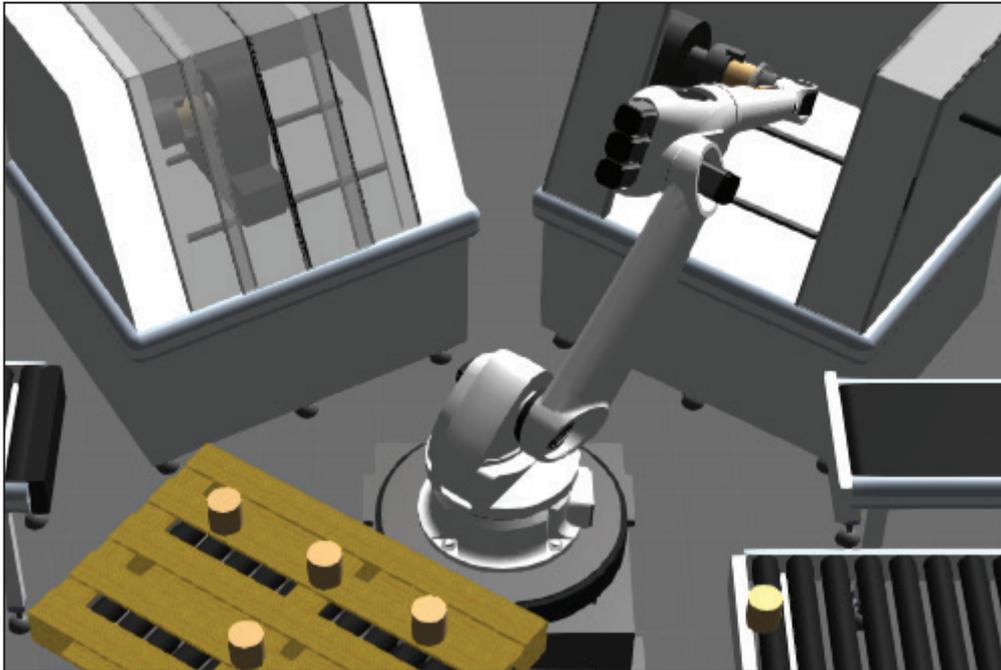


Quick Start for Machine Tending Library

Essentials | Version: August 22, 2016



The Machine Tending library allows you to build and test machine tending operations using robots and human workers.

This guide provides an overview of key components in the Machine Tending library and how to simulate common tasks in machine tending operations.

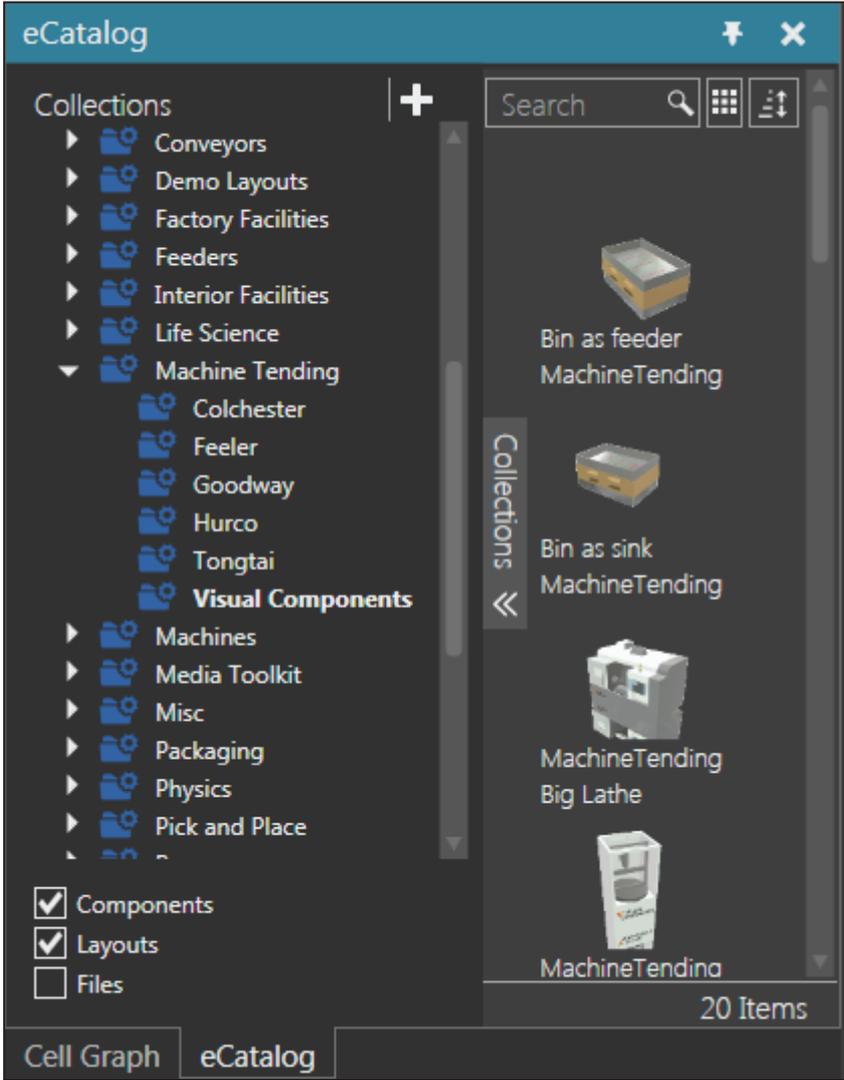
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Find Components

