Year 2 Review
Brussels, February 12th, 2010

Transversal Activity

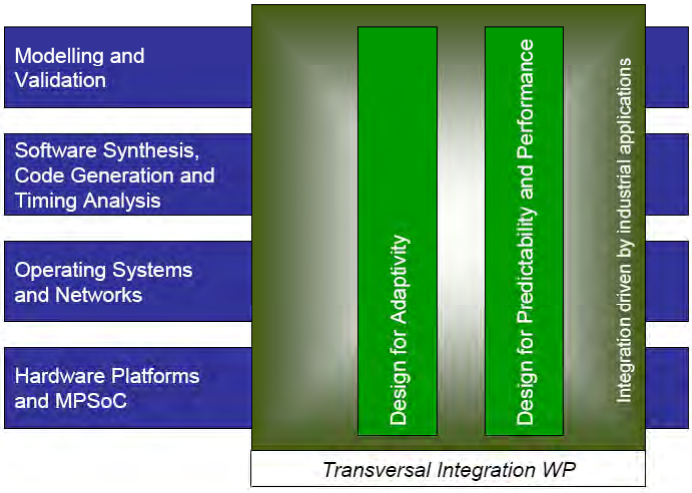
Achievements and Perspectives :

Integration Driven by Industrial Applications

Leaders: Alberto Sangiovanni Vincentelli (University of Trento)

Boudewijn Haverkort(ESI)

Ambition…



Main Trends in the Area

- High-tech industry is transforming into an ecosystem of system integrators and (1,2,3,...-tier) component suppliers
- To maintain quality and productivity such ecosystems must be managed as virtual vertically integrated industries
- This goal requires an explicit understanding of the relevant design flow(s) in an ecosystem, and ways to integrate methods and tools into such flows
- Research on design methods and tools that disregards design flows runs the risk of being industrially irrelevant

High-Level Objectives

- Goals:
  - To provide the “meta rules” for design flows according to which the design transformations are carried out and interfaces are built;
  - To provide an environment to the clusters to foster the integration their results into relevant design flows.
- Three approaches:
  - package design methods out of the thematic cluster results for relevant industrial segments;
  - identify main common features shared by different domains and work towards developing methods to address these topics.
  - Use workshops and Artist Design Meetings to enlarge the reach

Cluster Participants

This activity is de facto open to all core partners in the consortium, who can use the specific budget for this activity to attend its technical meetings

Most active participants:

- ESI
- IMEC
- OFFIS
- TU Braunschweig
- KTH ICES
- Bologna
- Trento

Building Excellence

Aims:

- Involve industry in Artist Design to foster research interactions and discussions on trends and challenges
- Inform Clusters of industrial trends
- Integrate research teams working on different tools and design approaches so that the outcome is industrially relevant

Instruments:

- Meetings with interested partners and industry representatives at Conferences, Workshops and special Artist Design events
- Interactions at Artist Design Plenary Sessions

Overview of the Cluster's Activities

- Design flows for automotive and aerospace
  Leader: Alberto Sangiovanni Vincentelli (TRENTO)
  - *interaction with COMBEST, ARTEMIS, US companies and research organizations…*
  - *outcome: meetings and impact on new directions (see interviews New York Times, KTVU Channel 2 SFO, papers in Proceedings of the IEEE, 3 best paper awards, META project, Musyc)*
- Design flows for health and nomadic
  Leader: B. Harverkort(ESI)
  - *interaction with GENESYS, ARTEMIS, …, NOKIA, Philips, NXP*
  - *outcome: meetings and industrial contracts*
- Investigate other important application domains

  Leaders: ASV and BH
  - *identified Energy Efficient Buildings*

Overall Assessment

Achievements

- Vision confirmed by industrial participants
- VERY Successful SEEC2009 Workshop (October 2009)
  - More than 100 participants from Academia, large and small industry, VC, research organizations, government agencies
- Meeting at CPS Workshop organized by Bruce Krogh, Raj Rajikumar and ASV in San Francisco with key US, Europe and Japan industrial players (GM, UTC, Boeing, Bosch, Daimler, Toyota...) (March 2009)
- Workshop on Embedded Systems in Healthcare, December 2009

