

# Image Processing

## ShapeTrax2 Tool

This series of technical documents allows you to efficiently learn image processing starting from the basics. The topic covered in this section is ShapeTrax2.

Conventionally the pattern search is often used for the position and angle measurements. However, the normalised correlation method used for the pattern search cannot support all types of detection/measurements. This section describes the characteristics and principle of the profile pattern search (ShapeTrax2) that enables the precision measurements even under poor imaging conditions. An explanation of when to use Pattern Search (normalised correlation) versus ShapeTrax2 is also included.

### 1. Conditions suited for Profile Pattern Search (ShapeTrax2)

In the conditions where multiple workpieces are touching or overlap each other, or workpieces that are dirty or have low contrast, the profile pattern search, which uses only profile information instead of the shape of entire workpiece for the detection, is useful. The following information shows in which conditions the profile pattern search, ShapeTrax2, is more suitable than the normalised correlation search.

#### Conditions where the profile pattern search is more suitable than the normalised correlation search

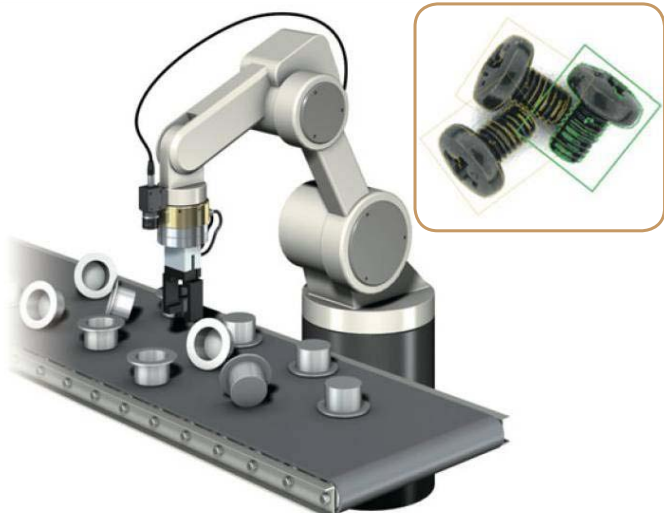
- Workpieces are touching each other.
- Workpieces overlap each other.
- Workpiece surfaces get dirty.
- Workpieces appear in inverted intensities.
- Workpieces change in size.  
(Distances between the workpiece and the camera vary.)
- More than 100 workpieces are detected at a time.
- Workpieces have low contrast.



#### Application for which the profile pattern search is suitable

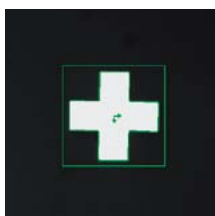
Position detection when workpieces are picked up by the robot

Even if workpieces touch closely or overlap each other, their positions can be reliably detected.

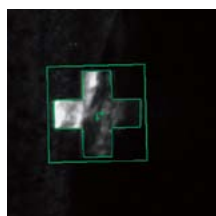


ShapeTrax2 is excellent in detection on the following images that are difficult to perform with the normalised correlation search.

(Registered image)



