

# Mixed Case Palletizing Robot



Mixed case palletizing is to palletize carton boxes or totes of different sizes and weights. The robotic system is supposed to plan and palletize items smartly to keep them stable.

XYZ Robotics' mixed case palletizing system is outstanding for its **smart pallet planning, high efficiency, and support for controlled/random sequences.**



## Smart Pallet Planning

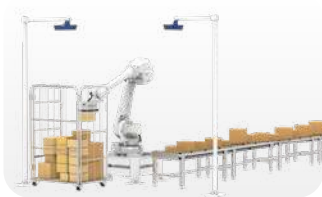
- Place lighter items on heavier ones to ensure stability and a high loading rate (can reach 1.8 m high with over 5 layers)

## Teachless and Efficient

- Generate a collision-free and time-optimal trajectory automatically without teaching
- The pick-and-place efficiency can reach 600 cycles/hour (90° layout)

## Support Controlled/Random Sequences

- Controlled sequence: plan the case feeding sequence in advance; achieve a high loading rate up to more than 5 layers
- Random Sequence: pallet planning in real time with no need to control the feeding sequence; can reserve a buffer area for temporary storage and sequence adjustment



## Core Technology 3D Camera



### ST Active Stereo Series 3D Camera

ST camera carries VCSEL to project high-power and high-density infrared patterns. With stereo matching algorithm, the camera is resistant to sunlight and ensures accurate 3D reconstruction with point clouds and RGB data.

The camera is suitable for **carton box, black barrel, bag, and aluminium ingot (de)palletizing, machine tending, and piece picking.**



#### Fast imaging

Imaging in just 0.23 s



#### Resist ambient light

60000 Lux @ 1.2 m



#### Anti-reflection

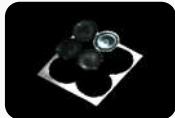
With a configurable projection module to upgrade anti-reflective performance



Carton boxes with tapes



Bags



Reflective black barrels



Small SKUs



### LS-XL Laser Structured Light 3D Camera

LS-XL camera projects high-power red laser and generates penetrating structured light through galvo, so it images effectively in conditions of low light, strong ambient light, and long distance.

The camera is suitable for logistics scenarios requiring **high precision**, such as **thin-framed totes and mixed case depalletizing.**



#### Large FOV

1.5 - 4 m



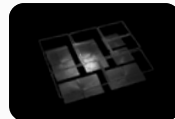
#### High precision

Z repeatability 0.4 mm @ 2.2 m

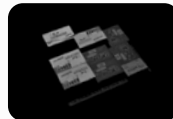


#### Fast imaging

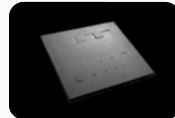
Imaging in just 0.5 s



Mixed totes



Mixed carton boxes



Accuracy-testing board

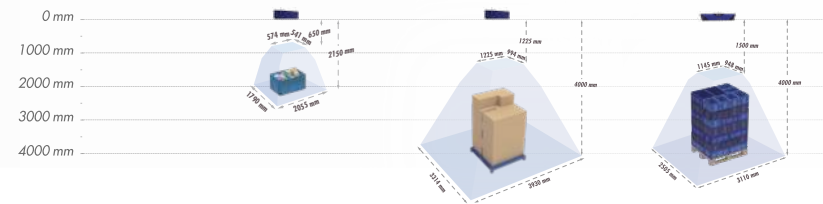
(0.1 mm)



Large cross member

#### Parameters

|                        | ST-L                        | ST-XL                    | LS-XL                       |
|------------------------|-----------------------------|--------------------------|-----------------------------|
| Scanning range         | 650 - 2150 mm               | 1200 - 4000 mm           | 1500 - 4000 mm              |
| Scanning area (near)   | 574 mm x 541 mm @ 650 mm    | 1225 x 994 mm @ 1200 mm  | 1145 mm x 948 mm @ 1500 mm  |
| Scanning area (far)    | 2055 mm x 1790 mm @ 2150 mm | 3930 x 3314 mm @ 4000 mm | 3110 mm x 2505 mm @ 4000 mm |
| Resolution (depth)     | 1280 x 1080                 | 1280 x 1080              | 2048 x 1536                 |
| Resolution (RGB)       | 1280 x 1024                 | 1280 x 1024              | /                           |
| Z Repeatability (σ)    | 0.7 mm @ 1200 mm            | 2 mm @ 2000 mm           | 0.4 mm @ 2200 mm            |
| Minimum scanning time* | 0.23 s                      | 0.23 s                   | 0.5 s                       |
| Baseline               | 200 mm                      | 200 mm                   | 400 mm                      |
| Dimensions             | 270 mm x 64 mm x 82 mm      | 270 mm x 64 mm x 82 mm   | 529 mm x 94 mm x 83 mm      |
| Data interface         | GigE                        | GigE                     | GigE                        |
| Weight                 | 1330 g                      | 1330 g                   | 3000 g                      |
| Operating temperature  | 0 - 40°C                    | 0 - 40 °C                | 0 - 40 °C                   |
| Power supply           | 24 V DC 2 A                 | 24 V DC 2 A              | 24 V DC 2 A                 |
| Cooling                | Passive                     | Passive                  | Passive                     |
| Protection class       | IP65                        | IP65                     | IP65                        |
| Laser class            | Class 1                     | Class 1                  | Class 3R                    |