Components in the Machine Tending library are available in the Visual Components Web eCatalog.

- In the eCatalog panel, Collections view, expand **Models by Type**, and then expand **Machine Tending**, and then click **Visual Components**.



About Components

Components in the Machine Tending library are customizable and parametric, thereby making them flexible enough to simulate a variety of machine tending operations. Most machine tending layouts will use one or more of the following components.

Machine Tending Inlet

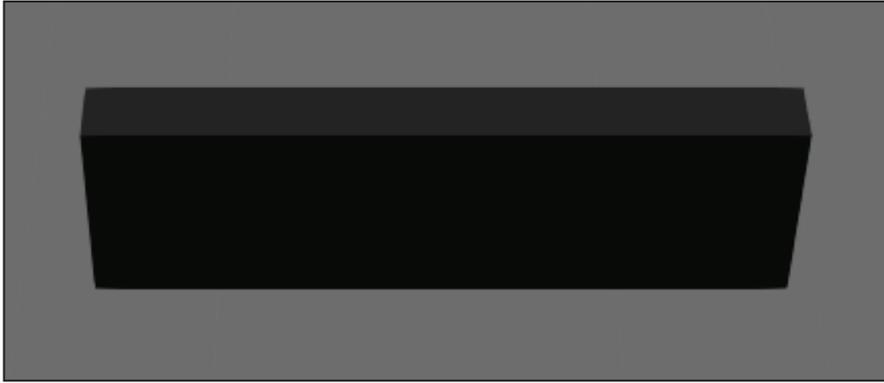


An Inlet stops the movement of a component on a path, and then requests from a manager that a resource move the component to the next step in a process. An Inlet can be connected to the output of a path or connected as a process point sensor at some distance along a path.

Important properties are:

- **BundleMode** - Indicates if an arriving component is a bundle of two or more components attached to another component, for example a stack of parts.
- **BundleWithPallet** - Indicates if an arriving component is on a pallet, thereby manager instructs resource to depalletize components.
- **ResourceLocationDistance** and **ResourceLocationAngle** - Define the location where a worker stands to pick up a component from the Inlet.
- **TriggerComponentArrivalAt** - Defines when the Inlet should stop an arriving component based on its geometry or origin. That is, you are defining how the sensor of the Inlet is triggered by a component.
- **ProcessIndex** - Defines the order of the Inlet in a process. Generally, an Inlet is the starting point of process, so its default index value is zero.
- **WriteProductID** - Defines if the Inlet writes the product id of an arriving component or pallet using a set of dynamic properties.
- **PassThruRouting** - A section of properties for defining how to route arriving components.

