

## Discrete-Event Modeling and Simulation Methodologies: Past, Present and Future

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**Abstract :** Modeling and Simulation methods have been used to better analyze the behavior of complex physical systems, and it is now common to use simulation as a part of the scientific and technological discovery process. M&S advanced thanks to the improvements in computer technology, which, in many cases, resulted in the development of simulation software using ad-hoc techniques. Formal M&S appeared in order to try to improve the development task of very complex simulation systems. Some of these techniques proved to be successful in providing a sound base for the development of discrete-event simulation models, improving the ease of model definition and enhancing the application development tasks; reducing costs and favoring reuse. The DEVS formalism is one of these techniques, which proved to be successful in providing means for modeling while reducing development complexity and costs. DEVS model development is based on a sound theoretical framework. The independence of M&S tasks made possible to run DEVS models on different environments (personal computers, parallel computers, real-time equipment, and distributed simulators) and middleware. We will present a historical perspective of discrete-event M&S methodologies, showing different modeling techniques. We will introduce DEVS origins and general ideas, and compare it with some of these techniques. We will then show the current status of DEVS M&S, and we will discuss a technological perspective to solve current M&S problems (including real-time simulation, interoperability, and model-centered development techniques). We will show some examples of the current use of DEVS, including applications in different fields. We will finally show current open topics in the area, which include advanced methods for centralized, parallel or distributed simulation, the need for real-time modeling techniques, and our view in these fields.

**Keywords :** modeling and simulation, discrete-event simulation, hybrid systems modeling, parallel and distributed simulation

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