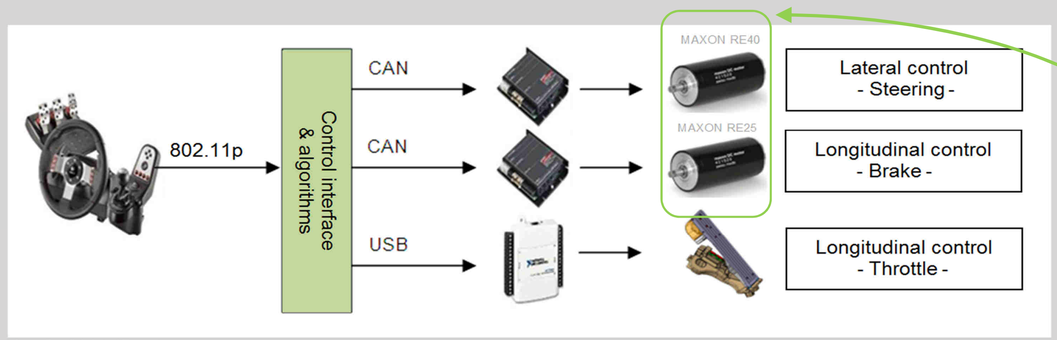
# Technology Transfer Process

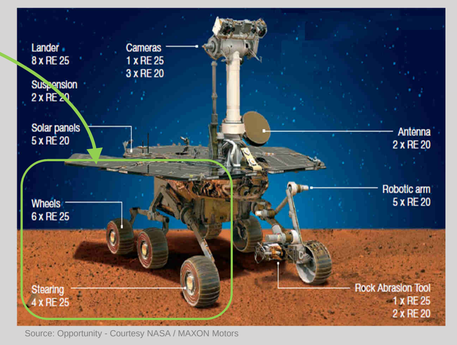
## From Space to Earth

### Technology transfer processes from robust proven space technology to Earth products

- Traction systems,
- Positioning technology
- Robotic wheels
- Sensors and cameras
- Comunications / remote control of vehicles
- Cooperative manoeuvres / robot swarms
- Navigation strategies and algorithms
- Decision taking algorithms

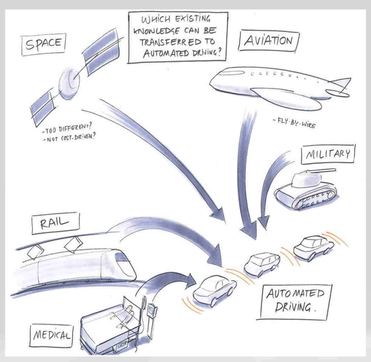


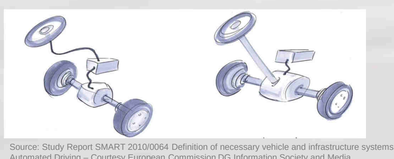

Source: Tecnalia Industry & Transport.



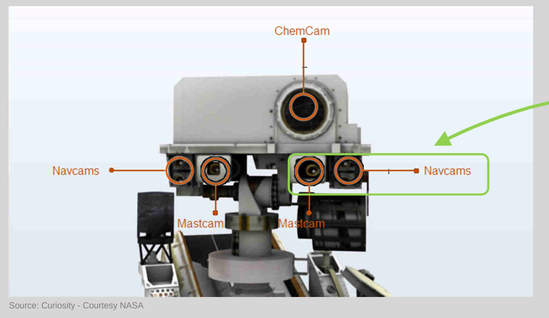

Source: Opportunity - Courtesy NASA / MAXON Motors

### Technological Synergies from Aerospace to Automotive



Source: Study Report SMART 2010/0064 Definition of necessary vehicle and infrastructure systems for Automated Driving – Courtesy European Commission DG Information Society and Media




Source: Curiosity - Courtesy NASA


Source: Tecnalia Industry & Transport.

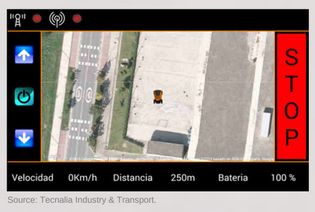

Source: Tecnalia Industry & Transport.

### Terrestrial target applications:

- Drive-by-Wire applications
- Autonomous driving for Car-sharing and platooning
- Safe, automated transport of aged, disabled persons and goods
- Automated vehicles as Cyberphysical systems
- Remote handling and tracking of robots and vehicles

### Reusability of experience and successful results in space applications on:

- Mechatronics
- Redundant hardware and systems
- Redundant and safe functions
- Cameras & artificial vision
- Positioning systems




Source: Tecnalia Industry & Transport.

