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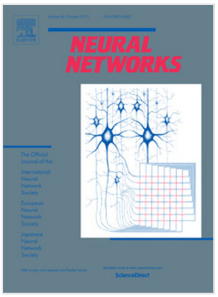

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Abstract

Simulation and positioning are very important aspects of computer aided engineering. To process these two we can apply traditional methods or intelligent techniques. The difference between them is in the way they process information. In the first case to simulate an object in particular state of action we need to perform entire process to read values of parameters. It is not very convenient for objects which simulation takes a long time, i.e. when mathematical calculations are complicated. In the second case, an intelligent solution can efficiently help on devoted way of simulation, which enables us to simulate the object only in a situation that is necessary for development process.

We would like to present research results on developed intelligent simulation and control model of electric drive engine vehicle. For a dedicated simulation method based on intelligent computation, where evolutionary strategy is simulating states of the dynamic model, an intelligent system based on devoted neural network is introduced to control co-working modules while motion in time interval. Presented experimental results show implemented solution in situation when a vehicle transports things over area with many obstacles, what provokes sudden changes in stability that may lead to destruction of load. Therefore applied neural network controller prevents the load from destruction by positioning characteristics like pressure, acceleration, stiffness voltage to absorb the adverse changes of the ground.

Keywords: Dynamic systems, Simulation and control, Decision support, Neural Networks, Heuristic Methods
2010 MSC: 37N05, 37F05, 00A72, 68U35, 78M32, 90C59

1. Introduction

Advances in Computational Intelligence (CI) give many possibilities to improve commonly applied methods of modeling, simulation and control. Instead of many experiments in reality we can simulate modeled object using computer machine, where proposed implementation simulates actions without unnecessary expenses in time, energy, money, etc. Nowadays we can proceed these numerical experiments even more easily without loosing precision in calculation since computer machines are much more efficient. Mainly during design process we must think about two important design aspects: gathering knowledge about the object we design and develop control methodology to maintain the object without damages. This situation is even much more complicated in case of dynamic objects, which mathematical models consist of many differential and integral equations, which in general demand complicated analytical approaches to solve them with necessary precision. However for both of these design aspects it is possible to implement CI methods that can co-work to build up efficient simulation and stabilization methodology, where CI can control parameters of dynamic systems with precision similar to analytical approaches. This was our motivation during research on presented methodology.

In general dynamic systems represent mechanical or mechatronical constructions where objects are modeled with various dynamic force dependencies, relations between pressure and dumping that occur during motion, equations of energy processes and models of other motion conditions which are represented in integral and derivative equations. Dynamic systems, like vehicles, vessels, compressors, suspensions, etc. in general are compositions of modules responsible for various aspects of stable work for which computational techniques can be used to optimize work conditions. That approach was discussed, i.e. by Smallwood and Whitcomb (2004) where developed devoted methods for underwater objects modeling were compared with traditional analytical approaches, while Nguyen et al. (2007) proposed hybrid controller design devoted for sea conditions. Sørensen (2011) presented extended survey of various models of dynamic control systems used in marine engineering. Uddin et al. (2005) discussed developed real-time evaluation for IPM motor drives, Rubaai et al. (2008) proposed devoted controller for high performance motor drives, and Zeng et al. (2016) discussed real-coded optimization methodology for PID controllers. Wang (2017) discussed control for dynamic object of uncertain states, which have many constraints important to evaluate. Computational Intelligence can be applied especially when we are interested in simulating various object