Machine Tending Outlet

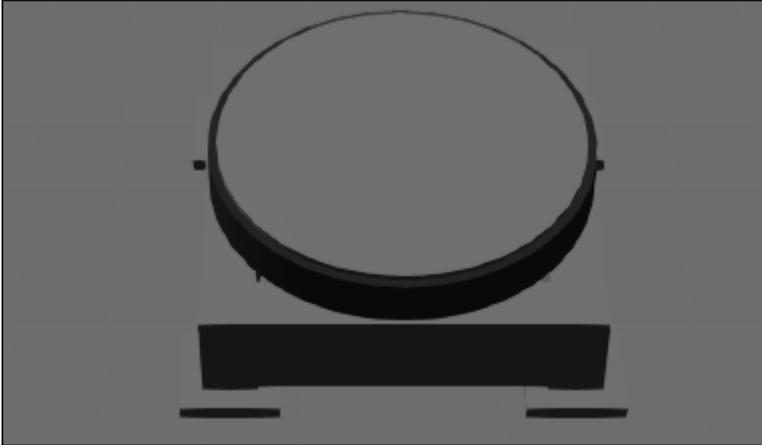


An Outlet is a location for transporting processed components or pallets that are waiting for processed components. An Outlet can be connected to the output of a path or connected as a process point sensor at some distance along a path.

Important properties are:

- **ProcessIndex** - Same as Inlet. Generally, an Outlet is the end point of a process, so its default index value is 99999.
- **ResourceLocationDistance** - Same as Inlet.
- **WorkPart_OffsetX** - Defines an offset along the X-axis of path in Outlet where part is to be placed by resource.
- **ApproachFrameOffsetZ** and **ApproachFrameOffsetX** - Define approach distances for placing a component at the Outlet, which are mostly used by a robot.
- **ProductID_filter** - Filters which components can be placed at the Outlet by their ProdID property. For example, if the ProdID property of a component was not listed in the ProductID_filter property of an Outlet, the component would not be placed there.
- **TestConnectedCapacity** - Defines if the Outlet tests the capacity of a connected, outbound path before transferring a component out of the Outlet and into that path.
- **MainPath** - A group of properties for controlling the path in Outlet.

Machine Tending Robot Manager



A Robot Manager is used to control a robot used as a resource for picking and placing components in a machine tending process.

Important properties are:

- **OnFlyProgrammingMode** - Defines if motion targets for picking or placing a component are given directly to a robot or are written in its program as motion statements.
- **Use ProductID filtering** - Turns on/off the use of product id filtering in components connected to manager.
- **Prioritize upstream tasks** - Turns on/off the ability of the robot to make the robot prioritize tasks that move components further along in a process. For example, a robot may disregard a transport task from an Inlet and instead execute a transport task from a machine to an Outlet.
- **Track** - A group of properties for controlling a robot connected to a track that extends its workspace.
- **Failure** - A group of properties for managing the time between failures and the time to repair failures in a connected robot during a simulation.

Machine Tending Resource Manager

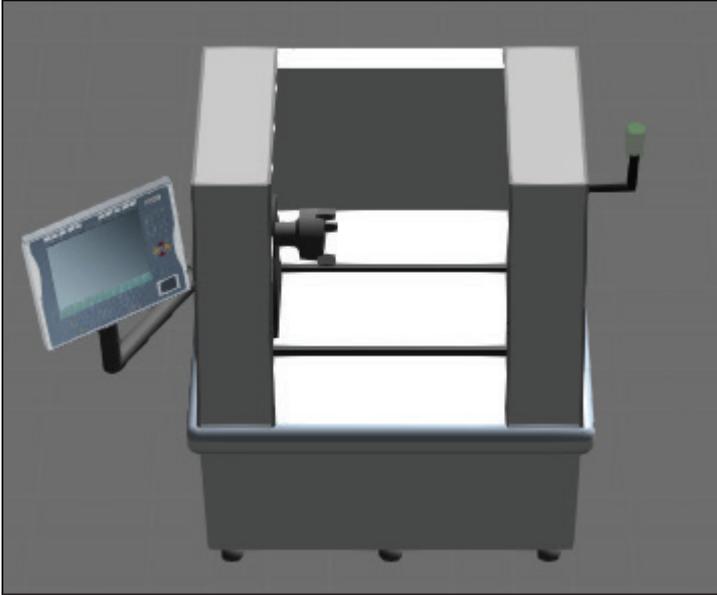


A resource manager is used to control and assign tasks to human workers in a machine tending process.

Important properties are:

- **AvailabilityCriteria** - Defines the mode for assigning a task to a resource, for example the closest available human worker or one who has done the least amount of work.
- **ShowPathways** - Turns on/off the visualization of a walking path for a human worker when performing a task.
- **Use ProductID filtering** - Same as Robot Manager.

Machine Tending Process Machine



All types of Machine Tending Process Machine components are used to execute a timed process during a simulation. In some cases, a process machine might be designed to be operated by a human worker. In other cases, a process machine might be designed to support a PLC connection.