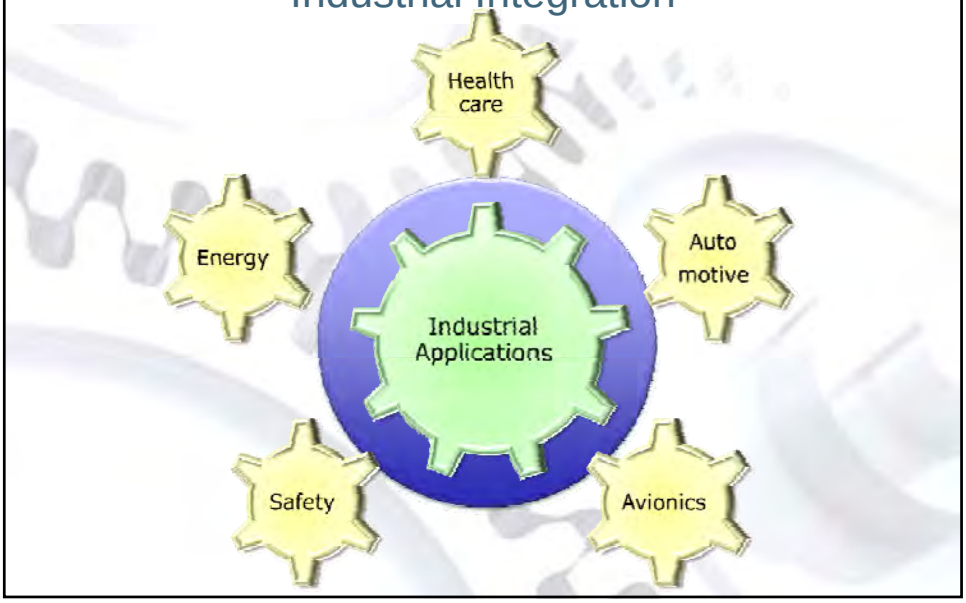
To be improved

- **More Partner involvement in operations of the transversal activity**

Outline

- Modus Operandi of our Cluster and roles of OFFIS, ESI, IMEC and ICES
- Automotive Activities
- Energy Efficiency Activities
  - SEEC 09
  - Projects
- Health and Nomadic Activities
  - Wshop on ES in Healthcare
- Future activities

Industrial Integration



OFFIS – Industrial Network

OFFIS

Cooperations with ArtistDesign Partners
- TUBS
- TRENTO
- INRIA
- Verimag
- CEA
- IST
- KTH
- Aalborg University
- …

VOLVO, EADS astrium, AleniaSIA, DAIMLER, EADS DEFENCE & SECURITY, Sagem Défense Sécurité, BOSCH Technik fürs Leben, Continental, IBTC Embedded Systems, AIRBUS, SIEMENS Transportation Systems, AVL, CRF CENTRO RICERCHE FIAT, AUTOSAR, Absint, THALES, . . .

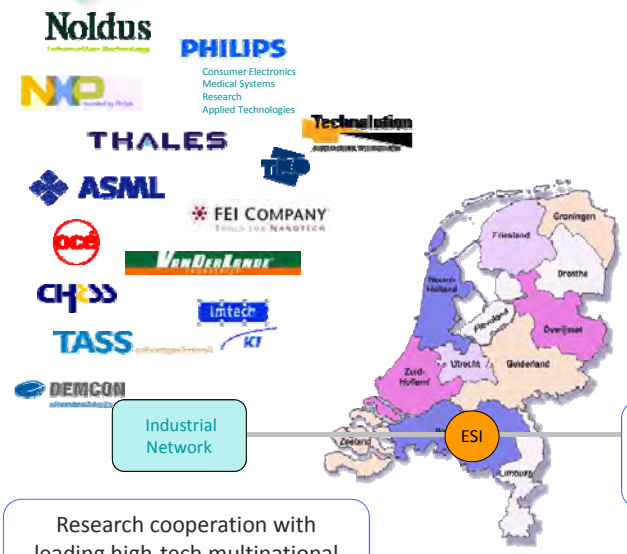
IMEC Partner Update

Micron, intel, QUALCOMM, NXP, qimonda, Infineon, ST, SONY, ELPIDA, Panasonic, hynix Semiconductor, SAMSUNG, PSC, tsmc

Partnerships in core Program IIAP's
The World's Largest Industry Commitment to Semiconductor Research in Partnership