\* The fastest scanning time is measured under specific graphics card configurations, exposure time and fast encoding mode.

## 2 Core Technology Vision Algorithm

- **99.99% Accuracy**

Verified with the WCS/WES data

- **Rapid Imaging**

0.5 s for top-layer object recognition  
No robot waiting time via async vision processing

- **Robust**

Model-free and accurate recognition of 10,000+ random items through innovative algorithms, such as the deep learning algorithm  
Resist vision interferences including densely packed black items, complex patterns, straps, tapes, deformed bags, etc.

VISION  
ALGORITHM



Mixed



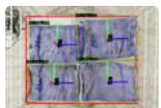
Dark



Highly reflective tapes



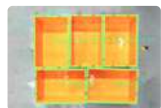
Strapped



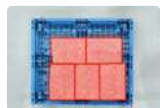
Bags



Barrels



Totes



Densely packed items with the same color

## 3 Core Technology Motion Planning Algorithm

- **Teachless**

Generate a collision-free and time-optimal trajectory automatically to achieve rapid deployment

- **High Efficiency**

Adjust speed dynamically according to items' weights to achieve higher throughput

- **Safe and Smooth Motion**

Avoid robot's singularities automatically to keep safe and smooth robot motion and prevent the emergency shutdown



# 4 Core Technology Pallet Planning Algorithm

- **Stable**

Plan the pallet considering carton boxes' sizes and weights, place lighter carton boxes on heavier ones to avoid damage and collapse

- **High Loading Rate**

Palletize to 1.8 m with over 5 layers (when cases are similar-sized)

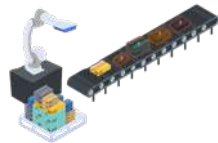
- **Real-time Simulation**

With order information input, the real-time simulation of automatic pallet planning will present on HMI

- **Random sequence mixed case palletizing**



Calculate the best possible placement in real time  
High loading rate



- **Random sequence with buffer mixed case palletizing**



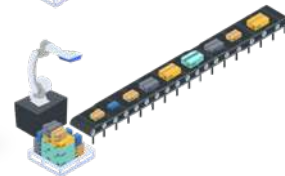
Pick the best case from A, B, C reserved in the buffer area  
Higher loading rate



- **Controlled sequence mixed case palletizing**



Predetermine the feeding order to globally optimize the pallet pattern  
Highest loading rate



# 5 Core Technology Gripper Design

- **Multiple Grippers**



Single-item suction cup



Multi-item suction plate



Vertical clamping gripper



Gripper for densely packed totes

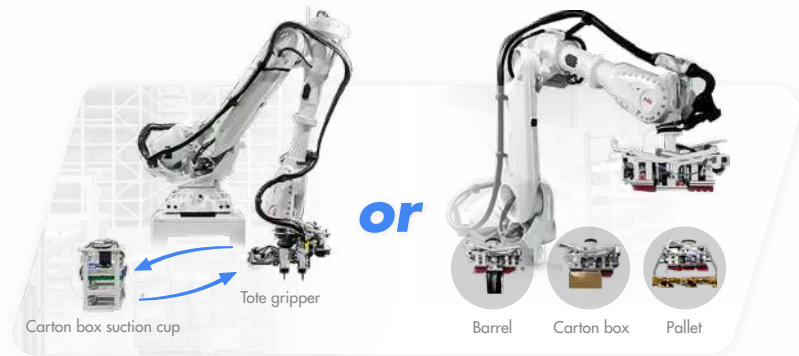


Bag suction cup



Scopper

- **Multifunctional Designs**



Gripper switching device

Compatible gripper (no need to switch)



### Rapid Exception Handling

- Provide intuitive guidance and solve exceptions in 3 steps
- Handle exceptions including carton box dropping, abnormal recognition, etc.
- Check task logs online or download for troubleshooting



### Smart Pallet Planning

- Choose pallet patterns with one click (including regular, labelled-side out patterns, etc.)
- Customize pallet patterns easily



### Overview

A leading Japanese 3PL company implements AS/RS system and mixed case palletizing robots to achieve fully automated inbound, storage, and outbound. More than 200 carton box types in the logistics center and more than 10 types on one pallet pose great challenge to the vision recognition. Manual lifting leads to high labor cost and injury risks.