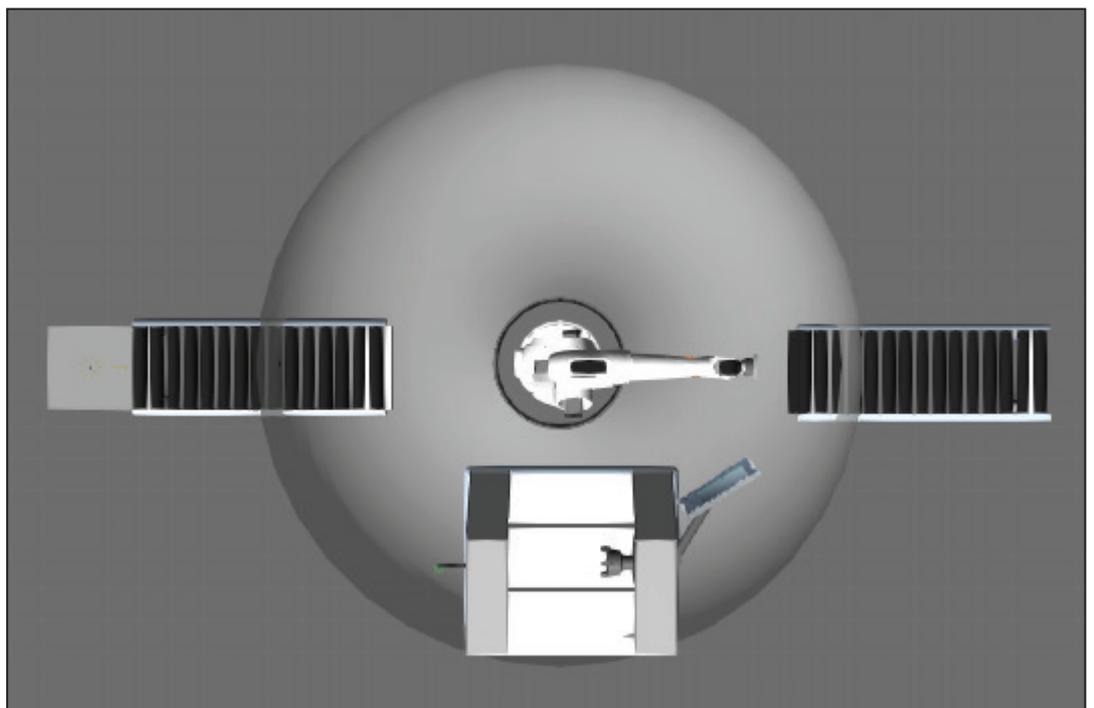
Important properties that may vary in name are:

- **Doors** - Defines the joint value of doors on the machine.
- **ShowPanel** - Turns on/off the display of a panel used by a human worker.
- **UseOperator** - Indicates if the machine requires a human worker to operate it.
- **OperatorWorkTime** - Defines the amount of time a human worker spends at the machine the operate it.
- **ProcessIndex** - Same as Inlet. Generally, a machine comes after an Inlet and before an Outlet in a process. In some cases, several machines share the same process index value. In other cases, two machines may come after one another in a process, and a machine might perform a tool change before completing a series of tasks, for example a machine that can perform both boring, milling and buffering of parts.
- **ProductID_filter** - Same as Outlet.
- **ProcessContainer** - A group of properties for defining how many components can be in the machine at one time.
- **Failure** - Same as Robot Manager.

Build Layout

A common machine tending layout uses a robot for safety reasons.

