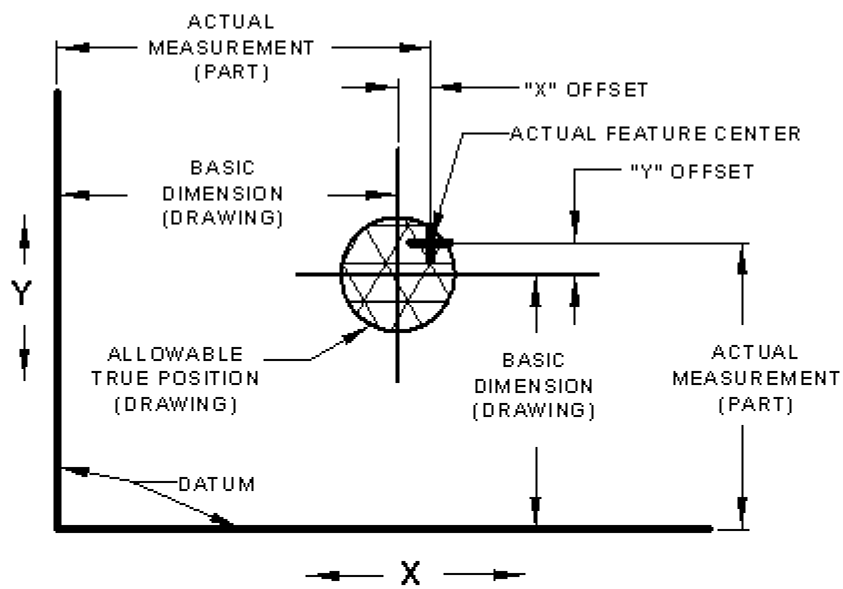
Connector Pin Tip True Position (TP) Gauging

One of the most common inspection requirements for a connector assembly is verifying the Pin Tip True Position (or TP). This inspection verifies that the X/Y position of the pin tip is within the radial tolerance of its expected location, as defined by the part drawing. The sketch below shows a general TP specification with actual values.



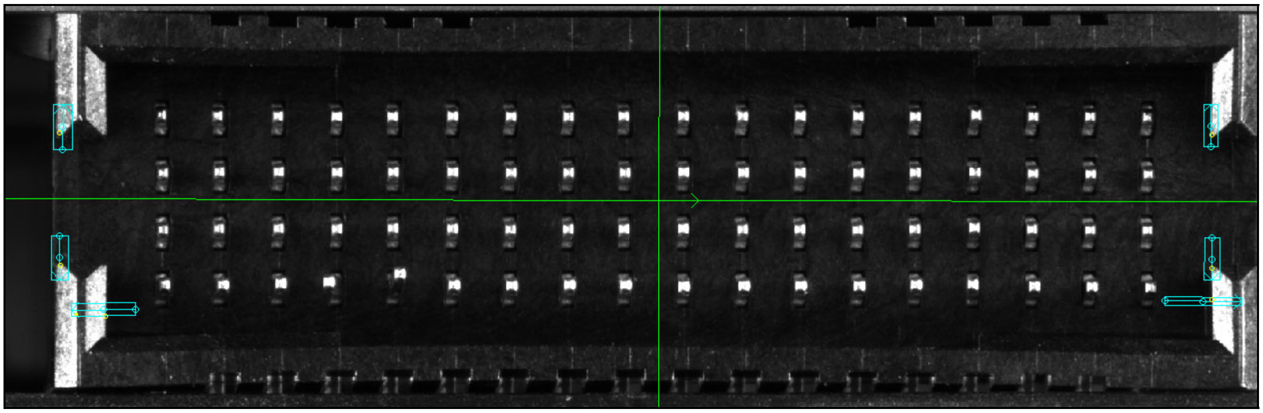
This type of inspection can easily be performed by IMPACT software. Typically, there are four steps to completing this inspection.

1. Establishing the TP datum reference edges or points.
2. Establishing the TP ideal (expected) locations.
3. Locating the actual pin tip positions of the current part under inspection.
4. Checking the actual TP versus the expected TP.

The following sections describe how IMPACT tools are used to implement this inspection.

