MOBILE ROBOTS AND AUTONOMOUS VEHICLES

- **1.** Objectives, Challenges, State of the Art, Technologies
- 2. Bayes & Kalman Filters
- 3. Extended Kalman Filter, Observability properties
- 4. Perception & Situation Awareness & Decision Making
- 5. Behavior Modeling & Learning

W1. Objectives, Challenges, State of the Art, Technologies

Socio-economic context

- Technological evolution of Robotics & State of the Art
- New challenges for Robotics in Human Environments
- Decisional & Control Architecture for Autonomous Mobile Robots & IV
- Sensing technologies: Object Detection
- Sensing technologies: Robot Control & HRI
- Basic technologies for Navigation in Dynamic Human Environments
- Intelligent Vehicles: Context & State of the Art
- Intelligent Vehicles: Technical Challenges & Driving Skills



A large number of Industrial Companies throughout the world, including SME & Multinational groups ... with more and more application fields

An increasing number of application fields

Automation & Manufacturing (initial main market)



- Automation & Manufacturing
- Defense & Civil Surveillance / Intervention



- Automation & Manufacturing
- Defense & Civil Surveillance / Intervention
- Health care, Surgery & Assistance



- Automation & Manufacturing
- Defense & Civil Surveillance / Intervention
- Health care, Surgery & Assistance
- Personal Service Robots & Entertainment



- Automation & Manufacturing
- Defense & Civil Surveillance / Intervention
- Health care, Surgery & Assistance
- Personal Service Robots & Entertainment
- Intelligent Vehicles & ITS



Worldwide Robotics Market Growth



2011 Statistics & Forecast (Japan Robotics Association)

Google Acquisition of 7 Robot Companies (2013) → Wants a big role in Robotics



Boston Dynamics



Google Self-Driving Car



Meka Robotics

amazon.COM[®] Acquisition of Kiva Systems (775 M\$, 2013)



Robotized warehouse operations

前田工業株式会社 KAWADA INDUSTRIES, INC. Nextage – Next generation of industrial robot ("Cobot" concept)



- Automotive & ITS Industry: Nissan, Renault, Toyota, Volvo, Mercedes, BMW, Tesla...+ car suppliers
- Concept of connected car & More autonomy (ADAS & Autonomous Driving)





Market forecast

- 2020 => 8000 cars sold
- 2035 => 95 Million

Some sale numbers in non-manufacturing sectors

Defense



PackBot, iRobot (2003-07) → 13 000 units sold Predator (2005) ~5 M\$
→ Used in most of recent wars (US Army)



Some sale numbers in non-manufacturing sectors



Da-Vinci, Intuitive Surgical (2002) ~2 M€ → 1750 in use in 2011

Some sale numbers in non-manufacturing sectors

Personal Service Robots & Entertainment



Vacuum Cleaner Roomba (2002) → 4 Millions sold in 7 years



Nao (2006) → Over 3000 sales

SONY



Aibo (2000-06) → **150 000** sales

Governments plans for supporting Robotics (USA)



Governments plans for supporting Robotics (France)





Priority Axes (100 M€) - 2013

- *Transportation & Logistics Defense & Security*
- Environment
- Intelligent Machines
- Personal Assistance

34 Industrial Plans (3.5 B€)

- Robotics
- Driverless Car
- Embedded Systems Factory of the future
- . . .

Governments plans for supporting Robotics

- Japan: Next Generation Robots = one of the 8 important areas promoted by the Government
- Korea: A 10 years Government plan (US\$ 316M) for developing Intelligent Robots
- Taiwan: Intelligent Robotics Industry designated as the nextgeneration industry by the Government (objective: over NT\$ 90 billion in period 2009~13)



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