ROBOTIQ

CHOOSING A ROBOT GRIPPER

TABLE OF CONTENTS

INTRODUCTION 3
1. PART ANALYSIS 4
2. PROCESS ANALYSIS 5
3. PART FEEDING ANALYSIS 6
4. ENVIRONMENTAL ANALYSIS 8
5. ROBOT ANALYSIS 9
CONCLUSION 11

INTRODUCTION

From the robot itself to the security devices, a lot of components are involved in the design of a robotic cell. It is sometimes hard to focus on all the details in the selection of all the different components. However, if your application needs to use a gripper, you want to make a good choice to have efficient operations in your robotic cell.

We decided to create this document to help you with all the specifications and factors that can influence your gripper selection. You may be looking at a couple of models, and because gripper manufacturers don't use the same definitions and don't always provide all the required information; we thought that with this document, you can go a little further and ask your vendor or supplier for specific specifications on your gripper.

This document has been split into 5 different sections that are really independent from each other. All the parts that have to be grasped by the gripper, the process that will be executed by the gripper, the way the parts are fed to the robot, the environment in which the robot will be working and finally the robot that will be used for your application.

1. PART ANALYSIS

The choice of your gripper will be significant for the success or failure of the integration of your robotic cell. You want to have an end-effector that is precise, simple and that can handle as many of your different parts as possible. Even though, you have to figure out exactly what kind of parts will be handled by this gripper. Here is a list of points that we systematically look at when helping a customer to choose a robotic gripper. The most important thing is to start the process with an open mind towards which type of gripper you will need. A gripper can work well and have good features, but if it doesn't suit your application in the end it won't really be that much of an advantage.

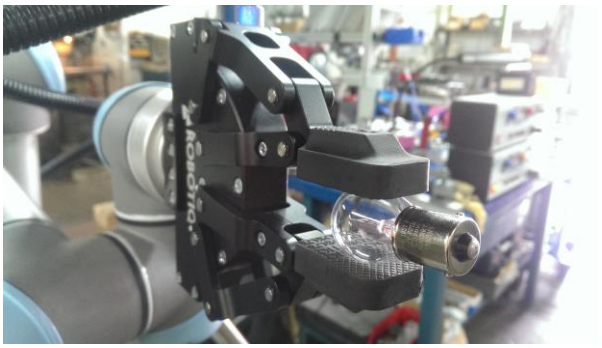
Dimensions

The minimum and maximum sizes for your part(s) are really important data. However, you may want to measure other geometric positions on your part(s) to see where the gripper can produce the best grasp. Internal and external geometry should be measured in order to have a maximum of possibilities when selecting a gripper.

Weight

The maximum weight of the parts has to be known for 2 different reasons. First, to know if you are respecting the gripper and robot payload. Second, to make sure your gripper has the required gripping force to handle your parts. To have further information on these aspects, take a look at a past blog post on Payload VS Grip-Force.

Material



The material composition of your parts can be a very limiting aspect of the gripping solution. In fact, even if the dimension and weight can be handled by the gripper, the material needs to be compatible with the gripper to insure a good grasp on the part(s). For example, some grippers cannot be used in the handling of fragile items (think food, ceramic, wax, thin metal or plastic, etc.) because they will damage the item you want to grasp. But with our Adaptive Grippers, the gripping surface can be adapted to reduce the impact on fragile part surfaces, thus force-controlled grippers can also be part of the solution.

Shape

Non-symmetrical, tubular, spherical, and tapered parts are a real headache for robot cell designers. It is really important to consider the shape of the parts when looking at a gripper. Some gripper manufacturers have options, like different fingertips, that can be added to the gripper to suit specific applications. Ask if the gripper you are looking at can be adapted to your specific application.

Number of Parts

The more different parts you have in your process the more adaptive your cell should be. Either you use a tool changer or an Adaptive Gripper, either way you will have to make sure all your parts can be grasp correctly by the robot tool. Tool changers are big and expensive, but can work on a virtual infinity of parts with the right custom tools. While an Adaptive Gripper such as the 2-Finger Adaptive Gripper-200 can grasp many very different kinds of parts using one single end-effector.

Future Parts

Also, you should think about your production, will it change or evolve over time? If the assembly line has been creating the same parts for the past 10 years, it might not change very often. On the other hand, if the assembly line is incorporating new parts every year, you should consider that the gripper should be able to adjust to these additions. Interestingly, you might even consider using your gripper for other applications. This might be a way to access the full benefits of your robotic cell and increase its up time making it more profitable to use. Consider this factor in the choice of a gripper and make sure the gripper can be adapted to future potential operations of the robotic cell.

