

# **Integrating Operations Simulation Results with an Immersive Virtual Reality Environment**

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# Objective

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



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# Definitions

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- **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).



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# Assembly Line Simulation at Deere

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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.



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# Why switch to VR?

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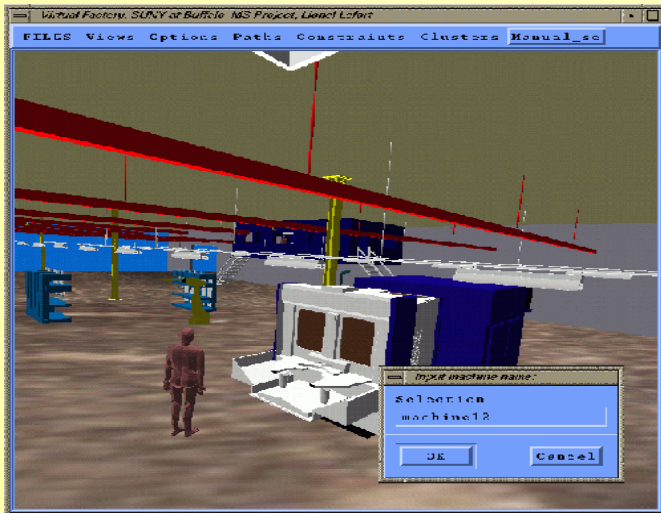
Limitations of the traditional simulation animation packages:

- Two-dimensional, schematic layouts
- Simple object geometry
- Limited object interrogation
- No direct human-model interaction



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# Current State of VR simulation



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

**VRFactory** – an interface to a commercial discrete event simulation software (SLAM II) (Vance and Kelsick, Iowa State University).



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# Expansion of ALiSS to VR

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- 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



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# The immersive VR environment

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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.



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# VR Components

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**Simulation Data**  
*(VRF file)*

**Path  
Layout  
Data**

**Geometry Data**  
*(CAD models)*

**Main Application Modules**

- Graphics
- Data Processing
- Logical
- Interaction

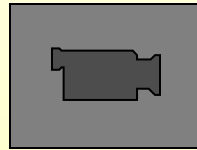


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# Application Testing

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- 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.



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# Conclusions and Future Work

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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.



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# Acknowledgements

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Deere & Company

Virtual Reality Applications Center

Iowa State University

[www.vrac.iastate.edu](http://www.vrac.iastate.edu)



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