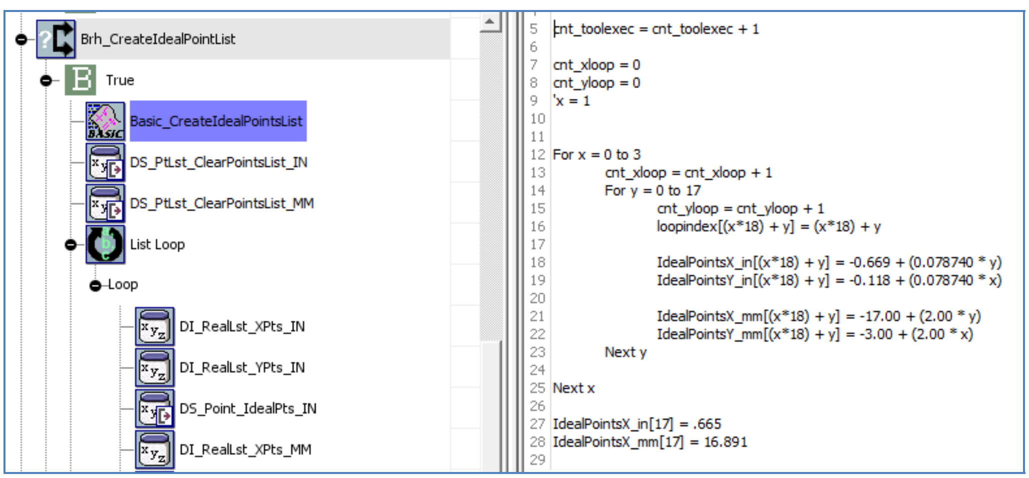
Establishing the TP datum reference edges

Any number of origin locator type tools can be used, depending on the image attributes and datum points. For example, if the datum points are based on "holes" and the image is backlit, then using a *Blob* tool, which reports centroids, in combination with a *Linear Regression* tool can establish a valid datum reference. Another example uses the *Origin* tool, with its sub-pixeling capability, to establish the datum reference. In any case, the established datum reference should correspond to the datum reference that is called out on the part drawing.



Establishing the TP ideal (expected) locations

In an ideal inspection, the expected TP locations are derived from the part drawing. Typical TP specs are called out in a grid configuration with a specific X/Y pitch or offset. From this drawing data, you can calculate the X/Y point pair locations of the ideal grid using the *BASIC* tool. (See the example below.)



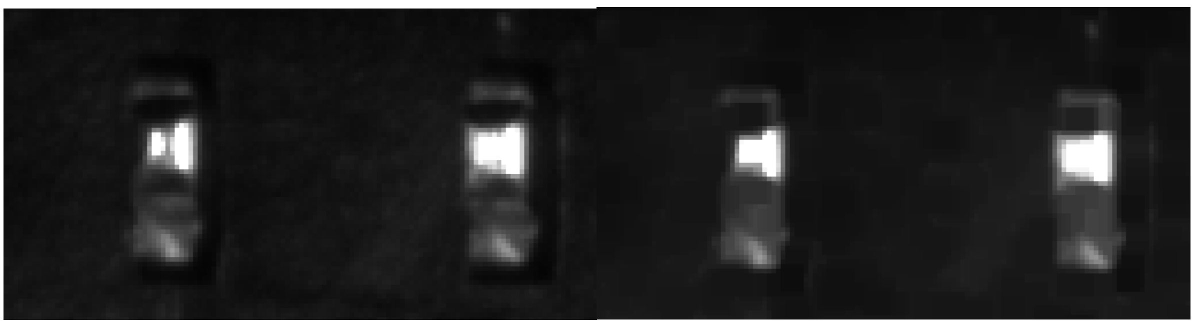
In a more relaxed specification, you can employ the *Point Match* tool's "trainable" ideal point list, where it is trained with the current pin tip locations as the ideal, assuming that the current part is the "golden standard." (See the example below.)

