SENSING THE FUTURE

PTA News Bureau

The tyre industry is witnessing several technological changes that will enhance vehicle safety and fuel-efficiency. *Dr Vladimir V Vantsevich*, a pioneer in mechatronics, says the increasing use of electronics in tyres and vehicles augurs well for sustainable mobility

With the rising numbers of vehicles on roads, the carbon footprint is expanding leading to climate change that is creating havoc to the environment. In order to address issues of green mobility, researchers like Dr Vladimir V Vantsevich are inventing new ways to reduce tyre's rolling resistance while slashing fuel usage in vehicle drive-lines.

The major elements in all these efforts are the emphasis on mechatronics – combined application of mechanics and electronics. It cuts across multiple engineering disciplines such as electrical, maths and computer sciences.

In an interview to ***Polymers & Tyre Asia,*** Dr Vantsevich said the introduction of intelligent tyre, which is a mechatronic system by its nature, is now the key element to improve fuel efficiency and reduce carbon emission in order to attain sustainable mobility. But it alone would not help resolve the problems facing the transportation sector.

In fact, intelligent tyre undesirably brings extra power losses generated by its electromagnetic and power electronics subsystems, argued Dr Vantsevich, who is a Professor in Mechanical Engineering and founding Director of the Master of Science programme in Systems Engineering at the Michigan-based Lawrence Technological University.

"For this reason, the problem of reducing mechanical power losses due to tyre rolling resistance and tyre slippage should gain further research attention and interest today," he said.

At his university lab, Dr Vantsevich and his colleagues are working on optimal tyre carcass curve with the objective of improving tyre-rim interaction. "We are developing methods for the direct measurement of rolling resistance components."

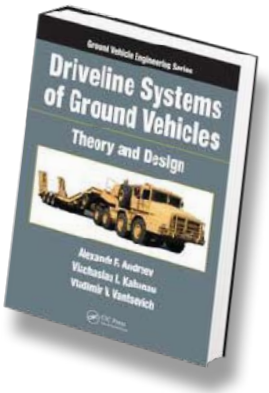
Rolling resistance

Besides recent developments in tyre-embedded sensors, he believes that self-inflated actuators, which convert energy into motion, are more feasible for commercial use.

He said one could control the vehicle dynamics and performance if one could control the tyre rolling process.

Dr Vladimir V Vantsevich

"Dynamics and performance of a vehicle manifest themselves in interaction of the vehicle with the environment."



Practically all major forces acting on the vehicle from outside appear at the tyre-patch. This fact makes the tyre an important key element in the proper formation of the vehicle-environment interaction which results in its operational characteristics, including fuel efficiency, mobility, tractive and velocity properties, stability of motion, safety, reliability, etc.

However, something important is often missing, he said pointing out that the listed vehicle characteristics are significantly dependent on the "cooperation" among the vehicle's tyres.

The "cooperation" itself depends on interaction of tyres with other vehicle systems. Said Dr Vantsevich: "For example, the same vehicle with a constant total power at all the driving wheels will perform differently when the total power gets distributed differently among the wheels. "

This vehicle will show different fuel consumption, different level of mobility and other properties at different power distributions among the wheels, he explained.

Such "cooperation" among the tyres of a vehicle and the tyres with various driveline systems is a subject matter of study at his university.

Research work

The course work that his engineering department is offering on "Autonomous Wheel Power Management System" was developed based on his own book Driveline Systems of Ground Vehicles: Theory and Design published by Taylor & Francis this year.

This innovative work, which comes in the series Ground Vehicle Engineering is brought out under his editorship. He has invited potential researchers and authors to join him in collaborative work.

A significant component of the course that he has launched includes studying the 4x4 vehicle chassis fitted with dynamometer with individual wheel control. It allows the study of vehicle dynamics/performance and fuel consumption depending on the power distribution among the wheels of vehicles with mechanical, individual electrical, hydrostatic, and hybrid drives.

Dr Vantsevich, who is credited with starting the first Intelligent Tyre and Reconfigurable Vehicle Mechatronics course in the United States, says it was developed in collaboration with Dr. Mukul Verma, an Adjunct Professor in Mechatronic Systems Engineering programme (see page 20) .

... continued on page 74

... continued from page 66

SENSING THE FUTURE

The programme, which is mostly attended by practising engineers, concentrates on manned/unmanned ground vehicles and robotics. The course is also well-received among OEMs and tyre companies.

Currently he is collaborating with Professor Eugene Rivin of Wayne State University, Michigan, on the problem of tyre damping enhancement.

When asked how close can analytical simulations be to reality as there are many parameters that can change from situation to situation, he said his response to this was the development on what he called “inverse vehicle dynamics.”

He has developed control algorithms which have adaptive features, but he hastened to add that it does not mean ‘’adaptive’’ as understood in the classical control theory.

“Such adaptive features provide “independence” from many non-linearities.

These algorithms demonstrate highly stable response within a wide change of parameters.

He also said that these do not require sophisticated sensors for sensing tyre-terrain characteristics. Some elements of his research have been included in the course Analytical and Adaptive Dynamics in Mechatronics Systems of the mechatronics programme.

When asked when ‘intelligent tyre’ be reality and a cost-effective option before consumers, Dr Vantsevich said: “The cost of electronics in 1970s did not stop the “mechatronisation” of vehicles. As a result, today’s cars are packed with electronics. On an average, a car has wires 2-2.5 km long with a mass of 30 kg.

The development of intelligent tyre is pre-determined by the human potential to invent novel concepts and implement them in proper designs. “I think the first phase of workable designs will come within next decade.”

VEHICLE TEST: vehicles are put through various tests at Dr Vladimir Vantsevich’s lab