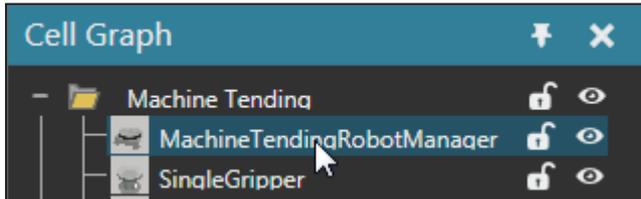
1. Add a **Machine Tending Robot Manager v3** to the 3D world origin.
2. In the eCatalog panel, Collections view, under Models by Type, expand **Robots**, and then click **Visual Components**. Next, add and connect a **Generic Articulated Robot v3** to the manager in the 3D world. Finally, in the Component Properties panel, click the **WorkSpace** tab, and then select the **Envelope** check box to show the area of reachability for the robot in the 3D world.
3. In the eCatalog panel, go back to the **Machine Tending** library, and then add and connect a **Single Gripper** to the end of the **robot arm** in the 3D world.
4. Add a **Machine Tending Inlet**, **Machine Tending Outlet**, and **Process Machine - CNC Mill** to the 3D world, and then move those components within reach and to either side of the robot. For example, move the Inlet to one side of the robot, the machine to the following side, and then the Outlet to a side opposite the Inlet in order to form a 180 degree arc around the robot. For the machine, the robot must be able to reach its chuck to pick and place components there.
5. In the eCatalog panel, Collections view, under Models by Type, expand **Conveyors**, and then click **Visual Components**. Next, add and connect a **Conveyor** to the input of the Inlet in the 3D world. Finally, add and connect a new **Conveyor** to the output of the Outlet in the 3D world.
6. In the eCatalog panel, Collections view, under Models by Type, click **Feeders**, and then add and connect a **Basic Feeder** to the conveyor connected to the Inlet in the 3D world.



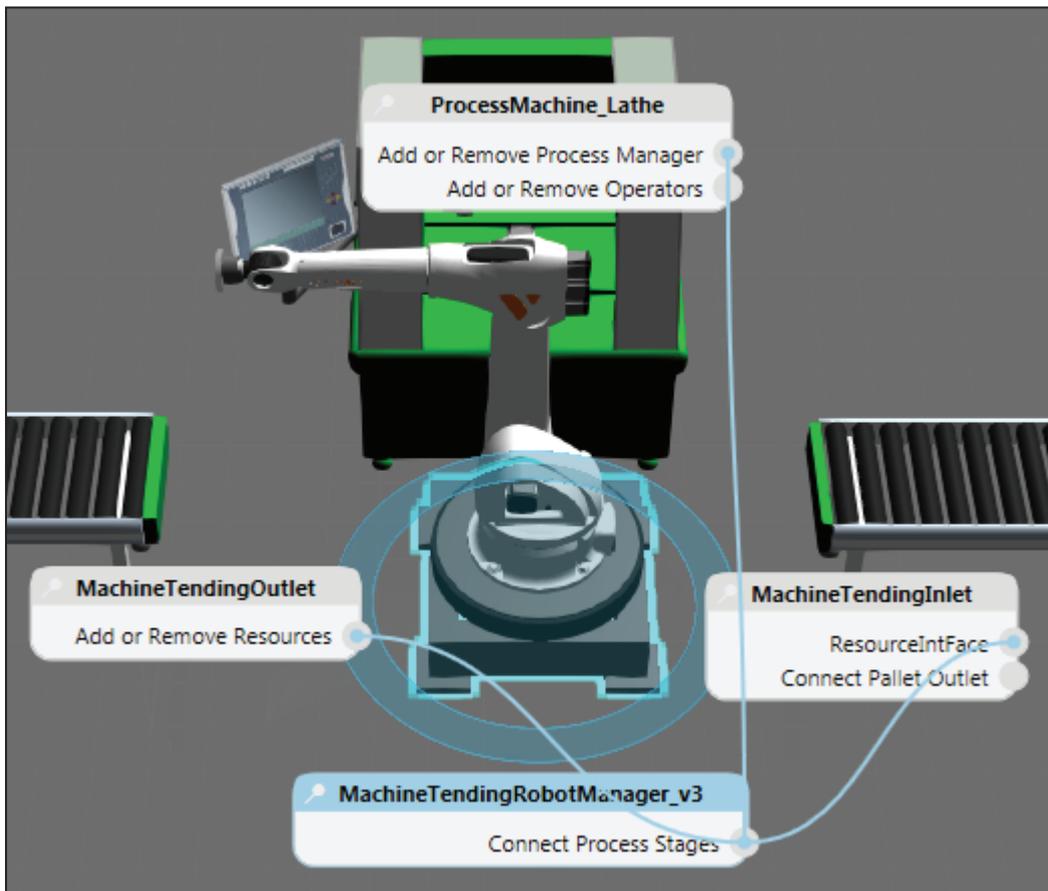
Configure Layout

The Robot Manager can automate a machine tending process by remotely connecting to the various stages in the process.

1. In the 3D world, select the robot, and then in the Component Properties panel, click the WorkSpace tab, and then clear the Envelope check box.
2. In the Cell Graph panel, click the label for the **robot manager** to select that component in the 3D world.



