PROJECT

APOLLO

Intelligent tyre for accident-free traffic

Funding: European (5th RTD Framework Programme)
Duration: Mar 2002 - May 2005
Status: Complete with results

Background & policy context:

Research and development work in automotive industry has been focusing at an intensified pace on developing vehicles with intelligent powertrain management, chassis control systems and driver support functions such as ADAS for improved lateral and longitudinal control of the car, as well as for monitoring tasks. Up to 2005, tyres had been only rubber systems representing ‘terra incognito’ in Advanced Driver Assistance System (ADAS) area without providing vehicle control systems or a driver with any information.

Tyres are, however, the most important system for the contact point between road and vehicle. The gradual introduction of intelligent functions in cars has opened up new possibilities for improving road traffic safety. Actually, a part of automotive industry has created the vision of accident-free traffic. A further step, in addition to the ones mentioned above to realize this vision, is the introduction of an intelligent tyre and the integration of this system into a part of vehicle control systems.

Objectives:

The objectives for the project producing a prototype for an intelligent tyre were:

- to increase road traffic safety by means of an intelligent tyre system;
- to enable improvements for vehicle control systems, Advanced Driver Assistance Systems (ADAS) and chassis control systems;
- to enable the introduction of innovative services concerning tyre and road conditions for different user groups both inside and outside the vehicle.

Three main research and technology objectives for the project were as follows:

1. Introducing innovative sensors for monitoring tyre condition, road condition and tyre-road interaction.
2. Developing novel solutions for a wireless communication interface and a batteryless power supply enabling intelligent tyre systems.
3. Creating an 'intelligent' tyre: integrating all electronic components into the tyre by means of mechatronic design, taking into account processes of manufacturing, handling and maintenance.

Methodology:

- Investigating the needs and expectations of various user groups concerning an intelligent tyre.
- Showing the added value the intelligent tyre can provide for driving safety and comfort as well as providing different user groups also outside the vehicle with other services.
- Defining a reference application for the intelligent tyre prototype.
- Developing a novel sensor system mechanically integrated into the tyre such as capacitive sensors for sensing the following signals or parameters: forces exerted on the tyre, slip, friction potential, tread wear and prediction of tyre damage, road surface qualities.
- Developing a new type of a wireless communication interface between tyre and vehicle.
- Developing a novel power supply technique without a battery.
- Developing an intelligent tyre/wheel prototype with integration of sensor system, communication interface and a power supply.
- Integrating the intelligent tyre prototype into a vehicle and verifying in real driving conditions that the signals from the tyre are available for vehicle systems as specified.
- Disseminating the results of the work throughout the project life-span and linking the project to
other ADAS-projects.
- Preparing the way and drawing up a road map for the exploitation of intelligent tyre systems.

**Parent Programmes:**
FP5-IST KA1 - Systems and services for the citizens

**Institute type:** Public institution

**Institute name:** European Comission, DG Information Society

**Funding type:** Public (EU)

**Partners:**

**Organisation:** VTT Industrial Systems

**Contact country:** Finland

**Key Results:**

The project was realised by developing sub-systems for communication from tyre to vehicle's systems, power generation for communication and the actual sensor for tyre-road contact monitoring. The realisation and integration of all these sub-systems into a mechatronic tyre prototype required innovative approaches and a new deep understanding of tyre phenomena and tyre-vehicle system level behaviour.

The target of the project was a prototype of a mechatronic tyre capable of providing information on various parameters of tyre-road contact such as forces exerted on tyre, slip information, friction potential, tread wear, prediction of tyre damage and road surface qualities. Many of these target information can be obtained by the new tyre but not all. Especially, friction potential seems to be out of reach by the system developed using acceleration sensor only.

**Technical Implications**

The project faced a number of challenging tasks all the way from system requirements to the first verification tests of the whole system. It is clear that many of the technical solutions are possible in the first prototype only. The weight and size of the electronics parts and components need to come down and the durability to be improved concerning series production. Moreover, better understanding of sensor signals is still needed and the theoretical model improved to have more precise information of tyre road contact and associated tyre deformations.

**Documents:**
- Final Report Including Technical Implementation Plan (Annex)

**STRIA Roadmaps:**

Cooperative, connected and automated transport, Vehicle design and manufacturing

**Transport mode:** Road transport

**Transport sectors:** Passenger transport, Freight transport

**Transport policies:** Digitalisation, Safety/Security

**Geo-spatial type:** Other