User Manual: IPA Data Processing Tool (DXF files)

Prepare DXF Files for Analysis in the IPA Analysis Tool

1 Introduction

The `IPA Data Processing Tool` is a web-based application that formats terrestrial laser scanner (TLS) data. Specifically, it formats individual data files collected during the OSAC Interim Performance Assessment (IPA) test procedure into a single coherent file that can be uploaded directly into the secondary `TLS Analysis Tool`.

> **NOTE:** This user manual is specifically for the DXF version of the `IPA Data Processing Tool`. A separate version exists for formatting CSV or TXT files. The DXF version is uniquely designed to check for and remove background noise (artifacts) in the dataset, whereas the CSV/TXT version assumes that no artifacts are present in the uploaded files.

During an IPA evaluation, four separate scans are taken of a stationary array of targets to collect their Cartesian (X, Y, Z) center coordinates. It is critical that the coordinates collected at each position remain in their individual coordinate systems and not be unified (registered) to a common coordinate system. This is achieved by saving a unique data file after each individual scan is performed.

However, the downstream `IPA Analysis Tool` requires that the scan data for all four positions be combined into a single file where the coordinates for any given target align perfectly in the same row. This requirement creates two primary data management problems:

- **Scrambled Target Order:** The scanner often saves the targets in a completely different order from one scan to the next. The data points must be rearranged to line up row-by-row.
- **Unwanted Artifacts:** Automatic target extraction software can accidentally detect stray background points. These extra coordinates must be identified and removed prior to analysis.

The `IPA Data Processing Tool` fixes these problems automatically. The application finds the matching targets across all four scans, removes any artifact coordinates, and bundles everything into one clean `.csv` file that is appropriately formatted for the secondary `IPA Analysis Tool`.

2 Getting Started

2.1 File Requirements & Constraints

To ensure the `IPA Data Processing Tool` can read the data, files must follow these rules:

- **File Type:** Native AutoCAD drawing files (`.dxf`) must be used. Standard text files (`.txt`) or spreadsheets (`.csv`) will not work.
- **Cartesian Coordinates:** The files must contain standard 3D point measurements (X, Y, Z). The tool identifies these by looking for specific identifying codes inside the `.dxf` file structure, where the code `10` indicates the X coordinate, `20` indicates the Y coordinate, and `30` indicates the Z coordinate.
- **Number of Files:** Exactly four (4) files must be uploaded at the same time—one for each scanning position.
- **Unique File Names:** Every uploaded file must have a different name. If any files share the same name, the tool will show an error.

3 The Screen Layout

The webpage is divided into two parts, as shown in Figure 1.

1. **The Sidebar (Left Side):** This section allows the upload of the four files, customization of target names, selection of units, and execution of the process button.
2. **The Main Screen (Right Side):** Under the header "Processed Data", this section will display warnings, a preview of the combined data, and download controls for the finished spreadsheet after the files have been processed.

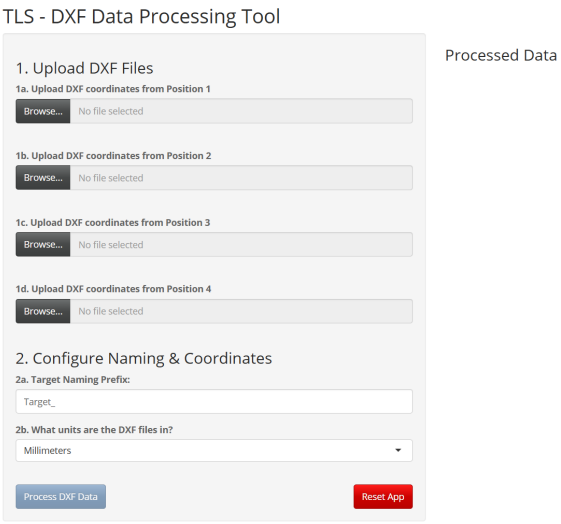

Figure 1: A screenshot of the DXF Data Processing Tool interface.

4 Step-by-Step Instructions

The layout of the user interface and the relevant entry fields are shown in Figure 1.

4.1 Step 1: Upload Files

Navigate to the box on the left side labeled **1. Upload DXF Files**. Select the four scanner files and place them into slots 1a, 1b, 1c, and 1d. The blue **Process DXF Data** button will stay locked until all four slots contain a unique file.

