DESIGN BETTER ROBOT WORK CELLS WITH VISUAL COMPONENTS

In this eBook, we’ll give you a quick and general overview of the steps in the OLP process, particularly as it applies to the planning and design of a new robot work cell.
Introduction to the OLP Process

Planning and designing a new robot work cell can be a challenging project for even the most experienced engineers. There are lots of moving pieces, trade-offs that need to be considered, and usually tight deadlines.

**Offline programming (OLP)** software is becoming an increasingly essential tool for manufacturing professionals charged with planning new robot work cells; and it’s being used for much more than developing the robot program.

OLP software helps with:

- planning and optimizing the work cell design
- virtually commissioning the robot
- accelerating the time to production.
OLP software uses 3D CAD data to create a virtual model of the robot and work cell, and simulate the processes and workflows inside and outside the cell – a powerful tool for engineers and planners to evaluate trade-offs and make better decisions.

**HOW DOES OLP SOFTWARE PROVIDE A MEANINGFUL RETURN ON INVESTMENT FOR AUTOMATION PROJECTS?**

- Saving time
- Improving productivity
- Identifying opportunities for cost savings
Steps of the OLP Process

There are many approaches and strategies to OLP, and we’re not advocating for one approach over another. The process we’re describing is adapted from a paper, which can be found here (1).

Overview

01 Generation of Models
Create a virtual model of the work cell.

02 Tool Path Generation
Extracting robot positions from 3D CAD data with a TCP.

03 Process Optimization
Trajectory planning, process planning, tooling design.

04 Post Processing
Convert robot program into the language of the targeted robot.

05 Initial Calibration
Calibrating errors between the work cell and virtual model.

Steps of the OLP Process

1. Generation of Models
2. Tool Path Generation
3. Process Optimization
4. Post Processing
5. Initial Calibration

1 GENERATION OF MODELS

The first step to OLP is to create a virtual model of the work cell. This involves creating or obtaining 3D CAD models of the equipment, work pieces, enclosure, tools, and other resources and fixtures that will be in the work cell; and importing them into your OLP software.

There may be extra steps in order to simulate resources and processes, depending on the OLP software being used. Accuracy of the models and process related information used is critical to generating a reliable simulation of the process and error-free offline program for the robots.

Take advantage of our extensive component library. With 1,400+ robots from more than 40 of the largest brands in industrial automation, Visual Components offers its users one of the most substantial libraries of predefined components in the industry, at no extra cost!

Browse through the Visual Components web eCatalog and see for yourself!
Steps of the OLP Process

1. Generation of Models
2. Tool Path Generation
3. Process Optimization
4. Post Processing
5. Initial Calibration

2 TOOL PATH GENERATION

Tool path generation involves extracting robot positions from 3D CAD data with a specific tool center point – the point in relation to which all robot positioning is defined. Many OLP software packages can do this automatically, and have built-in functions to automatically generate paths from features of the CAD models, such as corners, edges, or other geometry features.

With Visual Components, you can create programs that define the actions and routines to be performed by an industrial robot. This can be done by virtually teaching the robot positions, or by using the curve-teaching tool to generate paths.

The curve-teaching tool greatly simplifies the robot path teaching process. It analyzes object geometries, makes path predictions, and suggests robot paths. It then automatically generates the statements in your robot program code.

The key to this is virtual topology. When a CAD model is imported into Visual Components, our 3D geometry engine analyzes the model and provides structured data of the geometry’s surfaces, curves, and curve loops. The curve-teaching tool uses this data to make its path predictions and suggest robot paths.

Read more: Robot Teaching with Visual Components
Steps of the OLP Process

1. Generation of Models
2. Tool Path Generation
3. **Process Optimization**
4. Post Processing
5. Initial Calibration

### 3 PROCESS OPTIMIZATION

Process optimization incorporates trajectory planning, process planning, and tooling design. It’s an iterative design loop with a number of factors and trade-offs that need to be considered.

**HOW DOES SIMULATION SIGNIFICANTLY HELP WITH THIS PROCESS?**

1. **Trajectory Planning** involves determining the best route for the robot to make, from Point A to Point B.
2. **Process Planning** involves planning the processes and workflow in the work cell.
3. **Tooling Design** involves the selection, modification, and placement of tools.

With the Visual Components "Simple Robotics" toolkit, users can intuitively teach tasks to a robot and validate the design of the robot work cell. Simple robotics has built-in features for robot jogging, analyzing reachability and collisions, and defining robot logic and postures with control flow statements.

Read more: [The Simple Robotics Toolkit](#)
Steps of the OLP Process

1. Generation of Models
2. Tool Path Generation
3. Process Optimization
4. Post Processing
5. Initial Calibration

POST PROCESSING

After the robot program has been verified in the simulation environment, it needs to be implemented to the real robot. But first, the program must be converted into the language of the target robot. This step is called post processing. Post processors; the drivers that convert the robot programs; need to be created to perform this conversion. Post processors are specific to the robot brand, application, and other customer specific requirements for safety, usability, performance, etc.

CUSTOMIZATION

Post processors require some customization for your specific application and setup, and it is rare to develop these from scratch. About 80% of the commands are the same for each post processor. What does change is the local customization for each application, customer specific requirements, and special macro commands that have to be called at the beginning or end of a program.
Steps of the OLP Process

1. Generation of Models
2. Tool Path Generation
3. Process Optimization
4. Post Processing
5. Initial Calibration

**5 INITIAL CALIBRATION**

Initial calibration involves calibrating errors between the work cell and virtual model, and updating the virtual model to match. The goal is to ensure the offline program is running at 100%, with no unplanned operator intervention.

Calibration is performed using a tool center point on the shop floor.

Depending on the application, it’s also possible to calibrate without using a tool center point; as an industrial robot can be used as its own coordinate measuring machine to determine the relative positions of critical components in the work cell.

It’s not always necessary to perform initial calibration offline; it can also be done in the production environment.

For example, in robotic spot welding, there are usually around 10 to 20 points that need to be programmed in the robot. It would be much faster to have the operator calibrate the robot versus doing it offline. Similarly, in arc welding, there’s lots of variation between work pieces, and robots use vision sensors to compensate for work piece errors.
SUMMARY

In this eBook, we provided a quick and general overview of the steps in the OLP process. OLP isn’t just developing a robot program; it’s a process for designing and planning an entire robot work cell. OLP software helps manufacturers design better production solutions by allowing them to evaluate and visualize the many requirements, constraints, and tradeoffs in the OLP process.

**Visual Components Premium** includes advanced features and capabilities for manufacturers and OLP specialists involved in the planning of new robot work cells. It’s used by several leading manufacturers to design and commission advanced robotic work cells and speed their time to production. The **Visual Components platform** is also used to power commercial OLP tools that are in use by hundreds of leading manufacturers worldwide.
If you’re interested in learning more about how Visual Components can help you plan your next robot work cell, contact us to schedule a free product demonstration!