By determining your part specifications, you can now compare this data with the available gripper specifications. With the shapes and dimension of the parts that have to be handle, you can determine the stroke of the gripper you will need. Considering the material and the weight of the parts, the necessary gripping force can be calculated. Furthermore, by asking yourself what are the different parts that will be handled by the gripper, you can see if your robotic cell needs a tool changer or if a single gripper will work well.

2. PROCESS ANALYSIS

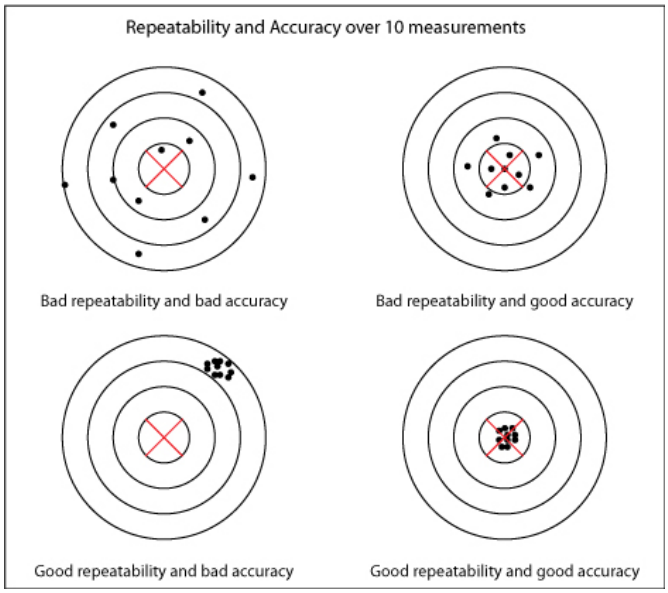
In the design of your robotic cell, once you have figured out which gripper would best suit your part(s), you then have to analyze the actual process. Even if the robotic tooling is able to grasp the part, can it do something useful with it after it has the part? Some applications require exact tool specifications and you should consider them in your analysis. The question you should ask yourself is:

What will my robot need to do once it picks the part and how will this influence my choice of robot gripper?

Cycle Time

Probably one of the most limiting aspect for a gripper is cycle time. Most industrial applications require a fast cycle time to achieve a certain production rate. So a fast/reliable gripper would be best for such applications. Although, if you are looking at applications for collaborative robots for example, the cycle time might be able to be a little slower due to safety requirements. This means that a fast gripper with a short cycle time is not a necessity.

Required Repeatability



This aspect can be limited for some operations, but has to be negotiated for others. Since the pick-up operation can (most of the time) have a larger tolerance (pre-ordered layout, belt, etc.), and the object drop tolerance/repeatability might have to be precise. For example, if the robot has to fit a shaft in a CNC machine chuck, you want it to be highly repeatable to make sure the part is easily entering into the chuck. The opposite case is if the robot is doing pick and place in a cardboard layout, the repeatability can be slightly less precise if it is not critical to place the part in the same 0.1 millimeter space.

Make sure to buy a gripper that has the required repeatability to fit your application(s). It can be good to have robotic tooling that can achieve an extremely good repeatability, but if your application doesn't need such precision, you will probably pay too 'much ado about nothing'.

Motions

Motions for the robot may seem to be a totally separate aspect from the grasping itself, but in fact you should consider the motions and more specifically the accelerations of the robot in your design. If the robot is accelerating at an outrageous rate to achieve a certain cycle time, your gripper should consequently still be able to retain the object. You don't want to slow down the process because the robotic tooling you're using cannot grasp objects hard enough. Some gripper manufacturers are offering personalized fingertip pads or fingertip options to suit your applications. Options such as rubber fingertips can be good to securely grip a part and make sure it doesn't slip while the robot is moving. Another factor maybe a gripper that has a self-locking mechanism. Check out this blog for more detail.

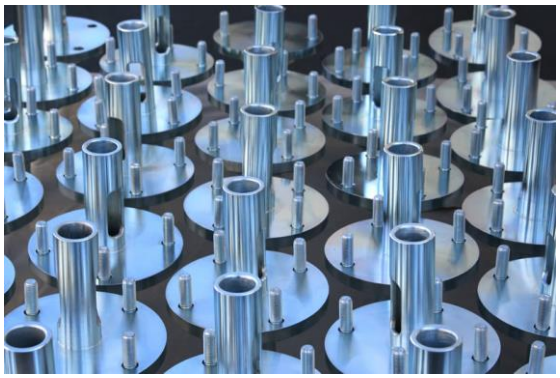
3. PART FEEDING ANALYSIS

The pick and place process has to be split into 2 different operations: the pick and the place (brilliant!), but seriously, you need to consider the space or environment you have or will have during this process on both sides of it. Some people only consider the starting pick operation and forgot to think about the final operation. I admit that most of the time, the pick operation is more difficult and can create a stronger headache, but you'll have to consider the dropping/placing operation as well to complete your reflection.

