Doming_analysis v.1.0

http://www.lancs.ac.uk/staff/jamesm/software/sfm_georef.htm

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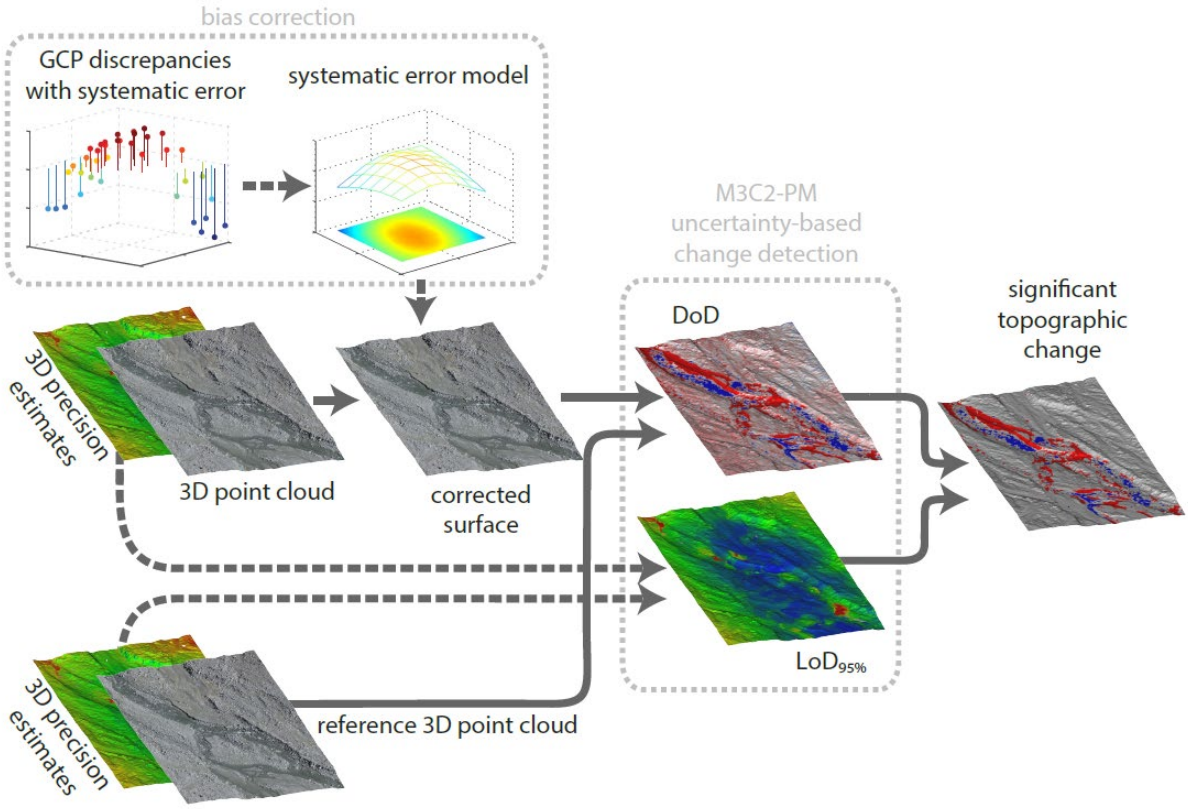

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1. Introduction

Doming_analysis is a gui-based tool for assessing and correcting systematic error in SfM point clouds processed in Agisoft Metashape, based on error information on control points. It provides the bias correction component within the flowchart diagram on the preceding page. Doming_analysis v1.0 is written in Matlab (release 2018a, Win.10 64-bit) and has been compiled as a stand-alone executable. To run the executable, you will need to download and install Matlab runtime libraries (see installation instructions below).

