Teachers need robotics-training, too

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What's Special about Stuttgart?

~ 595,000 inhabitants
~ Town of Porsche, Mercedes, Bosch, IBM ...
~ Culture and Wine ...
~ Research University with high Third-party funding per professor - 1st place in Germany
~ Highest rate of patent applications in Germany
~ 20,000 Students at the University of Stuttgart in 10 Faculties
Stuttgart: A Research University with a focus on Engineering and Natural Sciences

- Astronautics Centre
- High-Performance Computing Centre
- Research Centre for Simulation Technology
- VISUS
- SOFIA

Europe's largest driving simulator
Gender Gap & rising need of Engineers

For Immediate Release

ASEE: U.S. is graduating fewer engineers despite rising need

Washington DC – 06/18/08 – Despite a growing national demand for their skills, the number of engineers graduating from American colleges is going down, according to a survey to be released June 20 by the American Society for Engineering Education.

Engineering bachelor’s degrees declined in 2007 for the first time since the 1990s, ending seven years of previous year—the trend may continue for several years. That’s because undergraduate enrollment dropped sharply in 2005 and 2006.

"We are in a time of fluctuating degree and enrollment trends where the post-1990's recovery in engineering growing numbers has not kept pace with the growing demand," said John Simon, ASEE's director of data research, who compiled the comprehensive, 495-page survey, Profiles of Engineering Education.

The fall in the number of engineering graduates comes at a time of growing technological competition from the environment and infrastructure that require engineering solutions.

The U.S. Bureau of Labor Statistics has projected a need for 160,000 more engineering positions over the next decade, does not include the replacement of many retiring engineers.

Engineering master's degrees show an even sharper drop than bachelor's degrees, having declined 8.8 percent on average of 11 percent since 2004.

Within the field, aerospace and biomedical engineering have shot up in popularity while electrical and computer engineering and Civil Engineering have dropped.

The 2007 edition of the Profiles of Engineering and Engineering Technology Colleges details the state of engineering education in the United States and provides important data for students and professionals thinking about careers in engineering.

source: Spiegel Online, June 22 2008
Current Situation

Engineering Requirements:

- Interdisciplinary Skills
- Team Skills
  - hard to teach in most basic lectures
  - lack in deeper understanding
  - lacking correlation between content of different lectures
  - relevance for future jobs
Why do you use robots?

1. “en vogue” in pop-culture
2. interdisciplinary
3. sneak preview to engineering work
4. complex problem-solving strategies
5. encourage teamwork

⇒ use robotics as a starter drug
Robot Development

• **Multidisciplinary procedure:**
  – sophisticated robots demand for a variety of prerequisites:
    • body (suitable mechanic frame)
    • sensors (senses, to compass the surrounding world)
    • actuators (motors facilitating interaction with the surrounding world)
    • behaviour (process sensor input to generate an adequate reaction)

• **Development in teams**
  – Specialists from diverse disciplines
  – with different competencies
  – from different nations and cultures
What’s inside a Robot?

- **Computer Science:**
  - control programming, algorithms
  - communication networks, security
  - natural language processing,
  - Image recognition
- **Mathematics:**
  - behavior optimization using graph theory, statistical, combinatoric, numerical algorithms
- **Physics:**
  - kinematics, dynamics
- **Chemistry:**
  - development of sensors, specialized for the detection of specific substances
- **Biology and Bio-Technology:**
  - imitating nature: walking apparatus and sense organs

- **Traffic- and Machine-Systems:**
  - development of chassis and walking apparatus, grappler, etc.
- **Electrical Engineering:**
  - conception of suitable electronic components for sensors (Control Engineering)
  - signal processing
- **Power Engineering:**
  - autonomous energy supply
- **Materials Science**
  - choosing suitable materials

- **(Technology-) Design,**
  - exterior appearance, thus acceptance!
  - usability (user-friendly)
What are Mobile Robots good for?

- **Security:**
  - Surveillance of buildings and facilities
  - Accident-, crisis- und catastrophe-areas (search for blocked, entombed, ...)
  - Conflict areas (mine sweeper)

- **Exploration:**
  - Explorations of planets and moons, as alternate/pre-stage for manned space flight
  - underwater exploration in great depth
  - of inaccessible areas, e.g. pyramid-chambers in modern archeology

- **Care:**
  - Support care personal in labored physical tasks & cleaning tasks
  - Assist patients, for more everyday autonomy

- **Medicine:**
  - Surgical robots, optimizing precision, minimal invasive surgery by multiaxility
  - Assistant robots in case of deficit of extremities and sense organs, prosthodontics

- **@Home:**
  - vacuum cleaner, lawn-mower, window washer

- **Agrarian Economy:**
  - harvesters, automatic pest control, mechanic weed removal, robots in cattle breeding

- **as source of fascination:**
  - Edutainment, i.e. programmable toy (Lego Technics, Mindstorms, ...)
  - Construction of Humanoids and other nature-near forms
RoboTeach: Embedding

- Courses for teachers are integrated in the Robinson Program
- Cooperation with Roberta® Program
- Roboteach extends the coverage of the Roberta Regio Centers in Stuttgart and Berlin
Robotics Modules

Studies
- **Robinson Med**
  core elective course for medical engineers
- **Robinson Ing**
  core elective course for electrical engineers & computer scientists
- **Robinson Mixed**
  elective course aimed at students of non-technological fields

School
- **Roberta**
  high school courses (classes 1 to 12) to attract girls to natural sciences and engineering
- **RoboPed**
  courses for teachers, educators in Kindergarten and teacher trainees
Hardware

- LEGO NXT Mindstorms Kits
  - fast results, though
  - complex projects still feasible

- optional:
  - third party sensors
  - self-made sensors
Programming Environments

- several alternatives
  - graphical programming environments
    - NXT-G (based on LabVIEW, easy to learn)
    - Microsoft Robotics Studio
  - variants of “classical” languages
    - NXC (“not exactly C”)
    - RobotC
    - Java (w/ LeJOS)
    - ...
- choice depends on students skills
Didactic Approach

Depending on target group, age, time available and gender

- Roboteach Attendance Courses
- Roboteach – Distance Learning
- Roboteach – on Demand
- Roboteach – Material
Exemplary Student Projects

1. Shopping Assistant
2. Remote Controlled Soccer Player
3. Cargo Handler for Driving Train
4. Maze Runner
5. Plotter
6. Rubik’s Cube Solver
7. Segway
8. Parking Robot
9. Snowplow

“plotter” prototype

“Rubik’s cube solver” (different design built in course)
Thank you!

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