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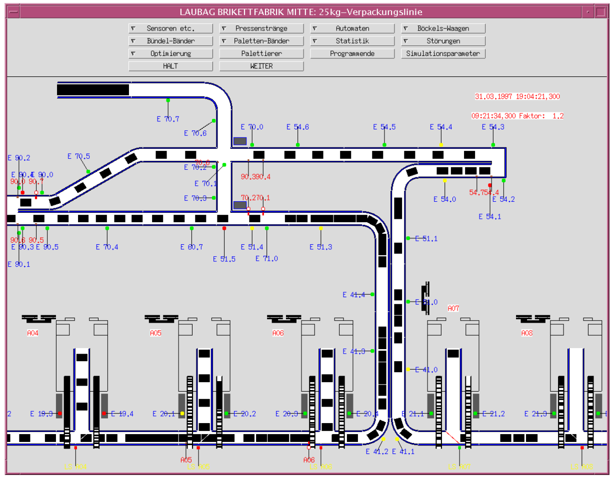
Why is simulation so important?

Real world problems in the field of production planing and process control often lead to dynamic and nondeterministic optimization problems. Computer simulation as part of computer integrated manufacturing (CIM) is a powerful tool to improve the efficiency of the industrial production.
To improve the output rate of a complex packing process for brown coal briquette bundles at factory “Mitte” of the East German brown coal industry (Lausitzer Braunkohle AG, LAUBAG) we designed a simulation system combining statistics, visualization and optimization routines using state-of-the-art object-oriented software design techniques.
Due to our simulation studies it was possible to realize a strong increase of the production output of the plant [1]-[3].



Visualization of transport streams

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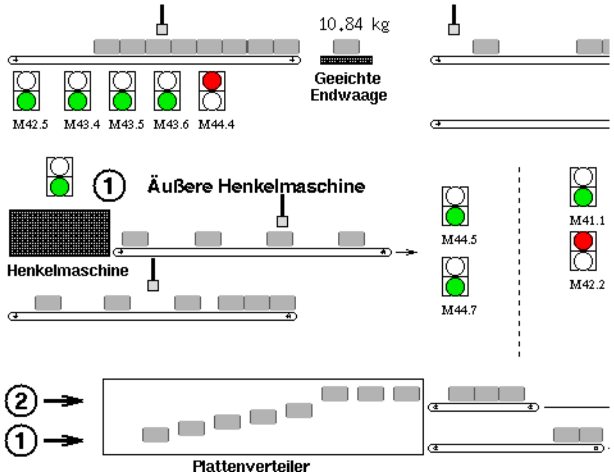
Can simulation help to solve your problems?

Simulation has long been used in the design of manufacturing systems - to specify the layout, select resources and buffer sizes, create routings, optimize scheduling, and define the number and type of operators needed.



Another example of visualization

But our simulation goes far beyond this in developing the logic to control factory systems, thus spanning the areas of control and simulation engineering.
With our simulation environment conveyor systems, robotic cells, and manual assembly stations can easily be simulated.
It also serves as a model for factory code validation.
This means that simulated real sensors and actuators are as close to reality as possible.

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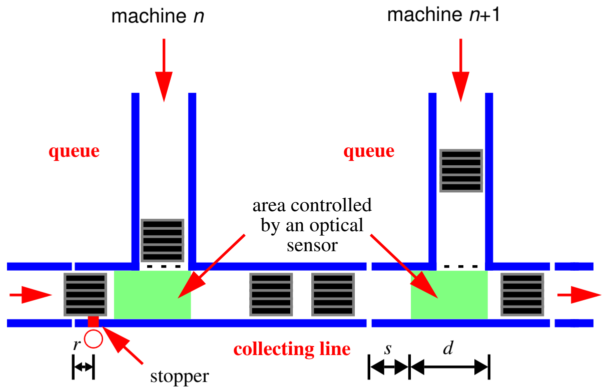


Intersection of queues and collecting line. One of the skids that may lead to unwanted limitations of the production capacity.

Features of our simulation system

Object-oriented graphical user-interface: The user may set and change parameters during the simulation by a pop-up dialogue box of the requested graphical object.
Integrated modelling and simulation: All mechanical gadgets, sensors and actuators are involved in the simulation with their corresponding physical and logical properties, e.g. conveyor systems, photoelectric barriers, stoppers.
On-line visualization: The current state of the plant can be visualized, quantified and analyzed at the same time.
Statistical analysis: Various statistics of simulated or recorded data can be calculated and plotted.
Adjustable speed: The simulation can be run in real-time speed or up to 30 times faster.
State of the art software techniques: Object-

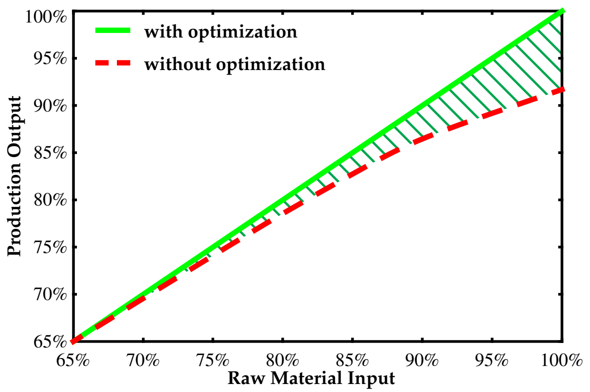
oriented techniques, e.g. inheritance, facilitate the adaptation to other problems.

Optimization: In order to optimize the various parameters of the plant the simulation is linked together with suitable optimization routines.

PLC Programming: There's no difference between input to control the simulation models or an actual factory system. As long as the simulation is written to emulate all the I/Os of the actual system, the PLC program can be fully written, debugged, and tested in the simulated environment.

The key to a complete solution

An increase of the production output can often be realized as is shown below for a project with one of our industrial partners.



Production output before and after parameter optimization

References

[1] J. Biedermann, L. Cromme, L. Rhede, K. Weber, and S. Würll. "Simulation and Optimization of a Production Process in Brown Coal Industry", Reihe Mathematik M-07/97, Technische Universität Cottbus, 1997

[2] L. Rhede. "Früher per Hand, jetzt elektronisch geregelt", LAUBAG report 8, No. 3, p. 4, 1997

[3] S.Würll, J.Biedermann, L.Cromme, and K.Weber. "Optimization of Quality Checks in a Fully Automated Production Process", Reihe Mathematik M-08/97, Technische Universität Cottbus, 1997

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Related Research Activities

- Application of Fuzzy techniques in modelling and control
- Real-time colour image processing for industrial quality checking purposes
- Optimal design of heat or power supply networks by means of Genetic Algorithms
- Practical applications of partial differential equations (FDM, FEM and BEM) in CAD
- Training algorithms for recurrent Artificial Neural Networks

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Process Simulation and Optimization