Sometimes picking the part is not the problem, but rather accessing them.

Once you have divided your process in two, there are basically 4 different scenarios that can occur. Here is a list of these scenarios beginning by the easiest to the toughest for the pick it part of the operation.

Ordered, with Spacing



This configuration is the easiest you can ever imagine in a robotic pick and place operation. You can picture this operation as a flat surface with parts being deposited in an assigned space. The parts will always be in the same spot whatever the situation. Why is this easier than other scenarios? It is quite simple; there are no adaptations! The robot has to go to the very same spot or go through the array of parts again and again. Once all the parts are picked, the robot just starts over and goes to the exact same coordinates. Most of the time, these operations don't need vision. A simple gripper and robot, with a good repeatability can be used. As you can see in the picture, the robot gripper will have plenty of space to grasp the parts. The spacing between the parts is adequate and the center of the parts will always be at the same spot as the production goes on and on.

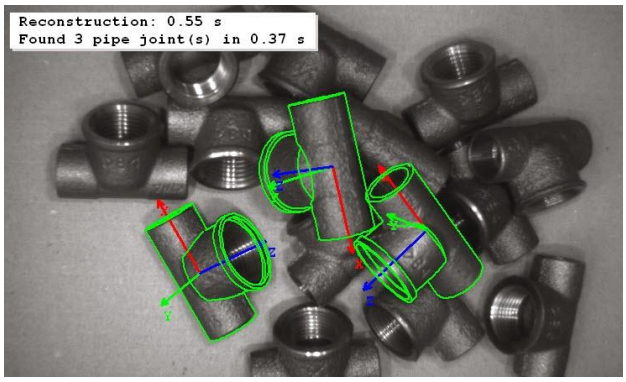
Non-Ordered, with Spacing

This configuration is basically where the parts are placed on a surface without any specific ordering, but they have plenty of space between them to be able to grasp a portion of the part. This is where it is getting a little tougher to integrate a robotic gripper. In fact, since the parts are not ordered, it makes it hard to predict how you are going to grasp them. Depending on the shape of the parts, you should be able to predict what side of it will be face up. Even though, there is still some uncertainties regarding the way to grasp it. To resolve this problem, you can use an Adaptive Gripper that can grasp a part depending of its configuration. Paired with a vision system, the gripper knows where the part is and what its configuration is. The robot controller/program can then analyze the different scenarios it was taught and respond with a motion according to these scenarios.

Ordered, Without Spacing

This configuration means you know where the parts are, but it is harder to grasp them. For example, the parts are ordered very close to each other or they are in a deep container. For this scenario to work, the choice of gripper is essential. The gripper has to be small enough to go in-between the parts and should have a variable opening so that it can partially open when other objects are close to it. When a layout is tight, you could also consider grasping the part by an internal feature (internal diameter, for example). And you might also consider buying personalized fingertips for your gripper. This could give you the supplementary reach you need for your application.

Non-Ordered, Without Spacing (A.K.A. Random Bin Picking)



Random bin picking is the most complex of the scenarios. In fact, there are now ways you can predict how a part is going to be presented to the robot. When trying to predict random placement, the use of a vision system is an obligation. Even though choosing a gripper for this type of application is still difficult, by selecting an adaptive gripper, you can adapt the motions you will need depending on the situation you are facing. Since all the picking operations will be different, you want to have a gripper that can grip it all. As you can see in the picture, the vision system is able to figure out what the orientation of the parts is, although your set up might not allow you to pick the part as you might want to. With a self-adaptive gripper, you can have a couple of options for the same scenario compared to other grippers that have only one way to grab the object.

At the end of the day, the part feeding process has to be identified and you need to choose your gripper with regards to your specific configuration. So what you have to remember concerning the end-effector is that a self-adaptive gripper can take the fullest advantage of the information from a vision system. And then don't forget to look at the placement of the parts you have just picked.

