Integrating Operations Simulation Results with an Immersive Virtual Reality Environment

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Objective

To develop a post-processed link between a discrete event simulation of an assembly line and a fully-immersive virtual reality (VR) environment.
Definitions

• **Discrete-event simulation** – a simulation in which the state of a model changes at only a discrete, but possibly random, set of simulated time points (T. Schreiber, 1997).

• **Virtual Reality** – a computer-generated three-dimensional environment, which can be interactively manipulated by the users (Barfield & Furness, 1995).
Assembly Line Simulation at Deere

ALiSS (Assembly Line Solution Set) is a discrete-event simulation model developed by Deere & Co., which relies on the following components for its functionality:

- Wolverine’s SLX (*Simulation Language with Extensibility*) for its simulation engine capabilities
- Microsoft’s Excel for the user interface
- Wolverine’s Proof Animation software for post-processed animation of the simulation results.
Why switch to VR?

Limitations of the traditional simulation animation packages:

• Two-dimensional, schematic layouts
• Simple object geometry
• Limited object interrogation
• No direct human-model interaction
Current State of VR simulation

VR-Fact – virtual environment for modeling and designing factories and shop floors (Kesavadas and Ernzner, University of Buffalo).

VRFFactory – an interface to a commercial discrete event simulation software (SLAM II) (Vance and Kelsick, Iowa State University).
Expansion of ALiSS to VR

• A new, independent SLX module has been developed and integrated into the ALiSS existing code.
• The new module
  – selects relevant information from ALiSS
  – passes it to an output ASCII file (VRF file)
• Selected information includes:
  – assemblers starting/ending tasks
  – parts arriving/leaving work stations
  – status of assemblers, parts, and vehicles
The immersive VR environment

General-purpose fully-immersive VR application for interactive post-processing the results of a discrete-event simulation created by ALiSS.

Capable of investigating a wide variety of assembly lines and corresponding scenarios.
VR Components

Simulation Data (VRF file)

Path Layout Data

Geometry Data (CAD models)

Main Application Modules
  • Graphics
  • Data Processing
  • Logical
  • Interaction
Application Testing

• A tractor assembly line was chosen to test the post-processed link between an ALiSS simulation and the immersive VR environment.

• The focus of the analysis is on a single station, where transaxle and frame are assembled to form the tractor chassis.
Conclusions and Future Work

The next project phase will effectively insert dynamic user input as a part of the simulation model.

The project long-term goals are:
• Pave new avenues for concurrent product and process design
• Create a virtual assembly training process and a virtual manufacturing laboratory
• Increase the ‘speed to market’ of new products.
Acknowledgements

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