Electric scooter – a student research project

Damijan Miljavec

University of Ljubljana, Faculty of Electrical Engineering, Tržaška 25, 1000 Ljubljana, Slovenia
E-mail: Damijan.Miljavec@fe.uni-lj.si

At the Laboratory of electrical machines, Department of mechatronics, Faculty of Electrical Engineering of the University of Ljubljana a group of students is assembling an electric scooter. By being assigned this task, students will get an insight into the research and development work. The work started upon a comprehensive analysis of the solutions available in the current market of electric cars, scooters and bicycles. In order to build a simulation model of the entire electric scooter, its basic models with their different parts and connections were defined (Figure 1).

The developed simulation model of the entire electric scooter covers the mechanics of the vehicle, which includes all the weights, rolling friction of the wheels, air-flow drag, gearing, braking system features and all the electrical components. The model was applied to the standardized European driving cycle (Figure 2).

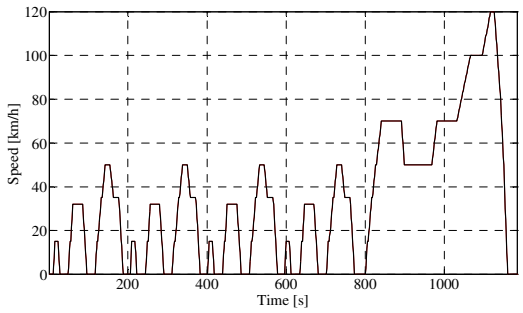

Figure 2. New European Driving Cycle (NEDC)

Based on simulation results, the power (Figure 3) to be used by the electric machine (Figure 4) and power-electronic converter features as well as battery capacity were determined. The simulation phase was followed by selecting components of the real propulsion system. At this stage, the Slovenian industry was invited to join the project. The response was positive.

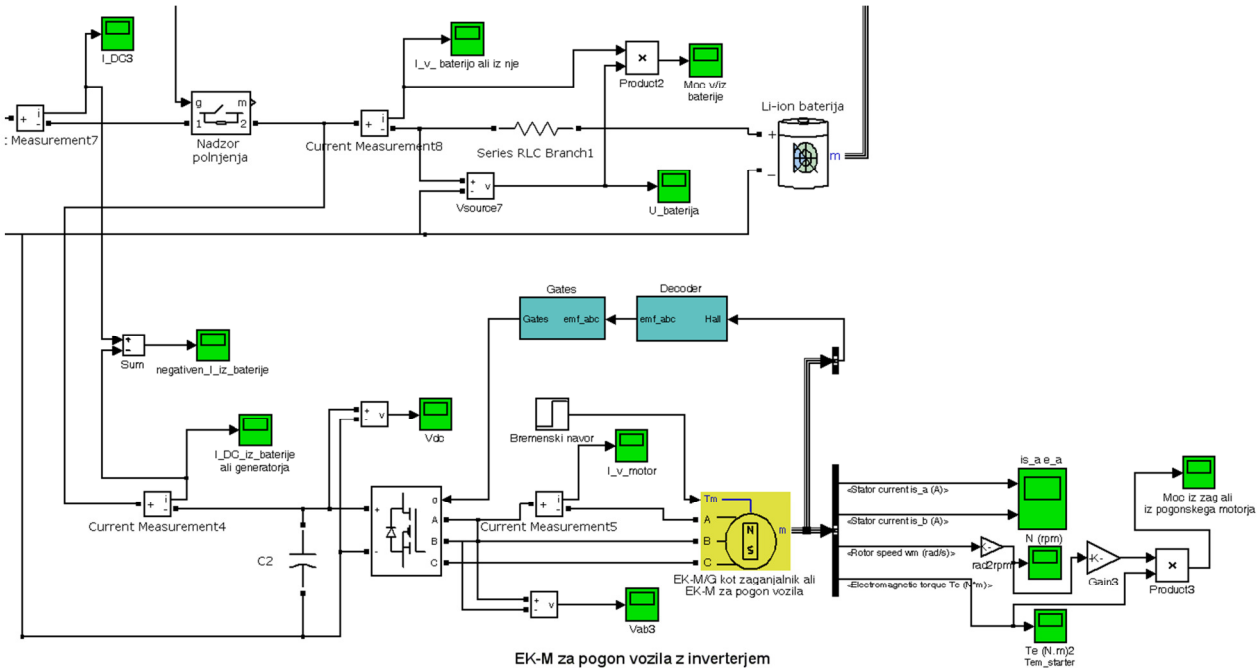

Figure 1. Part of the simulation model with electric machine, power-electronic converter and batteries

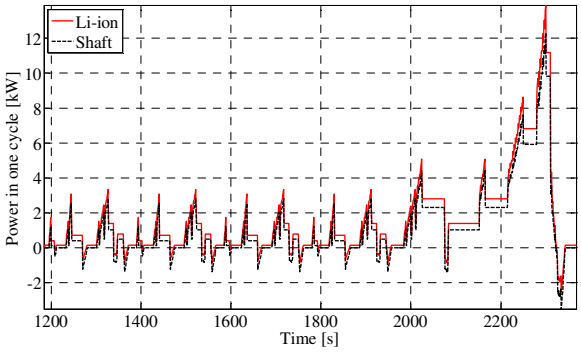

Figure 3. Power demanded by the electric scooter for the new European driving cycle.

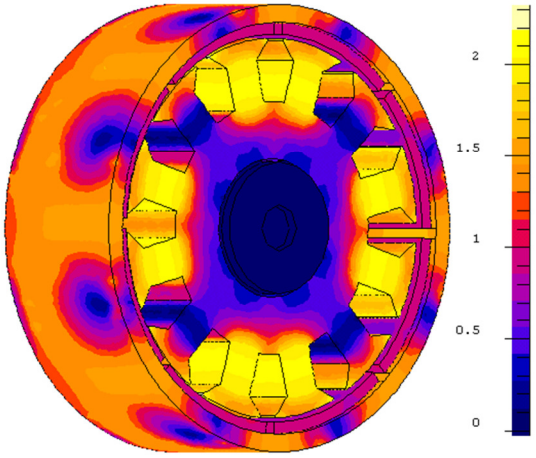

Figure 4. Magnetic-flux density in finite-element model of the electric machine.

Figure 5. Classic scooter equipped with the developed start / stop system.

Figure 6: Students at work.

The work of the team of students is not focused on the scooter bodywork but on a commercially available maxi scooter operating with an internal combustion engine. It is used as a prototype vehicle (Figure 5, 6). The students are mechanically adjusting the existing structure (Figure 6) and programming electrical properties of the driving system with regenerative braking.

Besides electrifying the vehicle another task assigned to the students will be increase the vehicle performance by adopting modern navigation systems. This particularly involves the use of GPS with topographic characterization of the driving landscape and information on the current traffic states. By using this data, better power-flow control and an increased driving range of the electric scooter will be achieved.

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