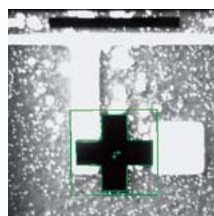
Dirty/Missing



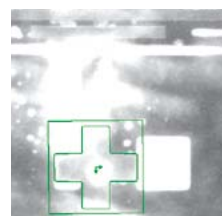
Blurred/Unclear



Inverted intensity



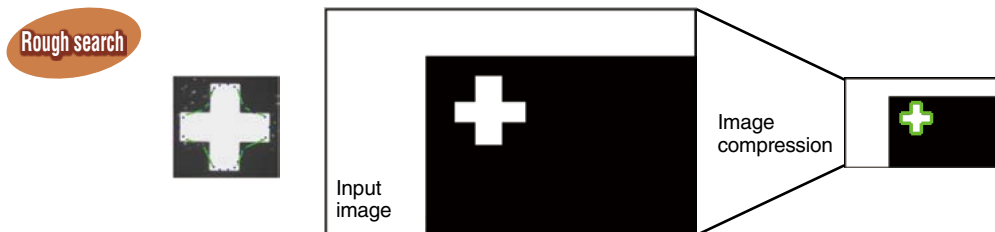
Low contrast



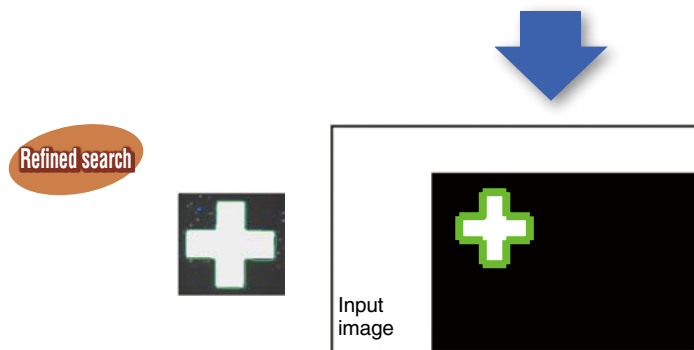
## 2. ShapeTrax2 Algorithm

The key points of profile pattern search lie in how to extract the workpiece profile information to achieve an accurate search and also how to maintain high-speed processing using a great deal of profile information. ShapeTrax2 employs the multi-step processing to satisfy the key point requirements.

### Basic algorithm for ShapeTrax2



The compression ratio is specified in the setting, and the surrounding area. The compressed image. Due to the small amount of information, the search can be performed at a high speed. Through the above search, the approximate position is detected.

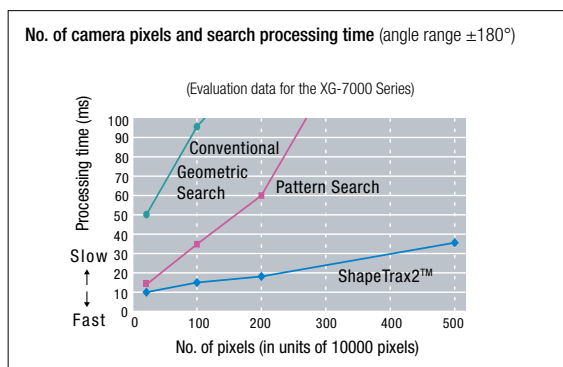


The search area is then narrowed to the position detected in the rough search and the surrounding area. The profile pattern is then searched on the uncompressed image. The refined search, which uses the full pixel information without compressing the image, allows for the accurate search. As explained above, ShapeTrax2 first locates the approximate position in the rough search and then detects the precise position with the refined search, achieving both high speed and high precision in the detection.

### High processing speed and accuracy of ShapeTrax2

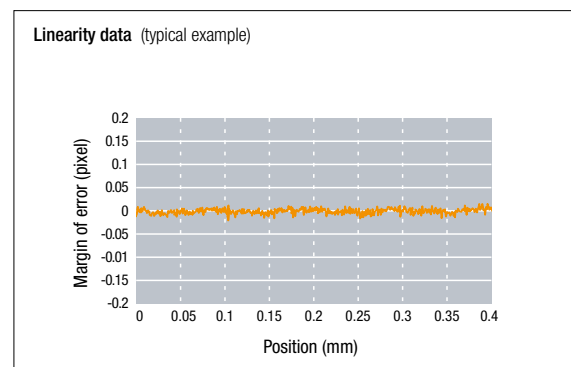
#### Ultra high-speed processing of max. 10 times higher than the existing search tool

The processing algorithm improvements achieve processing speeds max. 10 times higher than that of the existing search tool. Even an image of large capacity such as one of five megapixels can be processed at a high speed with an increase in processing time kept small.



#### Ultra high-precision at the level of 0.025 pixels

The highest search accuracy in the industry at 0.025 pixels has been achieved in terms of both linearity and repeatability. The precision level meets the requirements brought by target miniaturisation and a demand for the improvement of search accuracy accompanied by enhanced precision in detection.



### 3. When to use ShapeTrax2 versus Pattern Search

The profile pattern search is not suitable for all types of workpieces or backgrounds.

As its name indicates, the profile pattern search registers a profile pattern, which is formed with the profile information for the workpiece, as a template.

It is an algorithm for calculating the best correlation value by searching the workpiece on the screen using the template as a 100% reference pattern.

If sufficient profile information is not available or there is excessive profile data that are disturbed by noise, ShapeTrax2 can be inferior in the detection precision and processing speed compared to the normalised correlation search.

Choose the suitable search method based on the following steps.

#### How to choose the right search method

- 1 First try the normalised correlation search.



- 2 Compare the correlation value for the OK workpiece with that for the NG workpiece.



