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## **SPHERICAL TYRES FOR SELF-DRIVING CARS**

Nowadays it is difficult to imagine life without cars. Perhaps the future is not possible to imagine this part of our everyday life. One of the key elements of their design is elastic membrane installed on the rim of the wheel of the vehicle. In other words, it is a tyre. Pneumatic tyres are filled with air or any gas under pressure. Depending on the method of sealing the pneumatic tyre is produced in a chamber or a tubeless version.

The quality and condition of the tyre affects the car's operation, its stopping distance, speed, load and rolling resistance.

Load Index is a car's ability to bear the cargo, passengers and its own weight. Speed Index determines the speed limit when the tyre can operate safely.

During movement of a vehicle wheel brakes because some amount of energy is spent by the tyre for deformation as a result of spot contact displacement. This energy is subtracted from the kinetic energy. Rolling resistance can make up to 25-30% of energy consumption. However, this percentage is largely dependent on the speed of the vehicle. The index is low at high speed.

The main cause of an accident is the loss of control of the car which is directly connected with the tyres.

The company "Goodyear" presented a conceptual "smart" tyres Eagle 360 Urban for self-driving cars at the International Motor Show in Geneva. Their installation is possible only on vehicles with magnetic levitation. It is possible to achieve a new level of driving and safety and comfort for the driver and passengers due to the unique shape of tyres. They have a spherical shape and can rotate in any direction. According to forecasts of the company a market of self-driving cars is to be about 85 million units annually by 2035. They conclude that the use of tyres of unusual design will be one of the most promising innovations. They will be produced according to an individual design using a form of additive manufacturing technologies – 3D-printing, for example, their properties will be set depending on the location of the car and driving style of its owner.

Each tyre is a single mechanism with the electric motor and battery, and the voids are filled with reinforced foam plastic. They will rotate around their axis adapting to different weather conditions and road surface changes (driving on gravel or ice) and respond to them. Apart from increasing the smoothness control and maneuvering such shape of tyres also enables the car to move sideways.

The main idea of this concept is to provide tyres with artificial intelligence and functions of data exchange with the car, other road vehicles and the environment. To make driving more efficient and safer sensors will be integrated into Eagle-360 to monitor the condition of the road surface and can react to obstacles that may arise. Also, the tyres will transmit data about level of their deterioration and damage to the central control system of self-driving car information on the extent of its deterioration and

damage. In addition, the tyres can receive data about traffic and location of the vehicle in real-time.

The tyre is able to choose the best course of actions and make decisions because it will be able to combine different data sources using a neural network based on algorithms of deep learning and process their parameters efficiently. Eagle 360 has self-education i.e. can optimize the order of responses to the same conditions based on stored information about the actions that have been performed before thanks to the technologies of artificial intelligence.

The tyre has a capacity for a transformation i.e. the expansion and compression, since it is covered with bionic membrane made of superelastic polymer similar to human skin. Foam filler which retains its flexibility under this membrane and is strong enough to withstand the weight of the vehicle.

In case of damage of bionic membrane covering the tyre tread sensors will be able to find a puncture. When discovering the damage the tyre returns so that the puncture can not fall into the area of contact with the road surface. Moreover, the tyre has the ability to delay opening independently due to the innovative properties of the material.

Spherical Goodyear tyres have a tread pattern that resembles a natural surface structure of brain corals. Voids in tread surface are filled with the special material with properties of natural sponge. It will absorb water and then throw it through centrifugal force preventing the creation of aquaplaning effect i.e. total or partial loss of grip on wet surfaces.

A special system drives that work like human muscles by moving individual sections of the tread is located in the outer layer of the tyre. As a result of their actions tyre surface changes according to weather conditions. Detecting moisture the number of grooves increases and membrane is "smoothed" on the dry coating.

As the wheel in the shape of a ball is able to turn to 360 degrees and future technology may allow narrowing parking spaces, since cars equipped with spherical tyres need less space to maneuver.

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