ASML, ASM, APPLIED MATERIALS, Lam RESEARCH, KLA-Tencor, TEL, SOKUDO, axcelis, AMAT, SCREEN, ICOS, JSR, TOPPAN, FUJIFILM, varian, SEMILAB, RIXTRON, FEI, HITACHI, SiTerra, PHOTRONICS, umicore, nanocyl, extraction, SEMITOOL, ZEISS, NOVA, DNP, CYMER, Dow, Synopsys, MEMC, tok, Canon, HOYA, DUPONT, TAIYO NIPPON SANSO, DOW CORNING, ROHM&HAAS, BASF, AGC, Metryx

ESI Industrial Research Collaboration

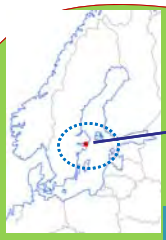


Industrial Network

Research cooperation with all Dutch universities with embedded systems research

Research cooperation with leading high-tech multinational industries & SME's

KTH – Industrial Network



KTH VETENSKAP OCH KONST

Cices
Innovative Centre for Embedded Systems

ARTEMIS

Cooperations with ArtistDesign Partners

- LTH, MDH, LIU
- CEA
- Offis
- INRIA
- CEA
- Parades
- Aveiro
- DTU, Bologna,
- …

SCANIA
ENEA
Prevas
VOLVO
VOLVO
Stoneridge
ABB
ERICSSON
TAKING YOU FORWARD
Haldex, SKF, StJude, Maquet
Atlas Copco
AIRBUS
DAIMLER
EADS DEFENCE & SECURITY
CRF CENTRO RICERCHE FIAT
Continental
SIEMENS
Transportation Systems
AVL
AleniaSIA
Sagem Défense Sécurité
THALES
. . .

ICES accomplishments examples

www.ices.kth.se

- Seminars and the ICES conference
  - ICES conference with ArtistDesign keynote
  - Platform based development (ABB)
  - Research and funding (ITEA2, FP7, Artemis) (KTH)
  - Testing and Verification (Scania)
  - HMI seminar (Stoneridge)

  > 200 industy participants. ArtistDesign dissemination
- Courses for PhD students and industry
  - Autosar and Functional safety for Embedded systems
- Spin off-projects: iFEST
- Mobility with ABB, Ericsson and Volvo
- Vision and goals document

CPS Week San Francisco

- Plenary Panel on April 21, 2009 with more than 200 people attending

http://varma.ece.cmu.edu/CPS-Forum/Organizers.html

CPS Forum

- 16:00 **Introduction to the CPS Forum**,*Taieb Znati, National Science Foundation*
- 16:15 **Panel 1: CPS Application Domains**, *"What are visionary and futuristic domains where advances in CPS will have broad impact?"* Moderator: Raj Rajkumar, Carnegie Mellon University

Jane Liu, National Taiwan University, Alberto Sangiovanni Vincentelli, Christoph Kirsch, University of Salzburg, Jack Stankovic, University of Virginia

- 17:00 **Panel 2: CPS Fundamentals** *"What elements are needed for a general theory of CPS that can provide a foundation for multiple application domains?"* Moderator: Rajesh Gupta, UC San Diego

Feng Zhao, Microsoft Research, Albert Benveniste, IRISA / INRIA, Rennes, Karl-Erik Årzén, Lund University,Peter Caines, McGill University

- 18:15 **Panel 3: Innovations in CPS Education** *"What kinds of initiatives are needed to create the next generation of CPS scientists and engineers?"*Moderator: Bruce Krogh, Carnegie Mellon University

Edward Lee, UC Berkeley, George Pappas, Upenn, Insup Lee, Upenn, Paulo Tabuada, UCLA

- 19:00 **Closing Remarks**

Outcome

- Joint EU/US research program planning:
  - light/tight integration
  - Each side funds its own institutions or combined projects?
  - Industry participation
- CPS document/white paper for discussion
  - Looking for feedback
  - Is the document ready to be widely circulated?

