What experiments, prototypes, and design studies are completed and in progress? What new tools and methodologies are being used? What are

the current limitations on advances? What is the theoretical, commercial, societal, and long-term significance of the work?

In addition to excellent presentations in the four topic areas, another highlight of the symposium was the dinner speech by Dr. Thomas M. Baer, consulting professor in applied physics, Stanford University, and founder, Arcturus Bioscience, Inc. Dr. Thomas described the growth path and what engineering is like in a startup. He addressed such specific issues as how R&D in a VC-funded startup differs from R&D in a large company and why Silicon Valley provides such a fertile environment for entrepreneurial ventures. The text of his talk is included in this volume.

The meeting was designed to give ample opportunity for discussion and networking among the participants through the Q&A sessions after each presentation in the plenary sessions as well as poster sessions that allowed each participant to showcase and talk about his/her technical work or research. In addition, the group took a tour of the Computer History Museum in Mountain View. The displays span the history of computing from pre-computing to supercomputing, and reflect the astonishing development in computing technologies.

The sixth Japan-America Frontiers of Engineering symposium is scheduled for November 9-11, 2006, in Japan.

In Appreciation

NAE, EAJ and JST would like to express our appreciation to our sponsors — Hitachi Global Storage Technologies, which hosted the meeting; the U.S. National Science Foundation; the United Engineering Foundation; the Japan Science and Technology Agency; the National Academy of Engineering Fund; and the NAE Young Engineers' Fund — for their support of this symposium. Our appreciation also goes to the members of the Symposium Organizing Committee for their work in planning this event.