Pan-European Research and Innovation Strategies in the field of CPS and Embedded Intelligent Systems

IEEE – 13th System of Systems Engineering Conference - Paris

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Societal Challenges

- Ageing population
- Global warming
- Air quality degradation
- Traffic congestion harm mobility of citizens
- Limited energy resources,
- Mounting insecurity

**McKinsey:**

“... digitalisation will potentially add 1 trillion EUR to the GDP in Europe as our daily lives and economies become increasingly dependent on digital technologies ...”
Digitalization Helps Solve Challenges

Societal Challenges

- Transport & Smart Mobility
- Smart Health
- Digital Life
- Smart Production

Smart applications

Technology
- Business models
- Software
- Sensors & Systems
- Micro / Nanotechnology
Digitalization Helps Solve Challenges

**Software & Business Models**
- Services instead of products
- Autonomy
- Virtualization
- Software elasticity
- Artificial intelligence

- Advanced sensors
- Advanced HMI

**Nanotechnology**
- Falling cost of all semiconductors
- Ubiquitous and powerful connectivity
- Efficient power management
Electronic Components & Digital Intelligence
Digitalization Combines Three Aspects

- Micro/Nano Components
- Economy of scale
  - Supply-Chain
  - Production systems

Application:
- Agility
  - Domain specific
  - Integrated in mechanical/chemical systems

- SW Framework
  - Openness,
  - Eco-System
  - No production
Electronics Components and Systems with Digital Intelligence for European Leadership

ESSENTIAL CAPABILITIES

- Systems and Components: Architecture, Design and Integration
- Connectivity and Interoperability
- Safety, Security and Reliability
- Computing and Storage
- ECS Process Technology, Equipment, Materials and Manufacturing

KEY APPLICATION AREAS

- Transport and Smart Mobility
- Health and Well-being
- Energy
- Digital Industry
- Digital Life
Vision for automated driving

- Personal mobility for citizens of all ages
- More personal time
- Vision: fatality free mobility
- Better usage of scarce resource roads and streets
- Shared mobility
Gradual Introduction of Automated Vehicles

<table>
<thead>
<tr>
<th>Longterm Gens.</th>
<th>Automation Gen. 2</th>
<th>Automation Gen. 1</th>
<th>ADAS new</th>
<th>ADAS established</th>
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<tbody>
<tr>
<td>Driver Only</td>
<td>Assisted</td>
<td>Partial Automation</td>
<td>Conditional Automation</td>
<td>High Automation</td>
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<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<td>Intervening only in emergency</td>
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High velocity in structured
High velocity in unstructured

Existing
Low velocity in structured environment
Unstructured environment

Artificial Intelligence is new Game Changer

Global Revenue with Artificial Intelligence

Source: Tractica
Building blocks of automated driving

Perception

- Sensors & Connectivity
  - Radar, Camera
  - Lidar, GPS, Maps, 5G, ...

Processing and decision-making

- Path planning
  - Selection of optimal route
- Fusion
  - Multi-sensor data
  - Power computing
  - Cognitive data
- Decision
  - Decision-making
  - Driver interface
  - Driver-car hand-off

Vehicle control

- Steering
- Suspension
- Transmission
- Acceleration
- Braking
- Transmission
Main Question

How to make sure that the automated vehicle behaves correctly in EVERY situation?
SoS Challenges

Complex system

In a complex environment

- Weather conditions
- Traffic situations
- Road conditions
- Driver behavior
Coverage Challenge

Conventional validation on the road

~ **100M Km** to prove that the automated vehicle is as safe as a manually driven vehicle.

Simulation for more scalable validation

Challenge: Smart selection of test scenarios and parameter variations
Test distribution challenge

Scalable simulation environment

Identify critical regions

Validation using more detailed models

Virtual World

Real World
ECSEL Lighthouse Initiative: MOBILITY4.E

LIASE (Lighthouse Initiative Advisory Service) & ECSEL Governing Board
- Industry and Public Experts
- Implementation SRA and Roadmap

Collection of ECSEL and Non-ECSEL Research projects in Initiative
- Silverstream (User Experience)
- Dense (24/7 sensors)
- Robustsense (Sensing in harsh conditions)
- 3CCar (Connected vehicles)
- Autodrive (Fail operational)
- SetLevel4to5 (Level 4 and 5)
- ENABLE-S3 (Validation process)
- AscertAIN-S3 (AI validation, homologation)
- Pegasus (Scenario Lib)
- TrustVehicle (Homologation)
- V&V (Road testing)

Other none-technical stakeholders
- Legislation
- Standardization
- Domain specific bodies

- Knowledge exchange
- Networking
- Implementation of strategic research agenda