Outline

- Modus Operandi of our Cluster and roles of OFFIS, ESI, IMEC and ICES
- **Automotive Activities**
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Automotive Activities

- Integration of Tires within the active safety features (Trento, Pirelli et al.)
- Mixed criticality (TUB, Toyota!)
- Recomp (TUB + 41 Industrial partners)

Cyber™ Tyre Intelligent System

Vehicle dynamics control system

User Applications

Processing unit

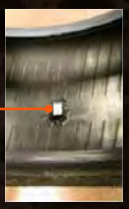
Receivers

Cyber™Tyre

Cyber™Tyre

TG5 Major broadcast channel in Italy

Marco Tronchetti Provera
Chairman of Pirelli & C. S.p.A
June 2009.



artist

Mixed criticality in automotive networks

- **Active steering system**
  - used frequently
  - failures may have serious consequences

→ **Highly Safety Critical**

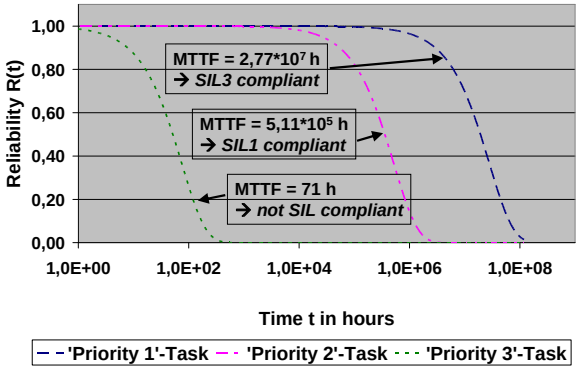
- **Dashboard system**
  - frequency of usage may fluctuate
  - failures normally have no hazardous consequences

→ **Non Safety Critical**

- Research focus: design of mixed-criticality systems
  - multiple safety integrity levels on the same components
  - not feasible with current safety standards (e.g. IEC 61508)

Current research results – mixed criticality

- Formal analysis allows to quantify the achievable safety integrity level "SIL" for different messages *on the same bus*

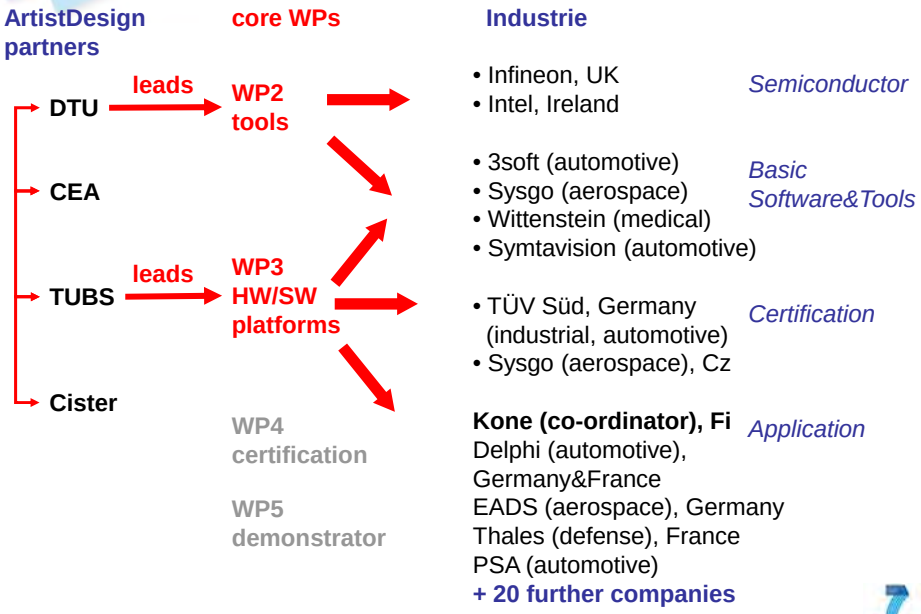


- **Collaborative research starting 2009 Toyota ITC, Symtavision, TUBS**
- **First Results presented on ArtistDesign MpSoC Cluster Meeting 2009**

RECOMP project

- RECOMP = "Reduced Certification Costs using Multi-core Platforms"
- EU ARTEMIS project – 2nd call – *ranked 2nd (of more than 40)*
- major research areas
  - tools support for certifiable multi-core platforms
  - design and implementation of safety-related, certifiable multi-core platforms
  - cost-efficient certification techniques for multi-cores based on state-of-the standards, e.g. IEC 61508, *target: mixed criticality*
- large project consortium
  - 41 partners from 9 countries, 25M€ budget
  - ArtistDesign partners played *key role* in project development and organization (country coordinators, WP leaders)
  - starts 4/10

RECOMP consortium (25M€)



Outcome

- Vision of virtual vertical integration confirmed
- Automotive domain mature for integration and transversal activity
- Frontier is at the cross road of different disciplines
- Distributed integrated fault tolerant architectures
- Role of fault-tolerant multi-core
- Zero-accident cars

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Trento SEEC 2009 - Network Building

E-RIC: Energy Regional Innovation Cluster

Energy Regional Innovation Cluster

Energy Efficient Building Systems Design Hub

- The Obama Administration has announced a multi-agency initiative to spur regional economic growth while making buildings more energy efficient.
- **Seven federal agencies** issued a combined Funding Opportunity Announcement of up to **$129.7 million over five years** to create a **regional research center** that will develop new building efficiency technologies and work with local partners to implement the technologies in area buildings.

