ZLoss App User's Guide

Introduction

Using a PiCUS® (Argus Electronic GmBH, Rostock, Germany) sonic tomogram, the ZLoss App estimates the load-bearing capacity of tree parts with internal damage by computing the percent decrease to the section modulus, Z_{LOSS} (%) (Burcham et al. 2019). This is equivalent to the percent increase in local stress caused by the loss of supporting wood, and it can be used by arborists evaluating the severity of internal defects during tree risk assessment. The estimates can be used to inform the likelihood of failure by material fracture (*not* buckling) for a tree part in bending, but it is important to remember that the estimate only provides information about the measured tree part (not the whole tree).

User Instructions

To use the program, you must provide two image (.jpg) files: a tomogram showing the visualized damage pattern (Figure 1A) and the corresponding geometry image showing only the blue trunk boundary outline (Figure 1B). The images should be oriented identically and exported without annotation from the PiCUS software. For optimal results, the images should be the same size and sufficiently large. In the PiCUS Q74 software, the size of exported images can be adjusted by changing the size of the window in which the tomogram is displayed.

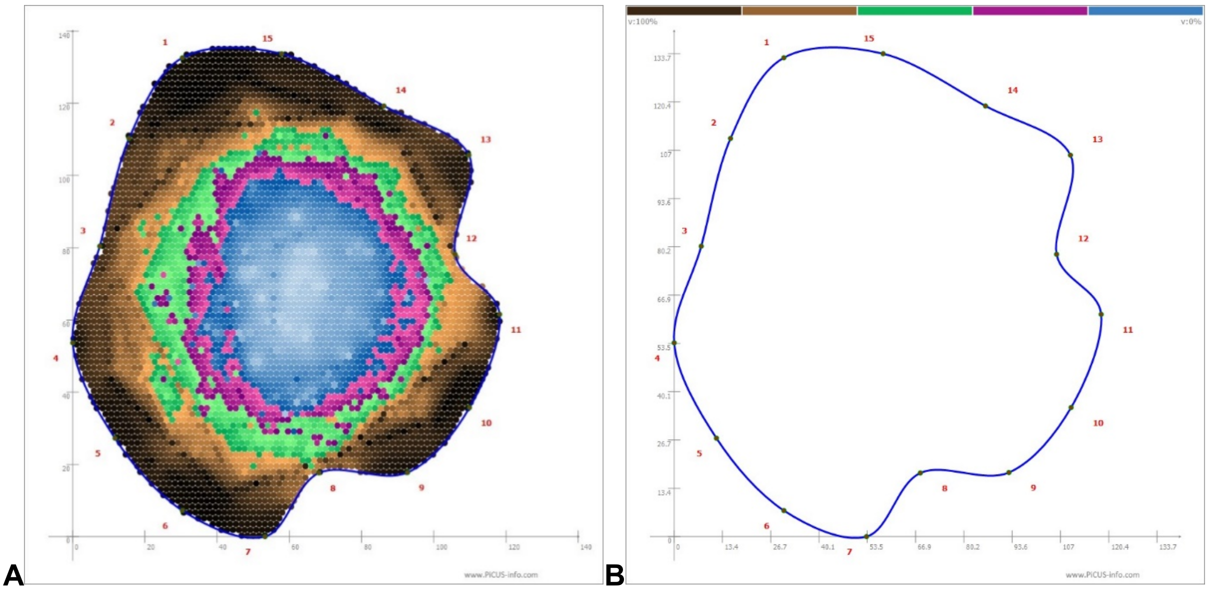

Figure 1: Two images are used for analysis, including a sonic tomogram showing the visualized decay pattern (A) and a geometry file showing the blue trunk boundary line (B).

The two image files can be loaded using the 'Select File' buttons (Figure *2*). If you hover over the field titles, a small window will appear with a brief explanation of the inputs required in each field.

