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INTERACTIVE ON-THE-FLY SIMULATORS: BENEFITS, ADVANTAGES AND APPLICATIONS

ABSTRACT

Interactive on-the-fly simulators offer key advantages over traditional simulation tools in all aspects of a simulation project life cycle. Unlike traditional simulators that require constant starting and stopping of the simulation engine to validate and develop models, interactive on-the-fly simulators allow for model development while the simulator is running. This new breed of simulation impacts model development, model validation, environment optimization, and provides a path to real-time self-modifying simulation models. Moreover, the interactive component of the new simulators allows for additional uses of the completed model such as employee training, risk mitigation, and real-time optimization.

Simulation projects are normally divided into 5 key milestones: simulation goal definition, model development, model validation, model analysis and optimization, and model visualization and presentation. Each milestone provides an important step that builds upon the previous one and sets up the success of the next one. All are interconnected, and contribute to the overall success of the simulation project.

Interactive on-the-fly simulators impact 4 of the key milestones that contribute to the success of the simulation project. During the model development phase, interactive simulators allow the simulation modeler to test and validate the changes to the model in real-time. As changes are applied to the model, the interactive simulator renders the implemented constraint in real-time through an integrated animation engine. The provided real-time feedback allows the modeler to validate the constraint change, assess the impact of the change, and better understand the model behavior. This process reduces the amount of simulation restarts and time waiting for the warm up state to complete. It also allows the modeler to quickly implement the changes, import new data, and test out different distributions.

At the model validation phase the modeler concentrates on the true behavior of the model, because all model changes were tested and validated in the model development milestone. An interactive on-the-fly simulator enables the model to run based on either distribution, actual loaded data sets, or a combination of both. Hence, the model can use existing historical data to validate the current model state, with a validation accuracy of 99.5% or higher. Presenting the model's current state using historical data also builds confidence in the simulation model audience and in potential end users of the results. The overall validation cycle is reduced by 30% to 60% depending on the actual implementation.

The model analysis and optimization phase also benefits from the ability to modify the model during the simulation run. The modeler can experiment with different scenario and play the "what if" game, live while the simulation is running. Whether the change requires adding equipment, modifying resource constraints, or changing speeds and cycle times, the simulation modeler is able to make the changes during the run, understand the impact of each, and generate a better optimization path for an improved flow. Another benefit consists of the knowledge that the modeler gains about the cause and effect of each constraint. Hence, the modeler becomes an integral part of the decision making process and minimizes the risk of the effect of change.

During the model presentation and visualization phase, interactive on-the-fly simulators allow the modeler to make quick changes and modifications to the model during the presentation. The simulation project end users are exposed to the real effect of each constraint by allowing them to experience the effect of each constraint in real-time.

Interactive on-the-fly simulators also have the ability to self-modify the model during the run. A properly constructed interactive model has the ability to add, modify, and delete constraints based on internal artificial intelligence algorithms. A model can detect, during the run, that a specific scenario requires the addition of a new station, adds the station, configures the station, and continues the simulation without stopping the simulation engine. This type of behavior becomes a critical part of any future optimization or scheduling implementation by allowing the models to self-evolve. The industrial applicability of such an environment is mainly seen when simulation is used beyond the initial simulation project goal, expanding the usefulness of the modeling effort. Self-modifying models can detect a change in the real-time environment and apply the change onto the model when simulation is used as a tool by an inexperienced user or as a background task constantly monitoring and optimizing a flow. This allows the models to constantly update themselves based on data and constraint changes without human interaction.

Developed and validated simulation models can easily be turned into interactive training tools. Specific scenarios may be applied to the model through external interfaces while allowing trainees to react and resolve the situation on the simulator. Interactive on-the-fly simulators have the ability to receive user input during the model run and modify the internal flow based on it. Mouse clicks and keyboard interfaces are handled during the simulation run, with the simulator reacting to the input and rendering the new model state. The completed solution can provide training for employees, both old and new, on new changes and the proper flow behavior.

Interactive on-the-fly simulators play a major role in providing real-time optimization and visibility of the implementation with the widespread adoption of IOT in today's industry. Multiple simulation models may be working together to provide extensive predictive and prescriptive analytics while providing valuable data to dashboards and real-time metrics, making the simulation environment an integral part of the overall solution.

Real-time simulation analysis interacts with real-time data (PLCs, RTLS, SAP, WMS, ERP, etc.) and constructs a current state view of the operation in real-time. Interactive on-the-fly simulation allows for all simulation models to collaborate in order to provide a detailed representation of the near future of the operation. Data is then provided to alerts and dashboards to be displayed to prospective users, in real-time. Interactive on-the-fly simulators are the only simulation environment that can effectively provide those benefits with minimal modeler effort.

Interactive on-the-fly simulators are being used to improve scheduling, optimize the flow, and provide simulation benefits to less experienced personnel. Using their internal self-modifying behavior, this new breed of simulation environments can learn from model changes and an input dataset to reconfigure

themselves and represent current constraints. Moreover, they provide all the required integration points for IOT and Industry 4.0. Interactive on-the-fly simulation will transition to be an integral part of every implementation by allowing models to interact and self-adapt during the simulation run. It provides a defined and robust path to transition existing simulation models to be part of the real-time optimization of every operation.

References

Book

Simcad Pro – Interactive, On-The-Fly simulation engine.