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Editorial

Modeling, Control, Optimization, and Analysis of Electrified Vehicle Systems

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Electrified vehicles such as battery electric vehicles (BEVs), hybrid electric vehicles (HEVs), and plug-in hybrids electric vehicles (PHEVs) significantly contribute to a sustainable transportation system by reducing consumption of fossil fuels and pollutant emissions. Electrified propulsion systems also facilitate renewable ways of generating electricity from wind, solar, and other alternative energy sources, which would result in a good synergy between transportation and energy sectors. Electrified vehicle technologies have been continuously improved owing to the advancement of powertrain modeling and simulation methodologies, system-level control and optimization, component sizing, lightweight design and integration, and mechatronic system diagnostics and prognostics, as well as economic and policy incentives, public awareness of energy sustainability/affordability, and environmental concerns. In terms of system-level analysis, a variety of optimization methods have been proposed to design advanced energy management strategies for HEVs/PHEVs, including dynamic programming (DP) [1], equivalent consumption minimization strategy (ECMS) [2], Pontryagin's minimum principle (PMP) [3], and convex programming [4]. In terms of component-level analysis, various identification approaches have been employed to parameterize high-precision battery models, including offline particle swarm optimization (PSO) algorithm [5], online least-squares method [6], and online extended Kalman filtering [7]. Model-based battery state monitoring techniques have also been intensively studied in both academia and industry [8–10].

The primary goal of this special issue is to provide timely solutions to technological and economic challenges in modeling, simulation, control, and optimization of electrified vehicle systems. The main focuses are on system-level modeling, optimization, and control, as well as component-level modeling and control, such as engine, electric machine, and energy storage.

For this special issue, 23 papers have been received, one of which has been withdrawn. After strict review processes, 15 have been accepted. The accepted papers cover a range of different aspects of automotive design and control. A brief summary of them is given as follows.

P. D. Walker et al. compared a single and a two-speed transmission system applied to electric vehicles, in which genetic algorithm was used to optimize the transmission ratios. B. Zhu et al. analyzed a two-speed dual clutch transmission (DCT) for electric drivetrain applications, in which the fundamental shifting control algorithm was experimentally demonstrated. Z. Lu et al. proposed a new solution of disc permanent magnet synchronous motor (PMSM) directly driven wheel for a low floor tramcar. C. Piao et al. proposed a fixed switching frequency sliding mode (FSFSM) controller and double-integral sliding mode (DISM) controller for two-stage dc-dc converter for electric vehicles. P. Michel et al. integrated a 3-Way Catalytic Converter (3WCC) into the PMP-based energy management of a gasoline HEV by minimizing the tradeoff between pollutant emissions and fuel consumption. Y. Yang et al. described a remote Controller Area Network Bus (CAN-Bus) data monitor and diagnostic system for HEVs by means of On Board Diagnostic version-II (OBD-II) and Android-based smartphone. M. Song et al. proposed an optimal line pressure control algorithm for the fuel economy improvement of an automatic transmission-(AT-) based parallel HEV. Y. Shi-chun et al. employed the PSSS (primary side series compensation and secondary side series compensation) model to explore the efficiency optimization of a high-power contactless power transfer (CPT) system, in which simulation and experiment were used to expose the main influencing factors of the system efficiency. C. Piao et al. proposed a new high-dimensional data stream outlier detection algorithm (DSOD) in order to effectively realize outlier detection in the realistic operation of battery system in electric vehicles. L. Zhang et al. elaborated on a parallelized parameter identification method for a thermal-electrochemical battery model with an obvious benefit in shortening the computational time involved. J. Li et al. proposed a combined particle filter (PF) and sample entropy method to estimate the remaining capacity for lithium-ion batteries. Z. Xing et al. employed an explicit nonlinear model predictive control (ENMPC) strategy to design a control law for a saucer-shaped UAV, based on a rigid 6-degrees-of-freedom (DOF) model. H. Ren et al. used unscented Kalman filtering to estimate the instantaneous vehicle speed, yaw rate, tire forces, and tire kinematics information in real time. Y. Sun et al. proposed a design method for a scientific and comprehensive test and evaluation system for autonomous ground vehicles competitions in China. L. Tang et al. portrayed a topology optimization model including ball joints and bushing for topology optimization of an aluminium control arm, where a ball joint was simplified as rigid elements, and the elastic properties of a rubber bushing were estimated using Mooney-Rivlin constitutive law.

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