Press announcement February 8th 2010

Smart and Energy Efficient Council (SEEC)

Dates and Location: October 8-9, 2009, Fondazione Bruno Kessler (FBK), Sala conferenze., Povo di Trento (TN), Italy

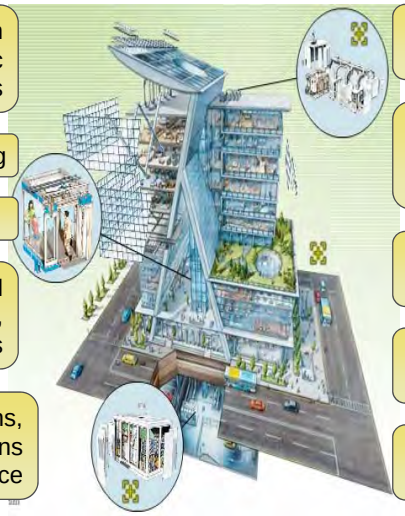
Overview

- The focus of the workshop is on energy efficiency as an alternative source of energy. Data shows that alternative energy sources alone are insufficient to meet the increasing demand. Higher efficiency is therefore required to address the energy problem, and is important also from an environmental point of view. Emphasis is on addressing the problem from a system standpoint.

Systems of Systems Approach to Energy Efficiency

Consider Buildings as Composition of Subsystems

- Buildings Design Energy and Economic Analysis
- Windows and Lighting
- HVAC
- Domestic/International Policies, Regulation, Standards, Markets
- Demonstrations, Benchmarking, Operations and Maintenance
- Natural Ventilation, Indoor Environment
- Networks, Communications, Performance Database
- Sensors, Controls, Performance Metrics
- Power Delivery and Demand Response
- Building Materials, Misc. Equipment



Integration: *The Whole is Greater than the Sum of the Parts*

Key Points

- Market pressures on increasing performance for buildings
  - *Energy efficiency: need to go to Net Zero Energy;*
  - *Security: need to improve false-alarm rates dramatically.*
- Current best practices for high-performance buildings
  - *Functional integration for increased efficiency.*
- Barriers for dramatically improved high-performance buildings
  - *Complexity, heterogeneity and emergent behavior of networked systems.*

R&D needs in Systems Technology:

1. Design processes that address complexity explicitly;
2. Modeling and analysis that is focused on dynamics;
3. Explicit representation and management of uncertainty;
4. Design methodologies for networked embedded systems;
5. Supply and demand side energy demonstrations.

List of Speakers (Partial)

- **Alberto L. Sangiovanni-Vincentelli (UC Berkeley and Trentino system)**, *Embedded systems for energy efficiency*
- **Michael Wetter, Computational Scientist, Lawrence Berkeley National Laboratories**
- **Luca Benini, Professor, University of Bologna**, **Fabio Bellifemine, Telecom Italia Lab**, *Energy-neutral distributed sensing for proactive energy management in buildings and plants*
- **Clas Jacobson, Chief Scientist, United Technologies Research Corporation**, *A Systems Approach for High Performance Buildings*
- **Petr Stluka, Lead Research Engineer, Honeywell ACS Labs** *Energy Efficiency Solutions for Buildings*
- **Manfred Morari, Head of Department of Information Technology and Electrical Engineering, ETH Zurich**, *Weather forecasts enhance comfort and save energy*

List of Speakers (Partial)