4. ENVIRONMENTAL ANALYSIS

In the last sections we discussed the best way to choose a gripper depending on the kind of parts you need to deal with. We introduced what you should look at according to your assembly or machining processes and your part feeding processes. We also considered that the environment where the gripper is working should play a big part in the choice of gripper. Here, we have detailed a couple more points concerning environments that you should look at before buying a gripper.

Temperature

Most of the time, when the temperature is a limiting factor in your application, it's more likely too hot than too cold. If the gripper is working near a welding torch or hot casting equipment, the requirements are different than if it's working in a temperate environment. In general, the gripper manufacturer will provide an optimal temperature range for operations. This range should be respected due to different factors, in fact, some gripper components can develop serious damage if the gripper is operated outside of its operating range.

Even if only temperature was mentioned, explosive environments should also be considered when making the choice of a gripper. Some plants out there are working with powders or gases that can explode when they come in contact with an electric motor or spark. This is a very limiting factor in your choice of gripper, because it's not just about the functionality of the gripper, but about the security of the plant. I know that some available electric motors are compatible with explosive environments, if this is your case, then you will have to look carefully at what the different options are for your robot and gripper application.

Fluids

Some applications, such as machine tending, use a lot of fluids. Coolant water and other liquids can damage your gripper if it doesn't have the required protection. If you have applications with a lot of fluids involved, you should make sure that the mechanism and electronics (if applicable) are well protected. You should also monitor the quantity of fluids that the gripper will come into contact with. Actually, if there are a lot of fluids in the application, but your gripper is not touching any of it, you could perhaps consider a lower protection than if the gripper has to be submerged in liquid.

To know what type of protection you need, the IP Rating is a good way to quantify this. In fact, the different ratings will help you monitor your application and determine your needs. All Robotiq Grippers are rated IP 67 which means that they are ''dust-tight'' and that they are protected against water penetration from 1 to 30 minutes.

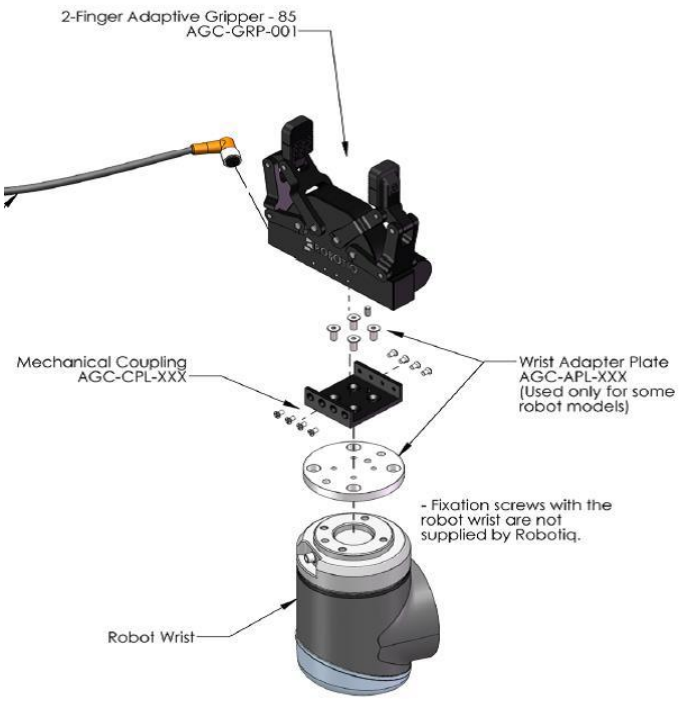
Cleanliness

Are there going to be some metal shavings or dust on the gripper? Does your process use small parts that can enter into the gripper mechanism? These are questions you should ask yourself when looking for a gripper. You should notice that the IP Rating is also available for solid state intrusion, so make sure to choose a gripper that will have the required rating for both dust and fluids.

Also, if the process needs to be done in a dirty environment, a cleaning station would be a great option to have available so that you can periodically clean your gripper. You should note that a clean gripper is not all about functionality, but also about accuracy. In fact, if your gripper's pads are dirty, less accuracy is bound to be achieved when a part is grasped.

5. ROBOT ANALYSIS

This analysis is probably the easiest you will have to do in your selection process. In fact, you cannot choose a gripper in relation to the robot you are using. However, some grippers fit better than others on certain types of robots.



Mechanical Coupling

Some robot manufacturers provide grippers that can easily fit on a certain type of robot. This makes your life much easier when it comes time to select which mechanical

coupling should be bought for your robot and how to install it. We are currently manufacturing kits for Baxter and Universal Robots for our 2-Finger Adaptive Gripper-85. This makes the integration easier for people that are using our Gripper with these robots.

