

Smart Rubber for Car Tyres

The R&D department of [Apollo-Vredestein](#) has identified monitoring as an innovation with a high potential to develop innovative tyres. Tyres with a monitoring system have a unique selling point: they provide the user with valuable information on the performance of the tyre. In the long run, the system is foreseen to evolve to an active system, further increasing drive safety and comfort.

A tyre monitoring system requires the development of an embedded sensor system, measuring a relevant, dynamic quantity. Piezoelectric material is an eligible candidate, but not the only. The objective of the assignment is to develop a sensor system that can be used in a rubber material.

Tyres A car tyre consists of different layers and components (see figure 1), each serving a specific purpose. Its performance depends on many variables, amongst which the road and weather conditions. Tyres are classified based on their grip, rolling resistance and sound performance (see figure 2), but at the same time should not wear too quickly. This often leads to conflicting demands.



Figure 1: Cross-section of a radial tyre: tread (1), subtread (2), sidewall (3), NOH nylon overhead (4), belt layers 1 and 2 (5), belt rim tape (6), carcass layer 2 (7), carcass layer 1 (8), bead filler strip (9), bead (10), inner liner (11) and rubber rim band (12) (courtesy of Apollo Vredestein B.V.).

Adding Intelligence to a Tyre Car tyres exhibit a complex dynamic behaviour. Although being intelligently designed, the tyre itself does not have any intelligence. The benefits from intelligence is that the dynamic behaviour during driving contains valuable information on the performance under various conditions.

Sensor Systems Integrating a monitoring system in a tyre requires the development of an autonomous sensor system and knowledge on its dynamics: the type of sensor depends on what is to be measured, the possibility of integration of the sensor and the possibility to make it autonomous.

Objective The objective of this assignment is to investigate and develop a suitable sensor system for a rubber. The following steps are required in this research:

- Investigate the material, the wear, the dynamics and performance of a tyre.
- Identify a feature to be measured.
- Select a sensor and design a sensor system.
- Proof of principle of the sensor system in an experimental set-up, based on a rubber patch.
- Build (part of) a demonstrator.
- Support the design and experimental work with physical, analytical and numerical models (where appropriate).

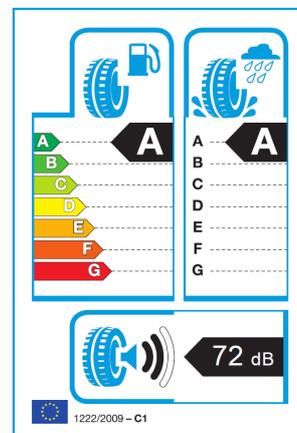


Figure 2: Quality classification labels of a tyre.

Partners The assignment will be performed at [Apollo-Vredestein](#) (Colosseum 2, Enschede) in close collaboration with the University of Twente, research groups [Applied Mechanics](#) and [Elastomer Technology and Engineering](#).

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