

# Learning from Simulations

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**Abstract:** Simulations have become the primary means for modeling and analyzing complex systems. They are used in areas such as medicine and biomechanics to model organs, as well as, for air frames to analyze design improvements through the use of finite elements. Agent-based simulations have become particularly useful as way to analyze complex systems. While simulations have proven their worth in a variety of domains, their popularity has created new requirements to analyze and manage the large amounts of data they produce. This presentation describes new methods for using data mining and knowledge discovery techniques to learn from simulations. The new approach extends response surface methodology to enable learning from simulations, particularly agent-based simulations, where the number of control variables can be quite large. Traditional response surface methods are limited in the number of variables they can handle and the types of models that can be developed. We show that the extended response surface techniques can dramatically increase the number of variables that can be modeled and that data mining techniques such as tree-based regression and splines can create non-linear fits that enable function approximation across large regions of interest. Finally, we combine data mining with search techniques to optimize or improve the performance of the system under study. As an additional benefit the extended response surface methodology provides a new approach to validating simulations. This presentation will cover both theoretical and practical aspects of extended response surface methods for learning from simulations, and will demonstrate the use of the method in conjunction with an agent-based simulation of first responders in an emergency medical situation.