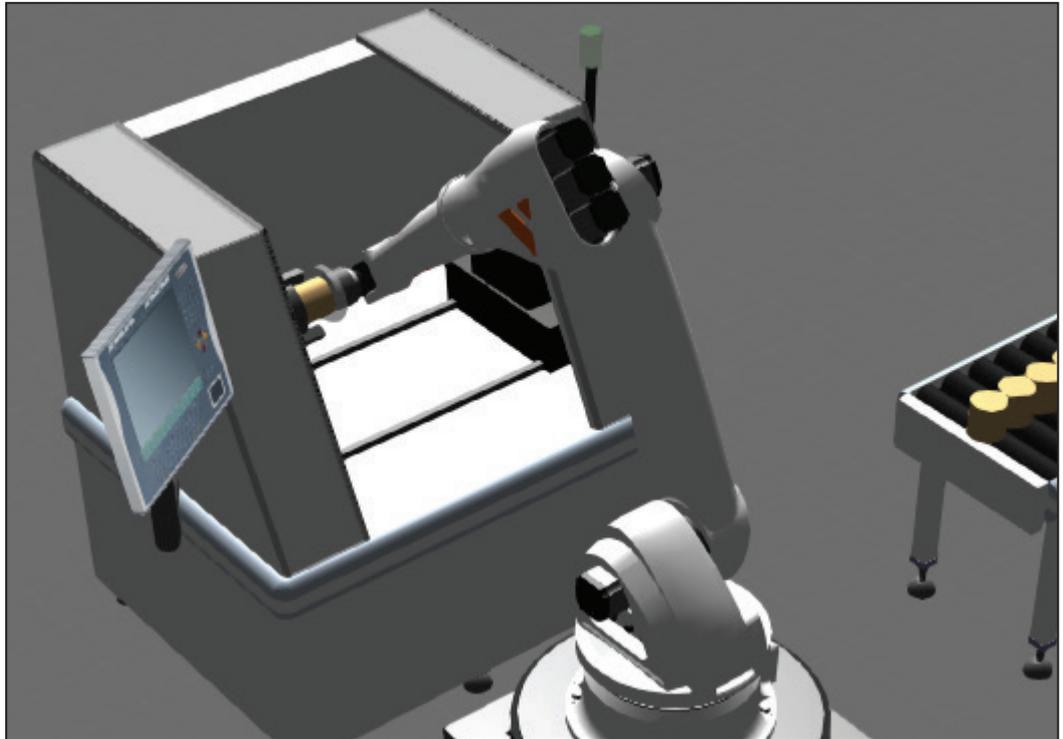
3. On the Home tab, in the Show group, select the **Interfaces** check box, and then use the manager's **editor** to wire connections to the **Inlet**, **Outlet** and **Process Machine**. For example, point to the circle of the Connect Process Stages interface on the manager's editor, and then drag the pointer to a display a wire, and then continue dragging the wire to a yellow highlighted section of the Inlet, Outlet or Process Machine. When the components are remotely connected to the manager, they will be highlighted green.



Test Layout

The layout is now configured to perform a machine tending operation.

1. Run the simulation to verify the robot picks and places components from the Inlet to the Process Machine, and then from the Process Machine to the Outlet.