### Highlights

- **Model-free recognition:** adapts to new cases coming in a random sequence and supports mixed case palletizing in real time
- **Pallet planning algorithm:** the mixed stack is stable and up to 1.4 meters high. This high volume efficiency reduces the cost of AMR transportation
- **99.99% order picking accuracy:** optimizes the distribution throughput

# 2

Case Study  
**CARTON BOX (DE)PALLETIZING,  
TOTE (UN)LOADING, PIECE PICKING**  
Electronics Distribution Industry



### Overview

One of China's largest electronics component distribution centers requires fully inbound and outbound automation. There are more than 10,000 carton box types waiting for vision recognition and robot picking. According to WMS orders, robots will palletize homogeneous or mixed cases onto pallets to achieve automated inbound and grid storage



### Highlights

- **Model-free recognition:** adapts to 10,000+ carton box types, supports flexible switch between single-item and multi-item picking modes
- **99.99% piece picking accuracy:** empowers efficient outbound
- **Precise localization:** localizes racks for accurate tote loading/unloading

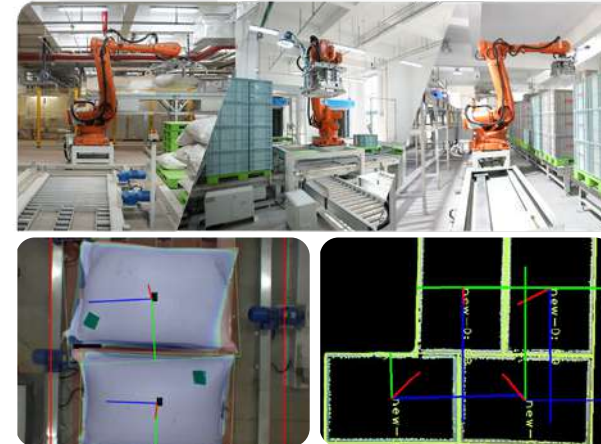
# 3

Case Study  
**BAG, TOTE  
DEPALLETIZING AND PALLETIZING**  
Pharmaceutical Industry



### Overview

A large pharmaceutical manufacturer requires coast-to-coast automation from raw medicinal material inbound to processed material feeding. Bag is a common storage unit of raw materials. Before production, robots will depalletize bags for workers to divide raw materials into totes in proportion. Bags and densely-packed totes are difficult to pick. Raw materials in forms of piece, branch, or chunk lead to uneven bags that can weigh up to 50 kg, so it is hard for common bag gripper to pick stably.



### Highlights

- **Deep learning + 3D vision:** accurately localize bags coming in different poses and sizes
- **Custom bag gripper:** handle both bags and pallets, stably pick bags weighing up to 50 kg
- **Custom tote gripper:** accurately and stably pick densely-packed totes weighing up to 50 kg
- **Eye-in-hand camera and ground rail:** enable robots operate flexibly in a compact layout

# 4

Case Study

## TOTE, CARTON BOX DEPALLETIZING AND PALLETIZING

E-commerce/Retail Industry



### Overview

A large Retailer requires a multifunctional robot to fulfill tote depalletizing, tote palletizing, and carton box in-tote palletizing. Totes are densely packed with 5 layers. For carton boxes, as various boxes are placed on different sections of one pallet, the customer demands high recognition, picking accuracy and optimized volume efficiency in totes.



### Highlights

- **Eye-in-hand camera:** with high resolution and large FOV, the camera accurately recognizes densely-packed totes and carton boxes placed on different sections of one pallet
- **Custom tote gripper:** depalletizes densely-packed totes with 8 seconds of cycle time
- **Smart gripper switch:** one robot can handle both totes and carton boxes, making it suitable for more pick-and-place scenarios flexibly
- **Intelligent in-tote stacking planning:** Given carton boxes' sizes by vision recognition, the algorithm automatically calculates the placement of boxes in totes to ensure the optimal fill rate

# 5

Case Study

## CARTON BOX, BARRE DEPALLETIZING (MULTI-ITEM)

Chemical Industry



### Overview

According to the WCS data, the robot depalletizes carton boxes and barrels onto conveyors in multi-item picking mode. Carton boxes and barrels of different sizes and colors (including black barrels) require accurate vision recognition.



