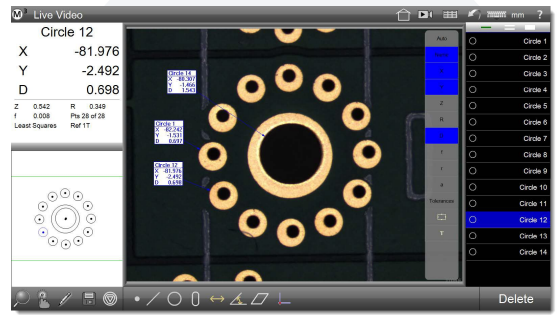


Line and Circle Fit Descriptions



Line Fits

The various fits are ways to estimate a projected (2D) line feature from a set of points. For the X/Y workplane, the estimated coefficients are X, Y (position of the center of the line), and A (angle). Line fits are also supported for the YZ and ZX workplanes. The “axis” feature is a 3D line in space and is not documented here.

For the following, each point used in the fit has some error in relation to the estimated line, i.e. each point is some distance from the estimate. The error could be zero if a point happened to locate exactly on the line.

Least Squares best fit: This is the “classic” fit used to estimate the position and orientation of a projected line. An initial estimate is calculated from two widely separated points. The fit algorithm then makes small adjustments to the X, Y, and A coefficients such that the sum of the squared value of the error of each of the points is minimized. All the points are used in the fit unless “point filtration” is active. This method filters any points that are statistical outliers (the errors of those points are larger some statistical threshold). Filtration is explained in more detail below.

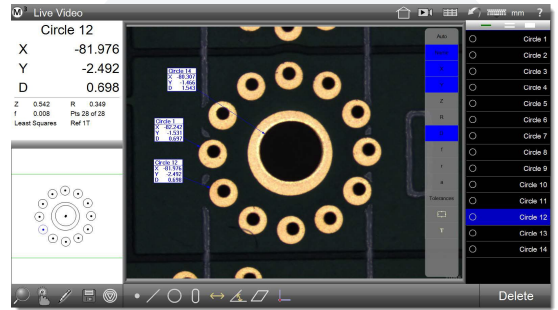
Best form fit: An initial estimate is calculated by least squares fit using all points. The fit algorithm then makes small adjustments to the X, Y, and A coefficients such that the sum of two “worst” errors (one point on either side of the estimated line) is minimized. Since this sum is reported as the form (straightness) of the line, this fit minimizes the actual straightness value. This fit may also use point filtration, but does not filter by default.

Two point MMC line: An initial estimate is calculated by least squares fit using all points. The fit algorithm then makes small adjustments to the X, Y, and A coefficients such that the estimated line is in contact with just two points of the material. The fit works as if you put a straight edge up against the material. The two “high” points of the material would constrain the straight edge from moving farther toward the material. Since just two points determine the fit, filtration is not ordinarily used here.

One point MMC line: This fit is used to find the X or Y datum position of a rectangular part. It is best explained by an example. Suppose a solid rectangular part is on the stage and the lower edge is the “skew” datum. The skew line has an angle of zero and a Y position of zero. Now probe a set of points on the left edge of the rectangle and apply the one point MMC fit. The probed point found the farthest to the left constrains a straight edge held at 90 degrees from moving farther toward the material. This point is the high point of MMC point. The fit determines the X position of the left side of the part and has an angle coefficient of 90 degrees.

One point LMC line: The fit algorithm is similar to the one point MMC fit, but the goal is to find the probed point farthest to the right in the MMC example description above. This is the lowest point in the material on the left edge of the part.

Line and Circle Fit Descriptions



Circle Fits

Circle fits may or may not be subject to “point filtration”. This is a function that may be used in conjunction with the circle fits to find the most useful answer. I will describe point filtration after the description of the fits. The circle feature may lie on any of the three workplanes, i.e. XY, YZ, or ZX. I use the XY workplane for examples.

Least Squares Best Fit: This is the “classic” fit used in most measure software. An estimate is made of the circle coefficients using three widely separated points. Initially those three points lie on the estimate. All points have “error” which is the distance of the point to the estimated perimeter. The three estimated coefficients are the center X/Y and the radius. Then the software will change the coefficients a little so that the sum of the squared value of each of the errors is minimized.

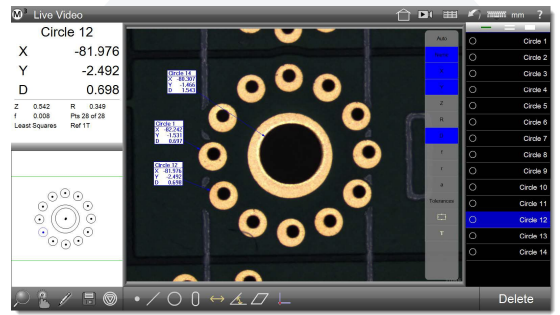
Maximum Inscribed Circle: An estimate of the circle is made using the Least squares fit described above. Then the software will find the distance from the estimated center to each of the probed points and find the minimum of those distances. The goal is to move the center coefficients a little such that this distance will be as large as possible. In this fit, all probed points lie “outside” the perimeter or on it. Generally three points define the fit.

Minimum Super-scribed Circle: An estimate of the circle is made using the Least squares fit described above. Then the software will find the distance from the estimated center to each of the probed points and find the maximum of those distances. The goal is to move the center coefficients a little such that this distance will be as small as possible. In this fit, all probed points lie “inside” the perimeter or on it. Generally two points will define the fit.

Best Form Circle Fit: an estimate of the circle is made using the Least squares fit described above. The points have “error” which is the distance of the point to the estimated perimeter. Then the software will change the coefficients a little so that the sum of the two “worst” errors (one on either side of the estimated radius) is minimized. The three coefficients are the center X/Y and the radius. The radius is arbitrarily set to the mean of the radii of the two worst points.

MMC circle fit (for a bore): This yields the coefficients of the largest boss that could fit inside this hole. The limit comes from the maximum material condition of the hole itself. If some surfaces extend toward the center, this interferes with the boss that is supposed to insert. It uses the maximum inscribed circle fit as a basis.

Line and Circle Fit Descriptions



Point Filtration

Many measurements, especially the VED type, will trigger on “false” edges due to debris or noise in the case of surface lighting. If there is enough data, then it is possible to reliably remove these “outlier” points from the set used in the calculation of the Least Squares Best fit estimate. For technical reasons, this is done by removing just one point at a time and recalculating the fit until all outliers are removed. The point filtration uses several parameters to perform its function. The user may change these or turn off filtration if desired. The mathematical heart of point filtration is the standard deviation of the point error. The algorithm is designed to eliminate points that are at the “tails of the bell curve”, i.e. the points have unexpectedly large errors and probably are not true edges of the feature.

Help and Resources

Please visit the support section at www.metlogix.com for access to MetLogix product documentation.

Watch tutorial videos for popular Mx functions at <http://www.youtube.com/metlogix>

Join the discussion on Facebook, search “MetLogix”.

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