- 3 If the difference in the correlation values is small or the detection is not performed stably, try ShapeTrax2.



- 4 If any of the following conditions is applicable, ShapeTrax2 is the preferred method:

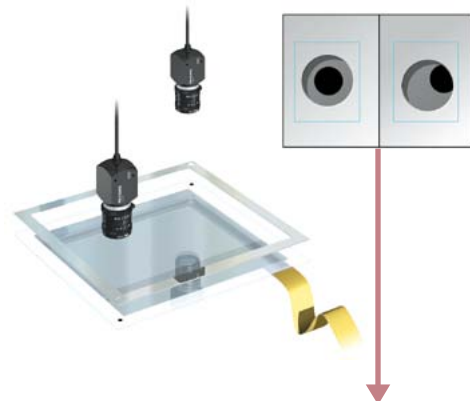
- Workpieces touch closely together.
- Workpieces overlap each other.
- Workpiece surfaces get dirty.
- Workpieces appear in inverted intensities.
- Workpieces change in size.
- More than 100 workpieces are detected at a time.
- Workpieces have low contrast.



- 5 After testing, determine the most suitable method for stable detection.

#### <Application for which the profile pattern search is suitable>

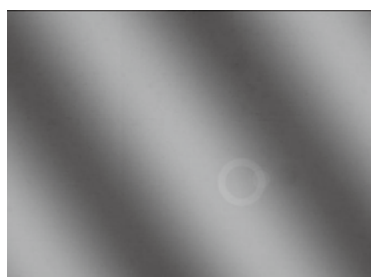
Alignment mark detection on liquid crystal glass substrates



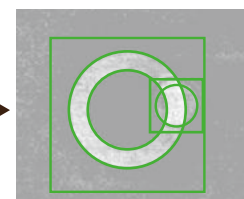
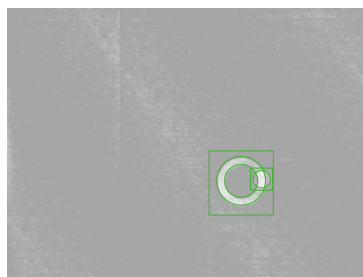
Even if a shape of mark changes due to its overlap with the frame, the stable detection is ensured.

### 4. Detection on a low-contrast workpieces (Utilisation of preprocessing function)

One of the ShapeTrax2 features is the easy detection of the low-contrast workpieces, but the utilisation of the real time shade correction filter, which is the pre-filter designed specially for the CV/XG Series, makes it possible to detect two alignment marks (a large doughnut-shaped mark and a small circle) as shown in the photos below. The elimination of shadow-like gradations which appear at intervals using the preprocessing function and the capability to detect low-contrast workpieces using ShapeTrax2 play important roles in the precision position detection.



The real time shading correction filter eliminates shadow-like gradations that appear at intervals.



## Image Processing Lineup

### XG-8000 / XG-7000 Series

#### Ultimate Vision Solution

Vast lineup of area & line scan cameras using high speed distributed processing with a wide variety of flexible interfaces that can be fully customised to meet the exact customer requirements.



### CV-X100 Series

#### Power Meets Simplicity

The Auto-Teach inspection tool recognises any differences on the target that do not conform to the trained good data. Multi-language support is incorporated for world-wide use by almost any user.



## Lineup of lights that support a wide range of inspections



Direct ring light



Multi-angle ring light



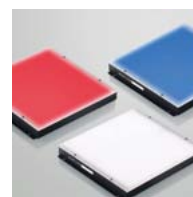
Multi-angle square light



Bar light



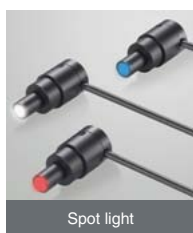
Dome light



Backlight



Coaxial light



Spot light



Low angle light



Square bar light



Line light



LED light controllers

## Lineup of lenses that can be selected based on the camera type and accuracy requirements



Super high resolution/low distortion lenses



High resolution/low distortion lenses



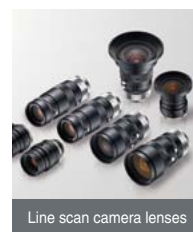
CCTV lenses



Macro lenses



Compact camera lenses



Line scan camera lenses

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### SAFETY INFORMATION

Please read the instruction manual carefully in order to safely operate any KEYENCE product.