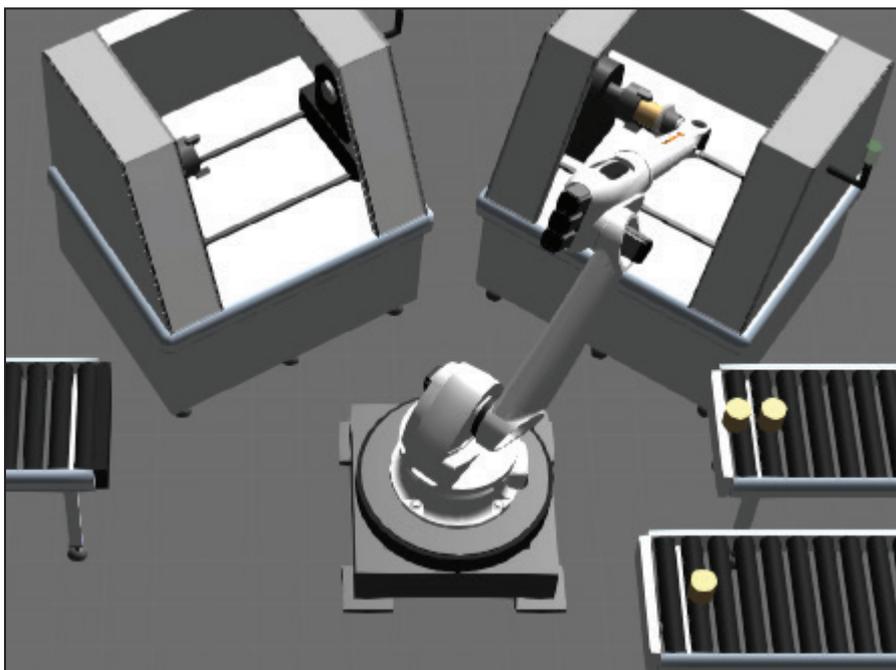


2. Reset the simulation, and then save the layout.

Use Product ID Filtering

Filtering can be used to route components to different stages in a process.

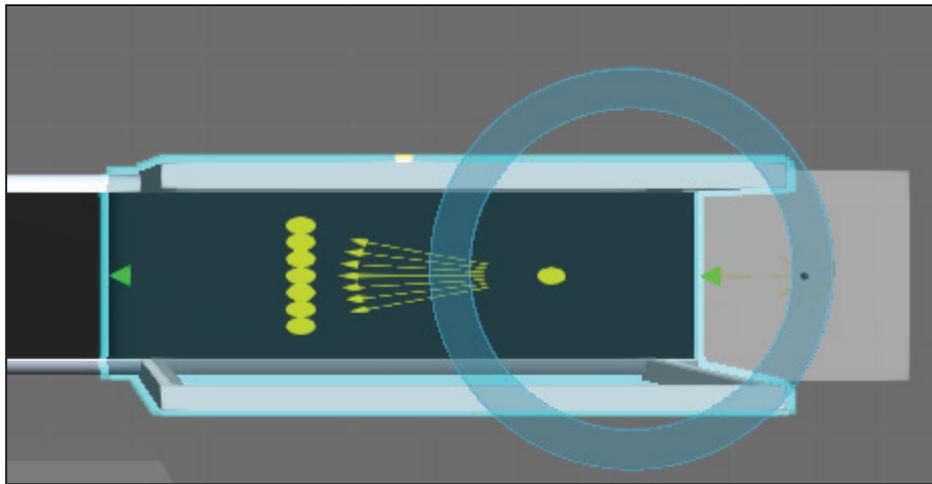
1. In the 3D world, select the **Outlet**, and then in the Component Properties panel, ProductID_filter box, add **444** to the list, for example 111,222,333,444.
1. In the 3D world, select the **feeder**, its **conveyor** and **inlet**, and then copy and paste those components. Next, move the **copied components** within reach of the robot.
2. In the 3D world, select **Inlet #2**, and then in the Component Properties panel, set WriteProductID to **UserDefined**, and then set ProductID to **444**.
3. On the Home tab, in the Show group, select the **Interfaces** check box, and then wire a connection from the **ResourceIntFace** of Inlet #2 to the robot manager.
4. In the 3D world, click the **process machine**, and then on the Mini toolbar, click **Clone** to generate a new machine. Next, in the Component Properties panel, set ProductID_filter to **444**, and then move the **copied process machine** within reach of the robot. You may need to rotate and move both machines if you want them to be side-by-side and within reach of the robot. Finally, in the 3D world, wire a connection from the **Add or Remove Process Manager** of the copied process machine to the robot manager, and then hide the interface editors.
5. In the 3D world, select both **process machines**, and then in the Component Properties panel, clear the **ShowPanel** check box since the machines are not operated by a human worker.
6. In the 3D world, select the **robot manager**, and then in the Component Properties panel, select the **Use ProductID filtering** check box.
7. Run the simulation to verify product id filtering of parts, and then reset the simulation.