Run Train

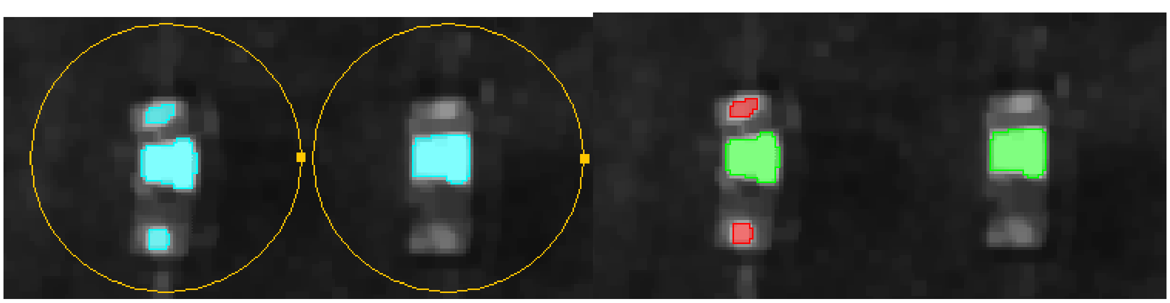
Name	Type	Value
Name	Name	Point Match_TP
Description	String	
Type	String	Point Match
Input Image	Image	[Connector Inspection.TPInspection.DI_Image_Inspection:value]
Tool Origin	Origin	((0.88976,0.591208),0.1177309°) [Connector Inspection.TPInspection.Blob_TP:Tool Origin]
Ideal Points	Point List	72 Points [Connector Inspection.TPInspection.DI_PtsLst_IdealPts_IN:value]
Actual Points	Point List	72 Points [Connector Inspection.TPInspection.Blob_TP:Output Centroid List]

<u>Locating the actual pin tip positions</u>

The most common way to locate the pin tips is with a *Blob* tool. Prior to blob detection though, you might want to use image morphology tools to improve the image quality of the pin tips. Many times the chamfer, cut-off methods, and plating can degrade the pin tip image quality. Employing morphology tools can make the pin tip more defined and contiguous by growing and merging blobs together.

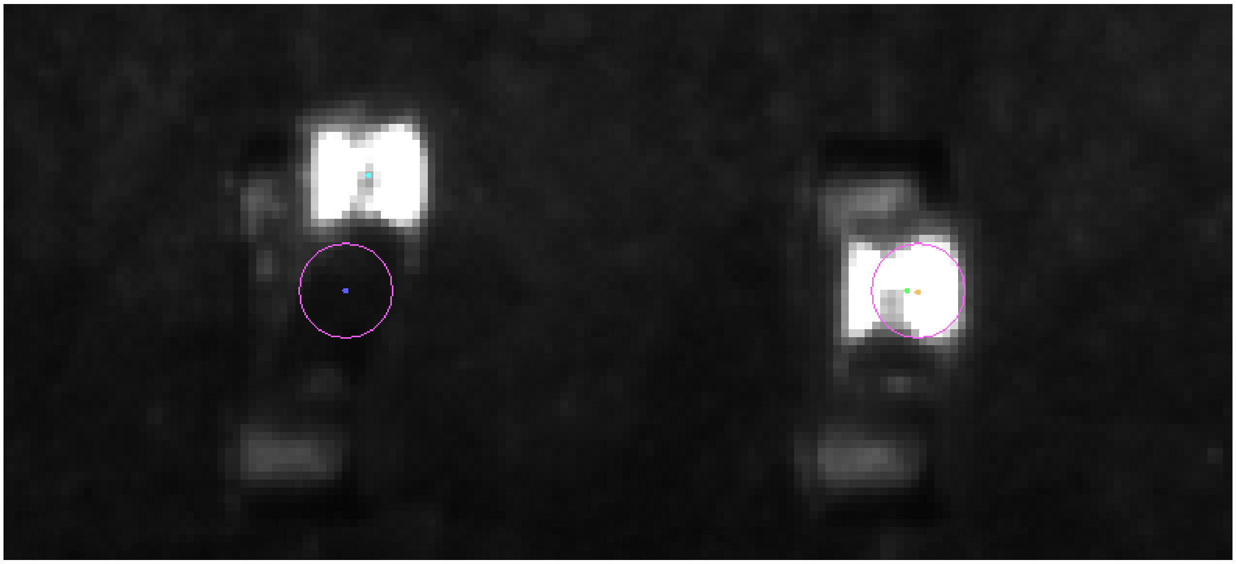


Once the image is improved with morphology tools, the *Blob* tool can detect these pin tips and report the centroid information. One additional feature of the *Blob* tool is a “Single Blob per ROI” filter setting that can also help improve robustness. With this setting, the tool can filter blobs to find the centermost or largest blob. This helps resolve a multiple blob scenario that may be beyond the morphological tool’s filtering capability or be the result of the threshold operation. (See the example below.)

