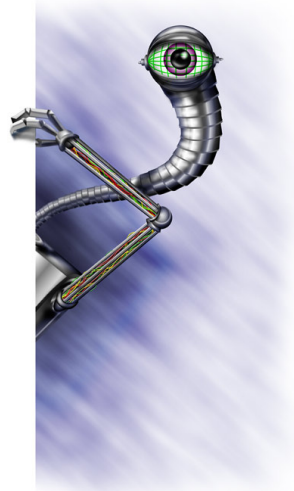


**WTEC**

World Technology Evaluation Center

# International Study of Robotics Research



*Sponsored by the National Science Foundation and National Aeronautics and Space Administration with additional funding from the National Institute for Biomedical Imaging and Bioengineering of the National Institutes of Health*

## Outline

- Objectives
- Executive summary
- Methodology used in the study
- The Team
- Sites visited
- Key participants from sponsoring agencies
- Questions asked of our hosts abroad
- Schedule and outline of presentations

## Objectives

- To assess the status of R&D in robotics in the US, Korea, Japan and Western Europe
- To compare US efforts with those of Korea, Japan and Europe in terms of quality, scope, and funding
- To encourage international collaboration
- To present our findings to our sponsors, other US Government agencies, Congress and selected visitors from industry and academia

## What did we find?

### Executive Summary

- **Robotics is a very active field worldwide.**
- **Japan, Korea and the European Community invest significantly larger funds in robotics R & D for the private sector than the US.**
- **There are numerous start-up companies in robotics, both in the US and abroad.**
- **The US currently leads in such areas as robot navigation in outdoor environments, architectures (the integration of control, structure, and computation), and in applications to space, defense, underwater systems, and some aspects of service and personal robots.**

## Executive summary-p. 2

- **Japan and Korea lead in technology for robot mobility, humanoid robots, and some aspects of service and personal robots, including entertainment..**
- **Europe leads in mobility for structured environments, including urban transportation, as well as eldercare and home service robotics.**
- **Industrial robots were invented and commercialized in the US, but are now made almost exclusively in Japan and Europe. The US could also lose its leading position on other aspects of robotics.**

## Study team

- **George Bekey**, Univ of Southern California,  
*Chairman*
- **Robert Ambrose**, NASA/Johnson Space Center
- **Vijay Kumar**, Univ of Pennsylvania
- **Arthur Sanderson**, Rensselaer Polytechnic  
Institute
- **Brian Wilcox**, NASA/Jet Propulsion Laboratory
- **Yuan Zheng**, Ohio State University

## Key Participants from Sponsoring Agencies

- **NSF:**
  - **Junku Yuh**, Director, Robotics and Computer Vision program
- **NASA:**
  - **David Lavery**, NASA Headquarters
  - **Mino Dastoor**, NASA Headquarters
- **WTEC:**
  - **Y.T. Chien**, Director of Research
  - **Hassan Ali**, Program Manager

## History and Methodology

- July 2003: Invited by J. Yuh (NSF) and Y.T Chien (WTEC) to form a team for the study. NASA joins as a major supporter in January 2004
- February 2004: Study Team meets with other researchers to plan a “US Workshop”
- July 2004: Held Workshop in Washington, DC to assess the status of robotics R&D in the US (~100 participants)
- October 2004: Team travels to Japan and Korea, visiting some 30 laboratories
- April 2005: Team travels to Europe to visit some 20 labs in six countries
- September 2005: Results presented to the Nation. Draft Final Report completed

## Sites visited



## Questions for hosts

1. **How long has your laboratory been in existence?**
2. **What fraction of the work in this lab concerns robotics?**
3. **How is your work supported? Government, university, or industry funds?**
4. **Is the level of support adequate for the work you plan to do?**
5. **What interactions do you have with academia, government and industry? .With labs in other countries?**

## Questions for hosts-2

6. **Who are the other major research groups in your country that are working in your area of robotics research?**
7. **Who are the other major research groups outside of your country that are working in your area of robotics research?**
8. **How do you assess the robotics research in the U.S.as compared to your country? In your field of robotics, do you think your country is leading the U.S?**

## Schedule of presentations

- Robotic Vehicles- *Arthur Sanderson*
- Space Robotics- *Brian Wilcox*
- Industrial, Service and Personal Robots- *Vijay Kumar*
- Humanoid Robots- *Rob Ambrose*
- Robotics in Biology and Medicine- *Yuan Zheng*
- Networked Robots- *Vijay Kumar*
- Discussion and summary- *George Bekey*
- Sponsors' Panel

## Outline of presentations

- Define the area
- Indicate why it is important
- Describe the major technologies needed
- Point out major applications with examples
- Outline major challenges
- Summarize major activities in US, Korea, Japan and European Countries
- Provide a qualitative comparison between R&D activities in these regions
- Describe present and future challenges