

ARENA Success-Story Sigpack Systems AG

The Company

The Company is the global leading supplier of packaging systems and machines for piece goods and free flowing goods. It is concentrated on packaging technology, handling, automation and process equipment for the pharmaceutical, food products and confectionery industries.

Recent developments had been focussed on Delta Robot packaging lines, which are ideal to perform operations that are monotonous and repetitive, but very demanding in terms of speed, precision and particularly the sensing of products and pick and place strategies.

Examples are online processes with heavy product flow like loading of cookies into trays, and offline processes for the manufacture of mixed packs like assorted pralines and lunchables.

Standard applications feature 4 to 24 robots which are capable of packing up to 2400 products per minute.



The Challenge

The challenge when designing a Delta Robot packaging line is to optimize efficiency, expressed as „Number of packed products in relation to the required resources“.

Calculations seem to be simple at first glance, as one could assume that the number of products to be packed divided by the number of products each robot is capable to pack equals the number of robots. However, there are boundary conditions and external disturbances which prevent the packaging line to be designed that easily:

On the contrary to systems with a constant and evenly distributed product flow, production processes of Delta Robot packaging lines can be very irregular with high fluctuations. Especially short-time, high amplitude variations of the product and tray flow result in almost unpredictable behaviour. Thus, if calculations are based only at a rough estimate, the installation of excessive over-capacity might be necessary in order to guarantee that every product is being packed.

Moreover, as with human beings, the performance of a team of robots can be optimized by not only improving the performance of an individual, but by implementing specific strategies which aim on optimal distribution of the work-load on all robots, called “line balancing”. Depending on the task to be fulfilled, different strategies lead to the best result.

As a result, for simulating Delta Robot packaging lines, a discrete event simulation tool such as *ARENA* should be capable of answering following questions:

Questions on system level:

- How many robots are necessary...
 - to pack all products?
 - to compensate breakdowns or interruptions?
 - to fulfil special boundary conditions (e.g. convert an uneven incoming product flow to a regular output for downstream machines)
- What is the optimal workarea and position of each robot?
- What is the optimal size and speed of the product presentation band?
- Preferred communication strategy between the robots?
- What are the best breakdown handling strategies? Does a buffer, one more robot, a second tray belt etc. improve the efficiency?

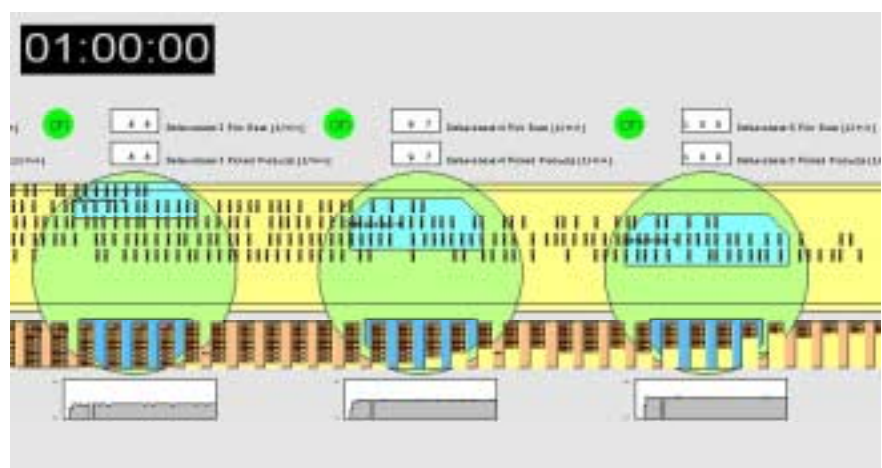
Questions on robot level:

- Pick strategy:
 - „Which product should be picked next?“
 - Of all products being in the pick area of the robot, the one product that is most advantageous with regard to the total efficiency must be selected.
- Place strategy:
 - „Which position in the tray should be filled next?“
 - Of all place positions being in the place area of the robot, the one position that is most advantageous with regard to the total efficiency must be selected.

Deliverables

A special *ARENA*-based software tool box for Delta Robot packaging lines was created by *SAT Simulations- und Automations-Technologie GmbH*, Freiburg, Germany, including all the specific components with their describing parameters which are necessary to simulate such lines: robots, product band, tray band, buffers, pick & place strategies, special control and communication strategies, and costing information.

All components of this Delta Line Tool Box are represented by icons, which allow the logic of the line to be set up very quickly, functional and clearly arranged just by dragging and dropping. Moreover, the automatically built graphic online animation is extremely helpful to control and understand the function and behaviour of the line.



Results

With the Delta Line Tool Box, it is now possible to get quantitative and comparable results in a very early stage of designing a Delta Line. Different concepts can be evaluated under specific, customer related conditions. Several projects already proved the Tool Box's capability to answer questions and set up concepts that could not have been solved or would not have been taken into account without the Arena simulation.

Moreover, as the optimal control strategies are identified beforehand, the time and labour costs to put the plant into operation can be reduced significantly.

Last but not least, the online animation is extremely helpful when presenting the concept of the packaging line to the customer – as pictures say more than words, moving pictures say all the more to optimize and help Sigpack Systems optimize manufacturing costs and profits.