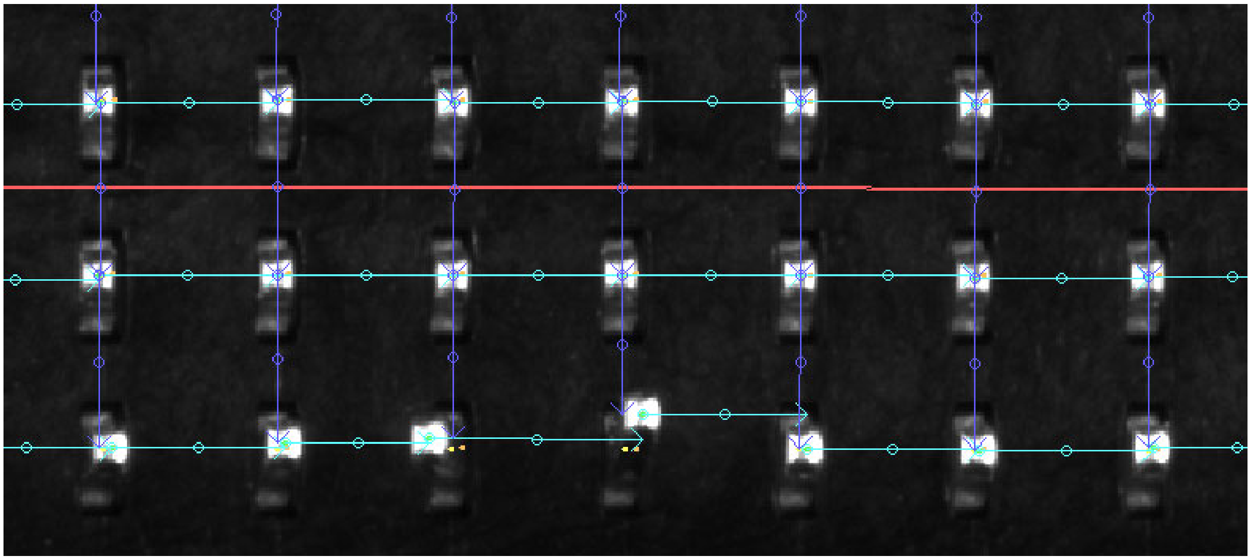


Checking the actual TP versus the expected TP

There are two tools in the IMPACT software suite, *Point Match* and *Grid Statistics*, which analyze TP data. The *Point Match* tool checks the actual point list against the ideal points list. Since the point data is not required to be in any particular order, the points are first analyzed to find "matching" points corresponding to the ideal list. Once all points are matched, they are then checked to see if they are within the positional radial tolerance (TP tolerance). Missing points or points outside the tolerance are identified as failures. The example below shows two points outside the tolerance.



The *Grid Statistics* tool does a similar, but more extensive, point matching analysis. The tool not only does the same tolerance check as the *Point Match* tool, but it also does a "Grid Fit" calculation that allows the entire grid to move within a specified tolerance. This type of Grid Fit inspection is useful for Ball Grid Array (BGA) type inspections. (See the example below.)



In summary, the PPT VISION IMPACT Software Suite has the analysis tools needed to perform True Position (TP) type inspections. The *Origin*, *Morphology* and *Blob* tools can be implemented to robustly find the datum edges and the pin tips. The *Point Match* and *Grid Statistics* tools can perform simple point matching or more complex grid analysis algorithms to determine the pass/fail status of the part under inspection.

To learn more about the PPT VISION IMPACT software, you can download a free version of the software at www.pptvision.com. or read about these analysis tools and many more here.