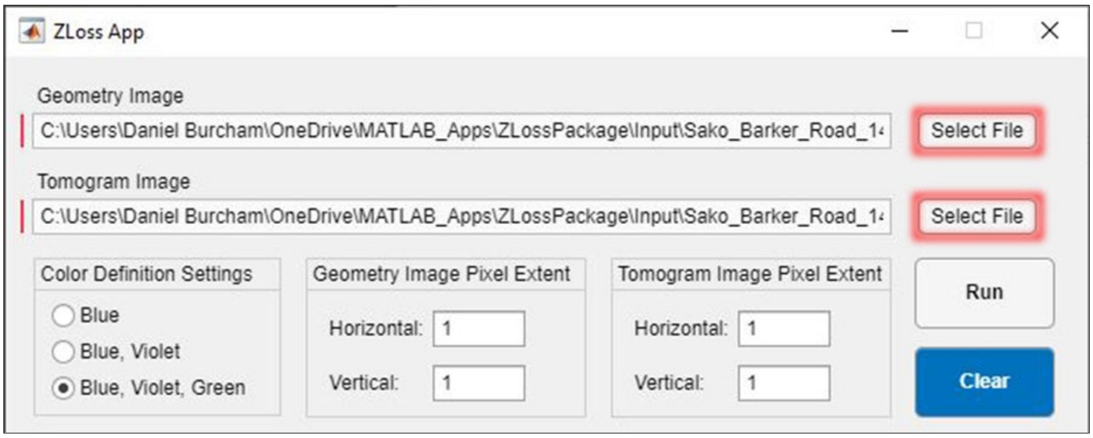

Figure 2: The geometry and tomogram image files can be loaded using the respective 'Select File' buttons.

In addition, you may provide two optional inputs to customize the results. First, you can specify the set of colors used to select damaged parts in the tomogram, either (1) blue, (2) blue and violet, or (3) blue, violet and green (Figure 3). These colors will be used to delineate damaged from undamaged wood, and you should choose a suitable area that compensates for any anticipated measurement error in the tomogram, depending on the species and geometry of the measured tree part. Without any adjustment, the default color definition settings (blue, violet, and green) will be used by the program.

Second, you can specify the physical extent of each image pixel (length per pixel) in the horizontal and vertical directions for both the tomogram and geometry image (Figure 3). Using the pixel indices of various tick marks on the x- and y-axis, this can be computed for each image as the actual length (any measurement units) divided by the number of pixels (*n*) spanning the length in the image. Unless changed, the default setting (1) will be used by the program, and the size of the tree part will be measured and displayed in pixels.

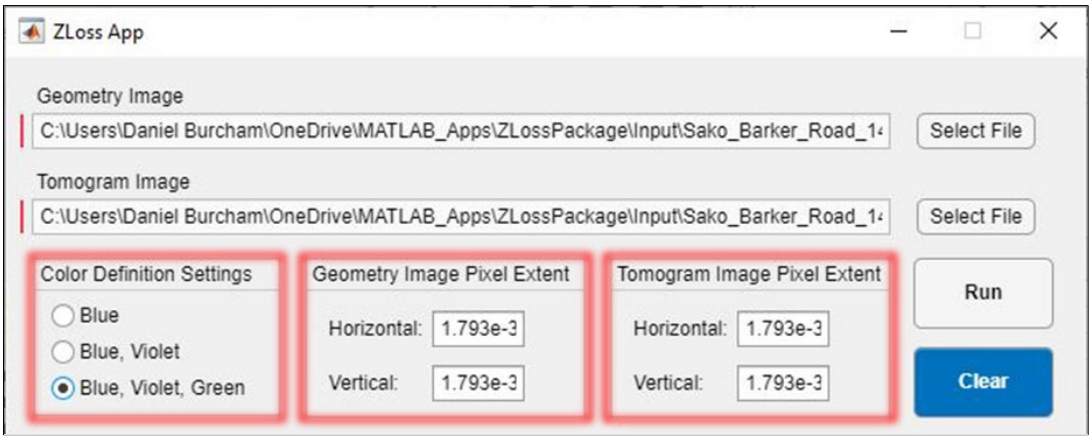

Figure 3: The colors used to select damaged areas in a tomogram can be selected using the radio buttons (left), and the pixel scaling factors for the geometry (center) and tomogram (right) image can be provided to display the results in any dimension.

After clicking 'Run', the Z_{LOSS} results will be displayed on a colored ring surrounding an image of the damaged tree part. The colors correspond to specific Z_{LOSS} values, listed on the colorbar on the right, for different directions of loading. For reference, the percent damaged cross-sectional area will be displayed in the lower right-hand corner of the window. You can explore and save a copy of the results using the toolbar in the upper-righthand corner of the figure (Figure 4).

