Scanning Physical Objects With MicroScribe/MicroScan

Prerequisites

Initial remark: If you did not do so already, visit http://update.microscan-3d.com where you can log in with your MicroScan's serial number and download hardware/software setup and installation instructions, software updates, and videos.

In order to use MicroScan make sure the following requirements are fulfilled:

- MicroScan sensor is mounted onto the MicroScribe's stylus and fixed in its position
- MicroScan, interface box, and power supply cables are connected properly to the MicroScribe and the computer
- MicroScan Tools software and PGR camera driver are installed
- MicroScan calibration and license files have been moved to their respective directories

Homing the scanner

Same as for the MicroScribe itself also for the MicroScribe/MicroScan combination an initial coordinate system must be defined before you can use it. This procedure is called Homing and can be done before or after starting MicroScan Tools software. To home the system do the following: Carefully and firmly insert the stylus tip into its home position (red MicroScan button facing away from the MicroScribe), rotate MicroScan counterclockwise until it touches the MicroScribe's shoulder joint, and press the white home button on the MicroScribe's rear panel. The color of the MicroScribe's indicator LED will change from red to green. Failing to properly home the system may result in sweeps that show distortions and appear in different positions on the screen.

Adjusting the sensitivity

Before scanning you may need to check and adjust the sensitivity of the MicroScan camera. Depending on the environmental light intensity as well as the color and reflectivity of the object surface to be scanned it may be required to modify the camera's default settings. To do so start MicroScan Tools software (see respective section for details) and either select Show Sensor Image from the MicroScan menu or click the Adjust button. When holding the sensor such that the laser line incides the object surface or sweeping the line across the surface you will see the camera image reflected in the Adjustment window. Depending on which workspace was chosen (large or small laser activated on the left side of the screen) the profile will be shown in different positions in the main window. If the object is outside the respective working space limits (sensor too close to or too far away from the surface) the profile disappears from the window. The small window can be slided arbitrarily over the profile curve to produce a zoomed view in the window on the right side of the screen. For optimum scanning the laser profile should appear as a narrow but solid curve with minor intensity variations only. If this is not the case you can adjust the scan rate, exposure, tolerance, and brightness parameters below the zoom window until these conditions are met. In most cases it is sufficient to only vary the exposure (in the range of 1-5 ms). When you are satisfied close the Adjustment window to return to the application screen. As a matter of fact, modifications to the sensitivity parameters are required in few cases only, e.g. when the object surface is very dark.

Calibration

There is basically no difference between a calibration and a standard scanning project except that after completing scanning you run the Calibrate command instead of post processing the data.
Once the system has been started as described in the next section it is ready for calibration. As a reference object use the white sphere mounted on a small tripod which is part of the MicroScan delivery. If MicroScan is used together with a MicroScribe G2LX or MLX, position the sphere about 10 inches away from the MicrosScribe's front left corner at an angle of about 45 degrees to the left. This ensures that the sphere can easily be accessed by the laser from all sides. If a G2X or MX is used, the sphere should be positioned somewhat closer to the MicroScribe. Now scan the sphere from the front, back, left, right and top perspectives. You can think of scanning five sides of a cube which encloses the sphere. Do 4 sweeps from each perspective (both in horizontal and vertical directions, back and forth by flipping the scanner around the stylus) to create a total of 20 sweeps. Use the default large working space for calibration. If you need to capture high detailed areas you may eventually want to

check the calibration with the small working space as well. The procedure is also shown in the sphere calibration video. (If not included on your MicroScan CD, the video and other info can be downloaded from http://update.microscan-3d.com as already mentioned above). Don't worry if the scans are not aligned perfectly during the initial calibration: This is due to the fact that MicroScan and MicroScribe data are not yet synchronized. After calibration these deviations will be compensated for. Be aware that the sphere calibration result is different from the scanner calibration file which comes with your scanner: The latter was created in the factory and belongs to your individual device only. It will never be changed while the calibration you just did is needed to synchronize the scanner to your MicroScribe and will be different if connected to another MicroScribe.

