

a marker is partially obscured it is only observed by one camera it cannot be identified as being part of the wand it could not be tracked in a camera's image it was too close to a junk marker to be identified with certainty or its residual value was too large. point_residuals this is an average of all point residuals in user distance units for all wand markers used for the calibration. a ray_residual is defined as the shortest distance between a ray and the calculated location of the point assigned to that ray. the location of a point marker center is computed by finding the point that has the smallest root mean squared rms distance to all rays assigned to that marker. so this value is an indicator of how closely the measured ray directions for all accepted wand markers intersect and provides a good indication of the accuracy of the calibration. wand_residuals the wand may be considered to be a rigid body having a much greater extent than a single marker. in certain circumstances a calibration could produce very low residuals in every location where individual wand markers are found yet the connection between distant markers may be incorrectly characterized resulting effectively in a distorted 3d space. the wand_residual is the rms value of all residuals in user distance units obtained when all markers on the wand which is assumed to be rigid are simultaneously fitted to their rays in each frame. its value will always be larger than the point residual but it should not be much greater. a much larger wand_residual would indicate that the distance measurements between markers further apart than the length of the wand would probably have significant errors. wand_length_sd this value presents the standard deviation of the distance between the two outermost markers on the wand over all frames in which the markers could be identified. it is perhaps a better indicator of the linearity of the calibrated volume. again the length units are user units. it should be noted that the residual values are a function of the accuracy of the calibration and also the noise inherent in the camera image data. the noise comes from the discrete nature of camera sensors as well as the processing electronics and software. using cameras with low resolution sensors especially when imaging small markers can be a principal source of noise and a major component of the presented residual values. here it should also be pointed out that a calibration with a smaller number of frames may have smaller residual values than one with a large number of frames yet the calibration will usually be less accurate. the reason is that it is easier to fit the many camera system parameters to a smaller number of input data points because the calibration is minimizing the overall residuals of all rays. it biases the resulting calibration to produce very low residuals at the participating points at the expense of locations that are elsewhere in the volume where the residuals may be quite high. camera_list_box this area provides some results for individual cameras as well as letting the user select the camera whose linearity grid is to be displayed in the main graphics area. rays this is the number of rays from a camera that were used for the system calibration. low values in relation to other cameras indicate that a camera did not successfully image many wand markers and that its calibration might be suspect. residual this value is the average residual in user units for all rays that could be used from the camera. again it should not be much larger than for the other cameras and it is somewhat dependent upon the resolution of the camera's sensor. image this shows the approximate percentage of the camera's image area that was successfully calibrated. any marker image falling outside the shown grid area will be ignored during tracking when this calibration is used. reference_points_box this list box provides a report on the reference markers that were used to define the global coordinate system in which all marker trajectories will be expressed. point

- ****% image**** it usually should not be difficult to get these values above 70%. if they are less, then either the wand has not been moved sufficiently or the camera is not placed close enough to the measurement area. be aware of the fact that for a marker image to be used in one camera it must, as a minimum, also appear in at least one other camera. this factor tends to complicate the cause and effect of calibration discrepancies. to be safe it is best to collect more frames with extensive wand motions to ensure that the maximum possible coverage of the camera image areas is achieved.

control buttons

- ****close**** closes the ***viewlin*** program.
- ****next**** closes the ***viewlin*** program and starts calibration of the next **.cen** file if multiple **.cen** files were selected for calibration in the amass shell, or display the next calibration file if multiple **.ca/** files were selected in the amass shell.
- ****apply**** writes the name of the currently displayed calibration file to the current project file's track parameters, to be used for the next tracking operation.
- ****delete**** deletes the currently displayed calibration file.

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