### Highlights

- **XYZ vision algorithm:** accurately recognizes black barrels with low reflectivity
- **Compatible gripper:** picks both carton boxes and barrels (multi-item mode) with 10 seconds of cycle time

Case Study

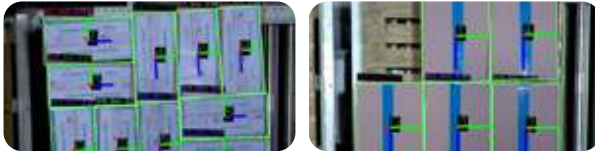
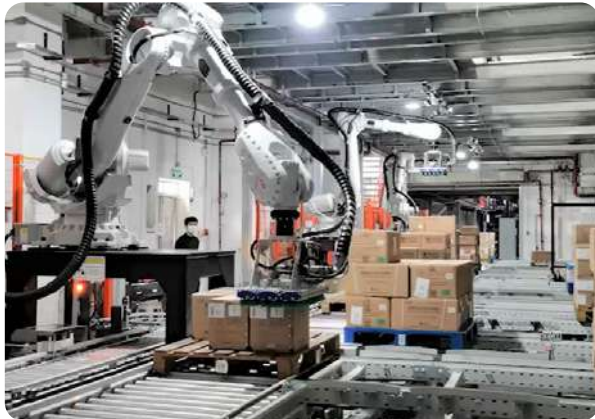
## CARTON BOX DEPALLETIZING AND PALLETIZING

Pharmaceutical Industry

### Overview

The customer is a leading pharmaceutical distribution company and requires vision-guided depalletizing and palletizing of 10,000+ types of carton boxes.

Robots should prevent the carton boxes with high-value medicines from dropping or over-pressing.



### Highlights

- **Model-free recognition:** recognize 10,000+ types of carton boxes (such as taped, strapped, and patterned ones) and greatly reduce deployment costs
- **99.9999% accuracy:** verified with WMS, the vision system recognizes and localizes carton boxes precisely to avoid dropping
- **Efficient and stable picking:** adjust the speed dynamically according to carton boxes' weights

Case Study

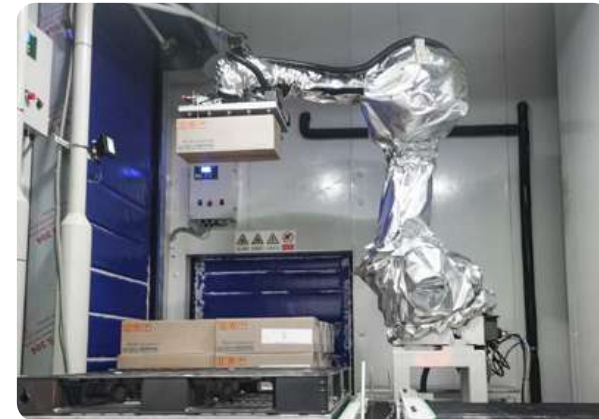
## CARTON BOX DEPALLETIZING AND PALLETIZING

Electronics Industry

### Overview

During the inbound process, the robot depalletizes carton boxes for barcode scanning and palletizes the verified ones on the pallet. Meanwhile, the robot places the carton boxes with abnormal results on the pause station and returns them to pallets for manual operation outside.

During the outbound process, the robot depalletizes carton boxes for barcode scanning and palletizes them on the conveyor.



### Highlights

- **Protection in the refrigeration storage:** protect cameras and robots for their stable operation at -5°C
- **Barcode scanning and exception return mechanism:** ensure correct inbound and outbound of the warehouse, and avoid manual operation in cold conditions



# 8

Case Study

## **CARTON BOX DEPALLETTIZING (MULTI-ITEM) AND PALLETTIZING (MULTI-ITEM)**

Electronics Manufacturing Industry

### **Overview**

A global top 100 PCB manufacturer requires multi-item depalletizing and palletizing of more than 30 types of carton boxes.



### **Highlights**

- **1000 cases/hour:** intelligently pick 1-3 cases per cycle in 7 seconds
- **Custom gripper:** support multi-item picking of various carton boxes

## **More Customer Cases**