4.2 Step 2: Choose Settings

Look just below the upload slots to set preferences:

- **2a. Target Naming Prefix:** Input the name to be used for the targets. The tool automatically adds sequential numbers to the end of the text string (for example, typing `Target_` will yield `Target_01`, `Target_02`, etc.).
- **2b. What units are the DXF files in?:** Select the measurement unit used during the scan. Choosing the correct unit affects the algorithm used to remove artifacts.

4.3 Step 3: Process Data

Once the files are uploaded and validated, the blue **Process DXF Data** button will become active. Click this button to run the application. The tool will automatically match the targets across the four files, remove any artifacts in the data, and combine the four separate files into a single, unified data file.

4.4 Step 4: Error Messages

If the application identifies any issues with the data, processing stops and a red error message appears at the top of the screen. Common errors include:

- **Data Loading Failure:** The file is not a `.dxf` file or a slot is empty.
- **Empty DXF Point Tables:** The file contains no actual 3D points.
- **Dimensional Structural Error:** One or more points are incomplete because they are missing an X, Y, or Z measurement number. Every point must have all three numbers to be valid.

4.5 Step 5: Preview and Download

When the processing completes successfully, a summary message appears on the right side of the screen displaying the final count of matched targets, followed by a preview grid of the organized data (see Figure 2).

The preview table should be reviewed to ensure the target names are correct and that the data contain the expected number of target coordinates. Clicking the green **Download Processed Data** button at the bottom of the main display panel saves the finished spreadsheet to the computer as a standard `.csv` file named with the current date.

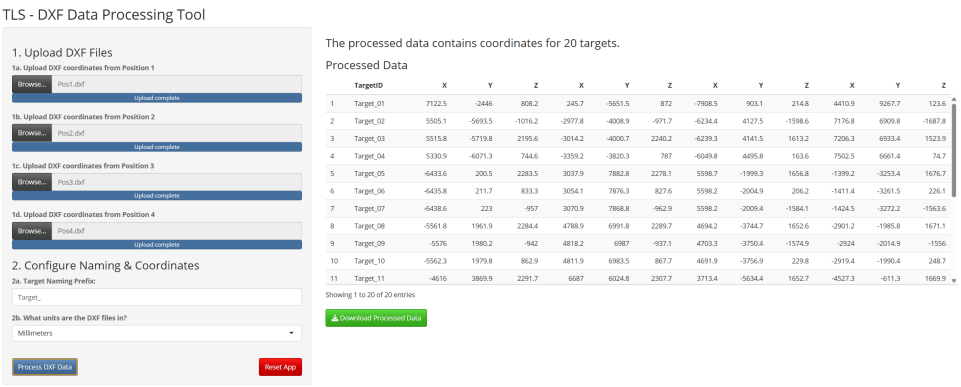

Figure 2: An example of the Preview and Download stage.

Important Note on Artifact Checking: If files contain a different number of detected targets, the tool will detect and remove artifacts. If this occurs, a red box appears on the screen to show exactly how many extra points were removed from each position.

The tool only checks for and removes artifacts if the four uploaded files contain a different number of coordinates. If all four files contain the same number of coordinates, no automated check is performed. The user should verify that the final number of targets shown in the processed data matches the actual number of physical targets in the scanning array.

4.6 Resetting the Webpage

To clear the environment and start over with a fresh set of data, click the red **Reset App** button at the bottom of the sidebar to refresh the application instantly.

5 Example Datasets

Two sets of example files are provided with the `IPA Data Processing Tool` to illustrate the application. Each set contains four separate position files:

- **Clean Example:** This example contains four `.dxf` files, each containing Cartesian coordinates for a fixed array of 20 targets. No artifact coordinates are in these files. The measurement units for these files is millimeters.
- **Artifact Example:** This example contains the same four `.dxf` files as the previous example, except the `Pos1.dxf` file now contains one artifact and the `Pos2.dxf` file now contains two artifacts. The measurement units for these files is millimeters.

Processing the files from either example set through the `IPA Data Processing Tool` creates a single, combined data file. When processing either example set the user input is the same, as the tool will automatically detect and remove the artifact coordinates contained in the second example set. Both examples return the same data. However, the order in which the targets are labeled in the resulting processed data file differs. The reason for this is because if no artifacts are detected, the tool aligns the processed data to correspond to the target order in the Position 1 data file (i.e., the first coordinate found in the Position 1 data file will be labeled "Target_01"). But if the Position 1 data file contains artifact(s) that are removed in the data processing, the order in which coordinates appear in the processed data will differ.