Very accurate cutting tools, especially diamond tools, are measured using a vision system based on a microscope, a digital camera and a pc with the necessary measure and analysis software.

It basically measures the radius and the waviness, but other shapes e.g. a facet is also possible. Important aspects for measuring very accurate are the edge detection and the fit algorithms. A good calibration results in an absolutely accurate result.

With more than 30 years of experience in developing highly accurate vision measuring systems, J.A.I.M.S. has upgraded the Diamond Tool Measurement and included new features.

The new generation Diamond Tool Measurement (henceforth DTM112) is based on a USB CCD (1600x1200 pixels and up) digital camera for high accuracy and stability. The measurement interface is user-friendly and improved supporting software guarantees an accurate measurement. This Diamond Tool Measurement type 112 measures of the convex and concave tools:

- the radius
- the waviness over the predefined arc

Both a front and back light can be used to measure the convex and concave tools, so a tool with a negative rake can also be measured.

It is possible to tune the predefined arc afterwards to select valid date within the specified arc for more accurate result. For facet tools the DTM112 measures:

- facet width,
- left and right angle
- included angle
- facet angle
- waviness of the facet.

Measuring the cutting tool radius and waviness

The objective of the microscope is manually selected. The DTM112 contains 2 improved focusing tools:

1. a focusing tool measuring the sharpness of the edge within a fixed segment, meanwhile the position of the tool edge on the microscope is measured. Combining these features the position in 3D is assured.
2. a universal focusing tool especially created for arc segment measurements and random shaped tool tips.

The DTM112 has the possibility to select the measurement arc range symmetrical by moving the selection line up and down on the screen. The other possibility of the DTM112 is to select the radius segment by drawing manually a line over the tool tip on the screen.

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Measuring the cutting tool radius and waviness
The radius and position of the tool is first measured to optimize edge detection settings so a very accurate measurement of the radius and waviness is performed. After measuring the tool tip edges with sub pixel accuracy the radius is calculated using a best circle fit. Next step is a waviness calculation with sub pixel accuracy.

For analysis and fine tuning a special pop-up screen gives the user the opportunity to select the valid data and the program performs an immediate recalculation.

In this pop up screen it is possible to tune the low pass filter length to reduce inevitable high frequency quantization noise.

When the measurement result matches the shape of the tool and are accepted by the operator, a measurement report generator creates a report or certificate. This report contains information fields which have to be filled by the operator. The operator can select to print the Center Hight on the final pdf report and an image can be saved on disk for future purposes.

The final report contains also companies logo, address, website and e-mail address.
Measuring accurate single facet and multi facet tools.

Focusing accurate single facet is performed by sharpness detection on the edges of the tool. Edge detection of the tool is performed within predefined areas.

Accurate single facet width measurement.

After edge detection the exact facet width is the distance between the intersection point of the best fitted lines through the detected edge points. Subsequently the waviness and the angles are calculated and the results are shown.

Next, the report generator pops up and shows the measurement results: facet width, included angle, facet angle and total waviness.

Facet selecting for measuring a multi facet tool up to 3 facets, is performed manually. The operator selects the start and end point of the facet by drawing a line between both points. The results of the facets widths and angles between the facets are showed.

Next, the report generator pops up and after the operator fills in the blank fields a measure report is generated. The operator also have the possibility to save the image.
Saving reports and measurement data
The results of the radius or the facet is saved in a final report, in pdf-format, on the server and a backup is stored on the local hard disk.
The measured data is also saved in an excel file for further analysis and statistical process control.

Extra features
Zoom function:
a zoom function gives the possibility to enlarge the image for detailed analysis. Automatically generated scroll bars gives the possibility to scroll and move the image.
Authorization:
pressing 'Log in' opens a log in screen.

When authorized, 'Password control' gives access to change and delete the password and also to change authorization.

The authorization of the extra features e.g. calibration, adjust settings, change directory settings, changing vision parameters and debugging can be freely changed by personnel with the highest authorization.

• Up to 8 levels of authorization are available.
• Up to 10 program levels can be separately authorized.

Extra features and settings for optimal performance.

Adjust settings: changing detection and measurement setting can be done by qualified personnel to tune the vision software if required.

Directory settings: camera, vision and measurement settings are saved in files. Directories for these settings and saving reports and also for measured data in excel file, can be customized to the company standard. Directories for saving test or debug images can freely selected.

Vision: basic vision settings can be changed and saved. Knowledge of basic vision is required.
The Vision tab also contains:
• Camera settings possibilities.
• Adding, deleting and changing the lens list.

Debug: extra measure and calibration data are available in the Debug tab. Also, saved images can be re-measured for debugging and tuning the software and require detailed information.

Lens list:
the used objectives or lenses can freely added, removed or changed in the lens list, using a pop-up screen (Vision tab). Each lens does have an unique number. Lens description can be filled freely in the Lens Description area.

Camera settings: exposure time, gain and frame rate can be changed (Vision tab) to optimize for best light intensities.
The user interface for 'Measure.'-tab is available and selectable in English, German and Dutch.

Hardware and Operating system:
Windows 7 or 10
Desktop PC (5x USB 2.0) incl mouse and keyboard
monitor 1600x900 or more
Laptop (screen size: 1600x900) incl mouse.
Memory: >500MB; Hard disk > 40GB; 4x USB 2.0

Special measurement programs
Optionally it is possible to develop special measurement programs which runs on the DTM112 platform with the same accuracy as the radius or facet measurement.
The accurate DTM112 focusing software to focus the tool on the camera including adjustment software guaranties a perfect measurable and sharp image.
Measurement of special shaped tool

First step is prepositioning the tool and select the measure program for this tool and the corresponding optics.

After selecting the measurement program at 'Tool shape' and the corresponding optics at 'Lens list', accurate focusing is executed. Aligning the tool special software is created to help the operator.

The measurement results are given and also showed in the image.

Measurement medical thread cutter

First step is prepositioning the tool and select the measure program ('Thread Cutter') for this medical thread cutter and the corresponding optics.

After focusing and tool alignment the measurement can be performed. The results: radii, distances and averages are presented and showed in the image.

The waviness of the circular shaped cutter profile is also measured and showed at the thread cutter result.

Thread cutter results presented in the image.