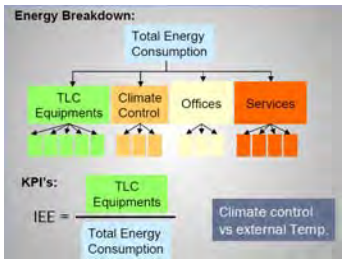
- **Markus Gwerder, Siemens Building Technologies**
- **Axel Seerig, Building Climate Control + Simulations, Gruner Group**, *Simulation based façade control implemented as a responsive building element*
- **Klaus Tochtermann, Dean of Computer Science, University of Graz**
- **Reiner Stegmann, Hamburg University of Technology**
- **Cristoforo Benvenuti, CERN**
- **Rik W. De Doncker, Director of the E.ON Institute for Energy Research, RWTH Aachen**
- **Antonello Monti, Director ACS, RWTH Aachen**, *Distributed Control and Power Electronics for Smart Grids*

EKREIT Project

- German national project (BMBF)
- initiated by ArtistDesign WS on Energy Efficient Buildings
- real-time system optimization for smart buildings
- 2 companies (iQST + Symtavision) and TUBS
- collaboration with department of architecture

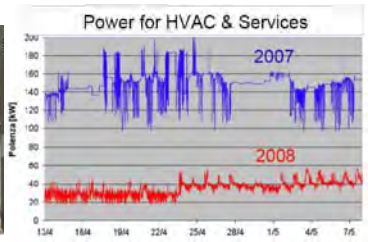
Energy-neutral distributed sensing for proactive energy management in buildings and plants (University of Bologna, Telecom Italia)

Kaleidos is an energy monitoring system based on WSN developed by Telecom Italia to control the efficiency of its communication equipment and the room temperature



TELECOM ITALIA LAB

University of Bologna has designed Energy Harvesting circuits exploiting the electromagnetic fields in the cable grid to supply the sensor nodes and to recharge the batteries



Highlight: The Energy-Aware House

INDESIT · H. Jespersen & son A/S · EL · SERVODAN · Brunata · WAVE ALLIANCE · DEVELCO · humm · Kamstrup · seluxit

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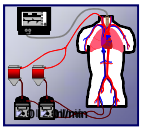
Workshop on Embedded Systems in Healthcare

- Eindhoven, December 9, 2009
- 31 participants from 5 countries
- Program:



Boudewijn Haverkort (ESI)	Introduction
Pierre America (ESI) Piërre van de Laar (ESI)	Healthcare in 2020: Consequences for Embedded Systems
Wim Pasman (Philips)	A (R)evolutionary Architecture for Philips Cardio Vascular
Elisabetta Farella (Università di Bologna)	Sensing and Actuating in Assistive Environments
René Roos (Cochlear)	Cochlear Implant Systems: Today's Challenges in Embedded Firmware Design
Thom van Beek (TU Delft)	Capture User Requirements using Workflow Scenarios
Johan Henning (Nucletron)	How to Design Long Lasting Devices for a Fast Changing World
André Stollenwerk (RWTH Aachen)	Embedded Contributions to an Intensive Care Safety Concept
Discussion	Consequences for Future Research

Nomadic Embedded Systems in IMEC

IMEC industry partnerships related to Artist

- Related to WP4 - SSCG
  - Multi-processor design technology (IMEC, Toshiba)
  - Future wireless communications (IMEC, Panasonic)
- Related to WP6 – HW&MPSoC
  - Green radio technology (IMEC, Samsung)
  - 3D Stacked IC Design using Through Silicon Vias - TSVs (IMEC, Qualcomm, Javelin)
  - Memory Aware Variability Modeling (VAM) for embedded SRAMs (IMEC, Samsung)
  - RF Tranceivers (IMEC, Renesas)

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Plans for Year 3

- Continue working with the network built so far (joint research, papers, special journal issues, conferences, workshops)
- Link into USA Energy Initiatives
- Continue organizing international meetings on topics of interest to the community:
  - **DATE March 2010**:
    - ASV Key Note
  - **CPS Week April 2010**, 5 Conferences co-located (HSCC, ICCPS, IPSN,LCTES, RTAS): ASV Plenary Key Note on Wednesday
    - **GREEMBED 2010:** A. Sangiovani Vincentelli, Huascar Espinoza, European Software Institute ESI-Tecnalia, M Di Natale, Scuola Superiore St. Anna, R. Passerone, Trento,
    - **Formalisms for Embedded Systems Architecture description & visualization:** Martin Torngren, KTH
  - **DAC June 2010** (Automotive Tutorial + Panel)
  - **ES Week October 2010**
    - Health Tutorial
    - Transportation Safety Wshop