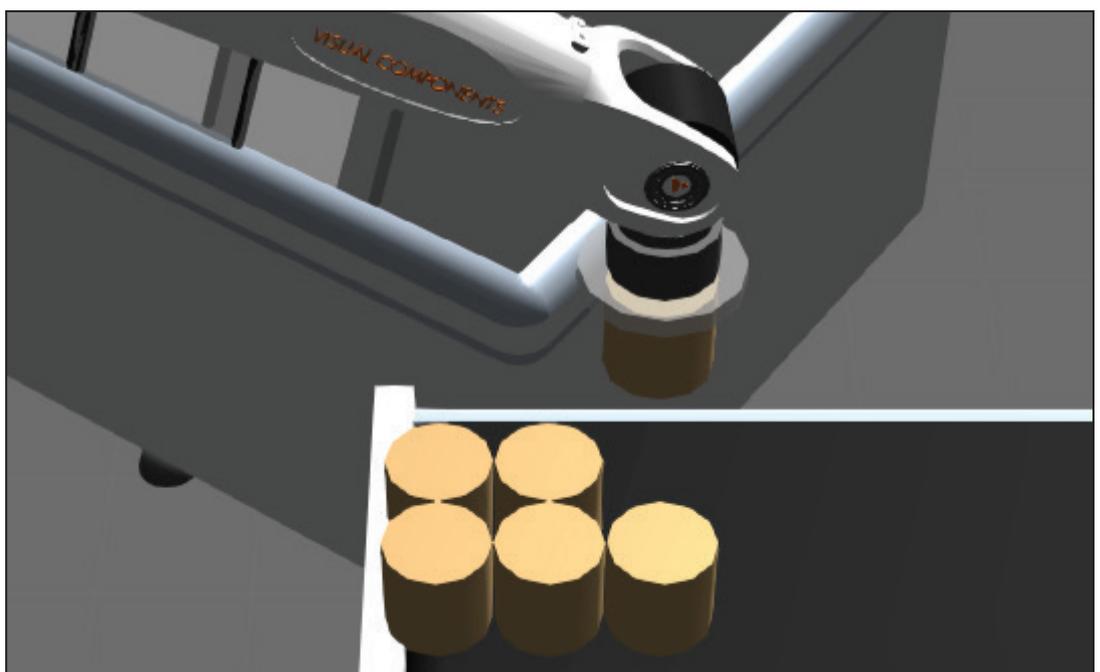
Pick and Place Bundles

An Inlet can inform a Robot or Resource Manager that arriving components are in a bundle or stack. In such cases, you can decide whether to pick bundled components individually or as a group.

1. In the eCatalog panel, Collections view, under Models by Type, click **Conveyors**, and then add a **XYZ Bundler** to the 3D world. Next, in the Component Properties panel, set ConveyorWidth to **400**. Finally, connect the **bundler** to a feeder and its conveyor. That means you must unplug a feeder from its conveyor, connect the buffer to the conveyor, and then connect the feeder to the other end of the bundler.



2. In the 3D world, select the **inlet** that will receive a bundle of components, and then in the Component Properties panel, select the **BundleMode** check box.
3. Run the simulation to verify the robot picks and places components in a bundle individually, and then reset the simulation.



Depalletize Components

An Inlet can inform a Robot or Resource Manager that components are arriving on a pallet and whether or not the components are bundled together.

1. In the eCatalog panel, Collections view, under Models by Type, click **Feeders**, and then add a **Shape Feeder** to the 3D world. Next, in the Component Properties panel, set Product to **CollarPallet** and CreationInterval to **60.0**, and then click the **ProductParams** tab, and then set Collars to **0** and ProdID to **pallet**.
2. In the eCatalog panel, Collections view, click **All Models**, and then in the Display area, search for a **pallet filler**, and then add and connect a **Pallet Filler** to the Shape Feeder in the 3D world.
3. In the eCatalog panel, Collections view, click **Currently Open**, and then add and connect a new **conveyor** to the pallet filler in the 3D world, and then add and connect a new **Inlet** to that conveyor. Next, wire a connection from **Inlet #3** to the robot manager, and then in the Component Properties panel, select the **BundleMode** and **BundleWithPallet** check boxes.
4. In the 3D world, move the added **inlet, conveyor, shape feeder** and **pallet filler** within reach of the robot, so that the robot can reach components that will be arriving on a pallet.
5. In the 3D world, select a **basic feeder**, and then in the Component Properties panel, copy the **Creator Part** property value. Next, use the Cell Graph panel to select the **pallet filler** in the 3D world, and then in the Component Properties panel, click the **ProductCreator** tab, and then in the **Part** box, clear the current value and paste a new value, so an arriving pallet is filled with cylinders. Finally, click the **XYZ Pattern** tab, and then set Z_Count to **1**.