After scanning, in the objects list click on the circular button left from the current object (default name Scan1) to select it. A read bounding box will be outlined around all the sweeps you did so far. Now select and delete all data except the data which directly belongs to the sphere. To invert the selection press Strg+I, to clear the selection press Strg+C. When selecting Calibrate MicroScan from the MicroScan menu or clicking on the Calibrate button calibration starts, monitoring how accuracy develops. Normally the system is very close to the final accuracy level after a few seconds already. The calibration result is stored in MicroScan Tools software and the calibration date shown in the application screen. From now on neighboured sweeps should align without showing sharp creases and edges between them anymore. Perfect alignment is achieved later on during postprocessing of the scanned data (sweep registration etc.). Regarding recalibration: This may be required after dismounting/remounting the scanner or when not having used the scanner for a longer time. To verify, just do a few sweeps and see how they align in order to decide whether or not recalibration is recommended.

Starting and using MicroScan Tools

When launching MicroScan Tools software the application window will come up on the screen. From the MicroScan menu select Connect MicroScan. The MicroScan segments and joints schematic diagram together with the laser fan will appear in the application window, reflecting the joint configuration in its current position and orientation. In parallel, MicroScan-to-MicroScribe synchronization is started. Once the synchronization is successfully completed the system status is reported as Ready (on green background). Basically you are ready to start digitizing now, provided that the system has been homed, the scanner sensitivity checked/adjusted, and the entire system calibrated. If not, please refer to the respective sections above to see how to do this. Scanning with the MicroScan is easy: Position the object relative to the system such that a large portion or even the entire surface of the object is within the reach of the scanner. Avoid moving the scanner near to its limits, better decide for comfortable operation and add scans from a second or third perspective to be combined later on. Scanning is controlled by the red button only: To start s single sweep just press and release the button. The system status is reported in red as Scanning. From now on data from the object can be captured and displayed on the screen in real time. Scan slowly and steadily at a constant distance from the surface, avoiding jerky movements. During scanning the scene window and the small range window on the left provide useful visual feedback on the scanning speed and object distance. To stop scanning just press and release the red button again. The system status changes to Synchronize and Ready again, indicating that the next sweep can be started. If you like or if you scan in a noisy environment you can activate acoustic feedback (Play Sound) on the status.

MicroScan Terminology

In MicroScan terminology, raw scan data is referred to as

- profiles (sectional curves created by the MicroScan laser sensor and combined with the MicroScribe position/orientation data for particular time increments),
- sweeps (collection of all profiles captured between the start and stop command during MicroScan movement across the object surface), and
- scans (collection of all sweeps taken from an object in a fixed MicroScribe/MicroScan-to-object orientation).

Without the need for further explanation profiles consist of all 3D point locations measured along the intersection of the laser fan with the object surface. In that concept, a complete 3D model may "consist of scans each of which consists of sweeps each of which consists of profiles".

Once the sensor has been mounted to the MicroScribe, calibrated (normally required only before using the sensor for the first time), and the sensitivity adjusted relative to the object surface, the system is ready for scanning. The process of creating a 3D model starts with the Scan Phase, capturing different sweeps from a fixed system position to define a single scan. If some parts of the object can not be covered from the current MicroScribe position or are out of the sensor's reach, either the MicroScribe can be reoriented or the object be relocated for one or more additional scans.

In Sweep Phase, different scans (part models) and sweeps can be registered and merged (aligned and united to yield a complete model). Prealigment of scans is possible either by manual orientation or by defining up to four reference points in the overlap region between pairs of neighboured scans. During subsequent precision alignment the orientation of all scans is optimized in an automatic iterative process. After merging the scans together all sweeps contained in the model are automatically registered to further improve the model quality and achieve the highest level of accuracy. If desired, a homogeneous wireframe mesh can be calculated by point resampling and triangulation, curvature-dependent decimation and smoothing included. By setting the values of some characteristic parameters the user can control and fine-tune each processing step.