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## From Earth to Space

### Unifying Control and Verification of Cyber-Physical Systems

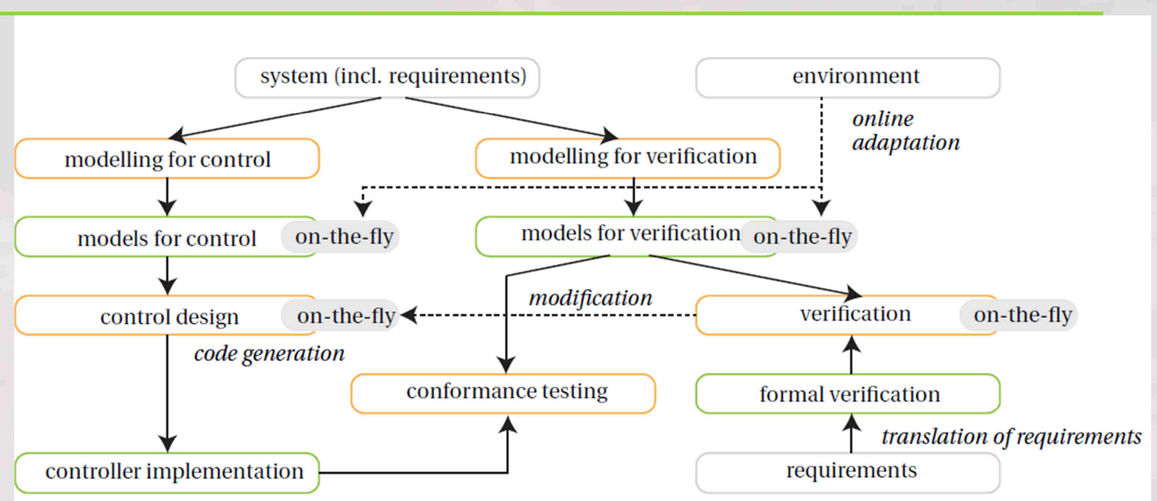
**H2020 - UnCoVerCPS project**

UnCoVerCPS provides methods for a faster and more efficient development process of safety-or operation-critical cyber-physical systems in (partially) unknown environments.

Cyberphysical systems are very hard to control and verify because of the mix of discrete dynamics (originating from computing elements) and continuous dynamics (originating from physical elements).

We present completely new methods for de-verticalization of the development processes by a generic and holistic approach towards reliable cyber-physical systems development with formal guarantees.
In order to guarantee that specifications are met in unknown environments and in unanticipated situations, we synthesize and verify controllers on-the-fly during system execution. This requires to unify control and verification approaches, which were previously considered separately by developers. For instance, each action of an automated car (e.g. lane change) is verified before execution, guaranteeing safety of the passengers.

We will develop completely new methods, which are integrated in tools for modeling, control design, verification, and code generation that will leverage the development towards reliable and at the same time open cyberphysical systems. Our approach leverages future certification needs of open and critical cyber-physical systems




**OBJECTIVES:**

Novel on-the-fly control and verification concepts.

Ground-breaking methods for unifying control and verification to quickly react to changing environments.

Seamless integration of modeling and conformance testing.

A unique tool chain that makes it possible to integrate modeling, control design, formal verification, and automatic code generation.

Prototypical realizations of the novel methods in automated vehicles, human-robot collaborative manufacturing.

Wind turbines and smart grids, which will clearly demonstrate the benefits of formal methods.

A new development process that reduces development time and costs for critical cyber-physical systems to strengthen European companies which design or produce cyber-physical systems.

Automated Vehicles

Wind Turbines

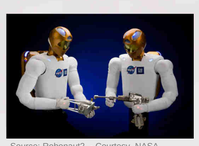
Human-Robot Collaboration

Smart Grids

**Control and Verification of Cyber-Physical Systems in Space applications, to allow working safely side-by-side with humans on Earth and in Space**

**→Based on terrestrial tools and experience**

Source: Eurobot2 - Courtesy ESA



Source: Robonaut2 - Courtesy NASA

**CONSORTIUM:**

- Technische Universität München (TUM) – *Coordinator,* Germany,
- Université Joseph Fourier, Grenoble 1 (UJF), France
- Universität Kassel (UKS), Germany
- Politecnico di Milano (PoliMi), Italy
- GE Global Research Europe, Germany
- Robert Bosch GmbH, Germany
- Esterel Technologies, France
- Deutsches Zentrum für Luft- und Raumfahrt, Germany
- Tecnalia Research & Innovation, Spain
- R.U.Robots Limited, United Kingdom

More information about the project is available online.
Please visit **http://cps-vo.org/group/UnCoVerCPS**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