Adapter Plate

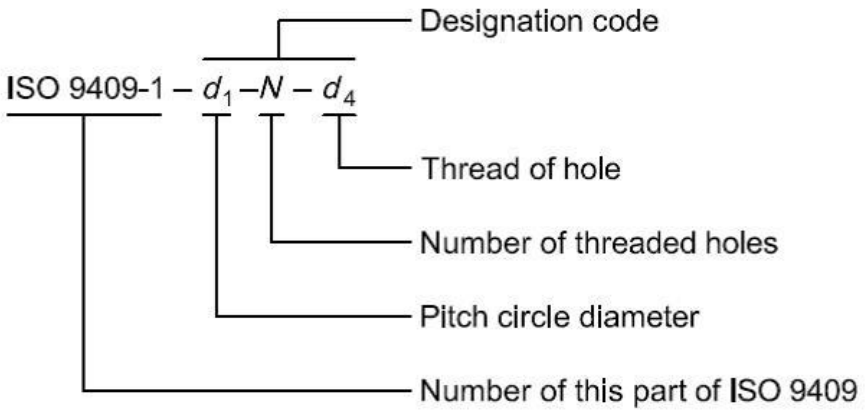
Some robots are less fortunate, they don't have a gripper that matches right up. Most gripper manufacturers can provide adapter plates that are placed between the gripper and the robot wrist to adapt to the required bolt patterns.

Bolt Pattern

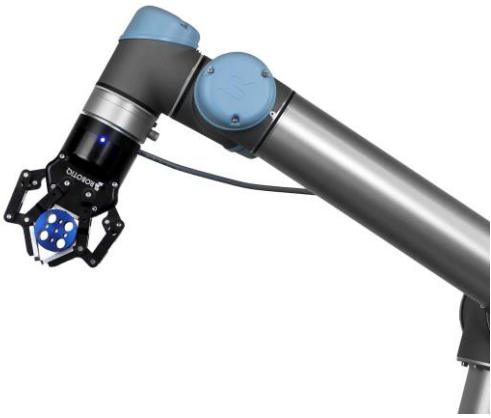
As you may have noticed, the robot wrist has a specific bolt pattern. A lot of robot manufacturers are respecting the standard bolt pattern of ISO 9409-1. However, some robot manufacturers don't respect the norm and create their own bolt patterns. This can be a real headache for the end user because of the mismatched nomenclature and fit.

Notice that the norms cover different aspects of the robot/tool interface, so it can be interesting to take a look at the entire section concerning *Mechanical interfaces* to get further information.

If the manufacturer is respecting the norm, he will include the relevant information in the technical specifications of the robot. Most of the time a representation of the bolt pattern will be shown. In some cases the ISO nomenclature will be used. To help you understand this nomenclature, see the following:



CONCLUSION



The key to success is really to identify what your applications need. In fact, analyzing your part(s), your process, your feeding operations and your environment will help your figure out which gripper should suit your applications. You should always keep an open mind at the very beginning of the selection process and eliminate some grippers when they don't fit your applications.

Ask...

You should definitively ask your gripper representative or application engineer if your applications are suited for certain types of grippers. Some gripper manufacturers can make customized grippers or gripper parts (customized fingertips, customized opening range) depending on your request. You should definitively tell the representative what your applications are and work around them instead of adapting your operations to the gripper.

For further information, feel free to visit our website: **www.robotiq.com**

ABOUT ROBOTIQ

Our goal is to enable all manufacturers — especially those dealing with high mix production — to take full advantage of robotics. We work with robot manufacturers, system integrators and end-users to automate applications that require flexibility.

Robotiq sells product in more than 30 countries, through our global network of partners.

TO LEARN MORE

For any questions concerning robotics and automated handling or if you want to learn more about the advantages of using flexible electric handling tools, contact us.

Phone (USA and Canada): 1 888 762-6847 extension 122
Phone (Anywhere in the world): 1 418 380-2788 extension 122

Email: info@robotiq.com

Website: www.robotiq.com
Blog: http://blog.robotiq.com/

Let's keep in touch via social media

ROBOTIQ'S BLOG

LEARN ABOUT ROBOTIC INDUSTRY NEWS, APPLICATIONS AND TRENDS

facebook

GET THE LATEST NEWS ABOUT ROBOTIQ

YouTube

WATCH VIDEOS OF OUR PRODUCTS

LinkedIn

GET THE LATEST NEWS ABOUT ROBOTIQ