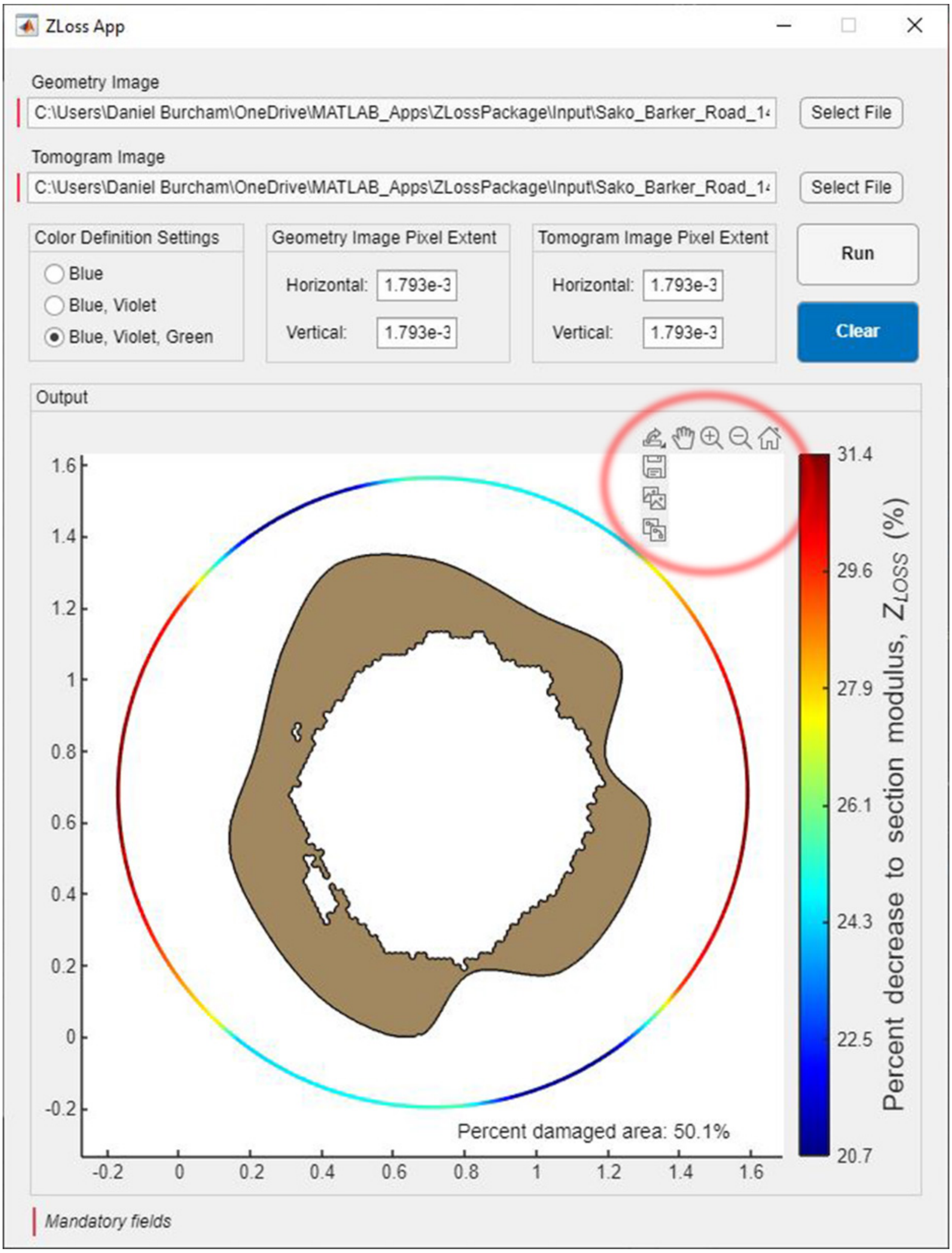

Figure 4: The estimates are displayed using a red, green, and blue color scale showing directional Z_{LOSS} between the minimum and maximum values for a cross section. For this case, the measurements were computed by using blue, violet, and green to select damaged parts.

This program was developed with support from the National Parks Board (NParks), Singapore. If you have any questions or suggestions, you are welcome to send an e-mail to Daniel Burcham (daniel.burcham@colostate.edu).

Literature cited

Burcham DC, Brazee NJ, Marra RE, Kane B (2019) Can sonic tomography predict loss in load-bearing capacity for trees with internal defects? A comparison of sonic tomograms with destructive measurements. Trees 33:681–695. https://doi.org/10.1007/s00468-018-01808-z