2. Installation

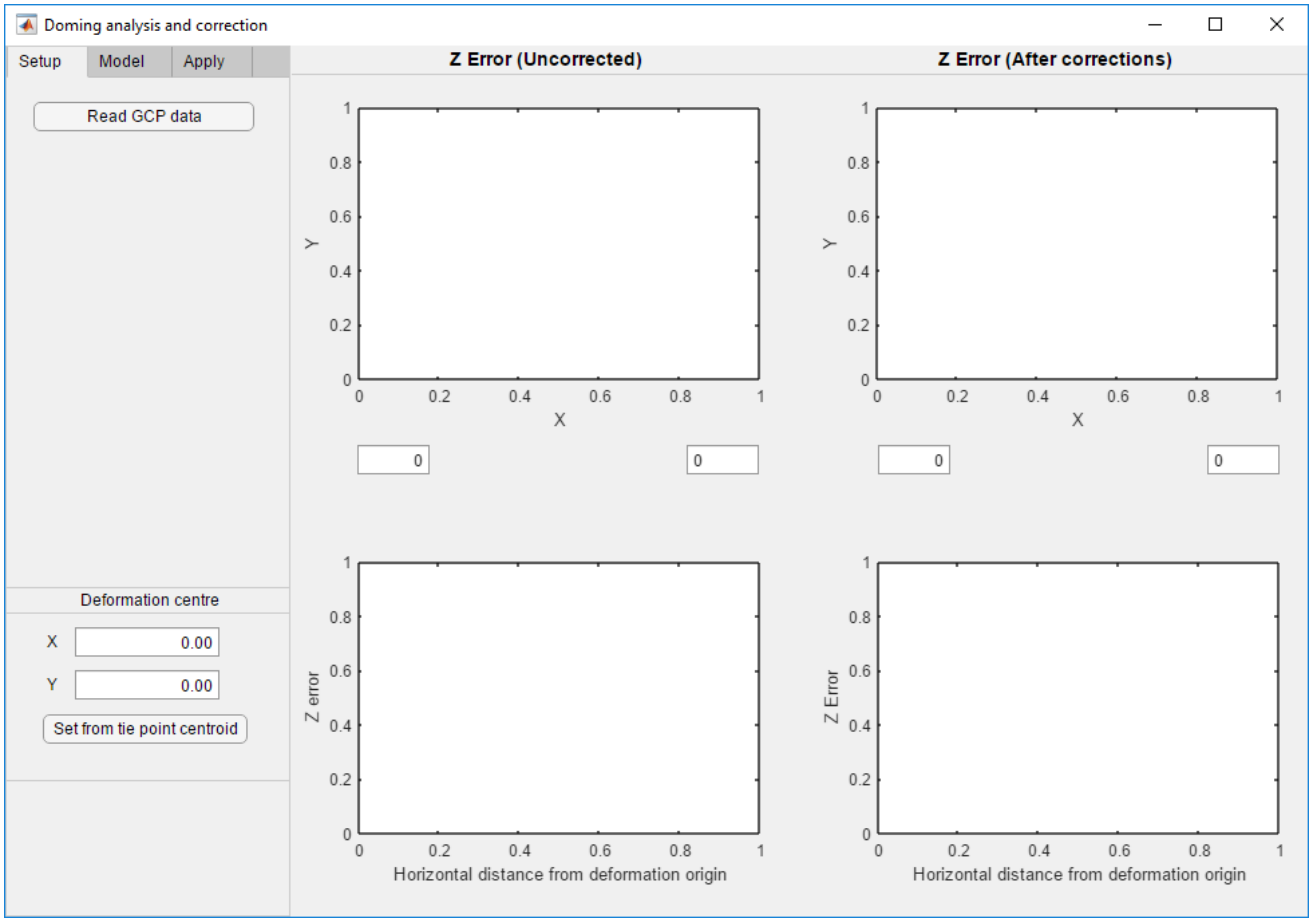
1) Download and then uncompress the file Doming_analysis_v1.0.zip to a folder. The executable itself (doming_analysis.exe) needs no further installation.
2) Download and install the Matlab Compiler Runtime. For sfm_georef v3.1 the version required is R2018a (9.4) , 64-bit and can be downloaded from:

   http://www.mathworks.co.uk/products/compiler/mcr/

   Doming_analysis will not run unless the correct runtime version is available. If you already have other versions of Matlab Compiler Runtime installed, you will still need to download this one, and multiple versions can co-exist without difficulty.

3. Modelling and correction of systematic doming error

Starting the application presents the main window, comprising empty plots on the right and, on the left, the three tabs (**Setup**, **Model**, **Apply**) which represent the three stages of use.



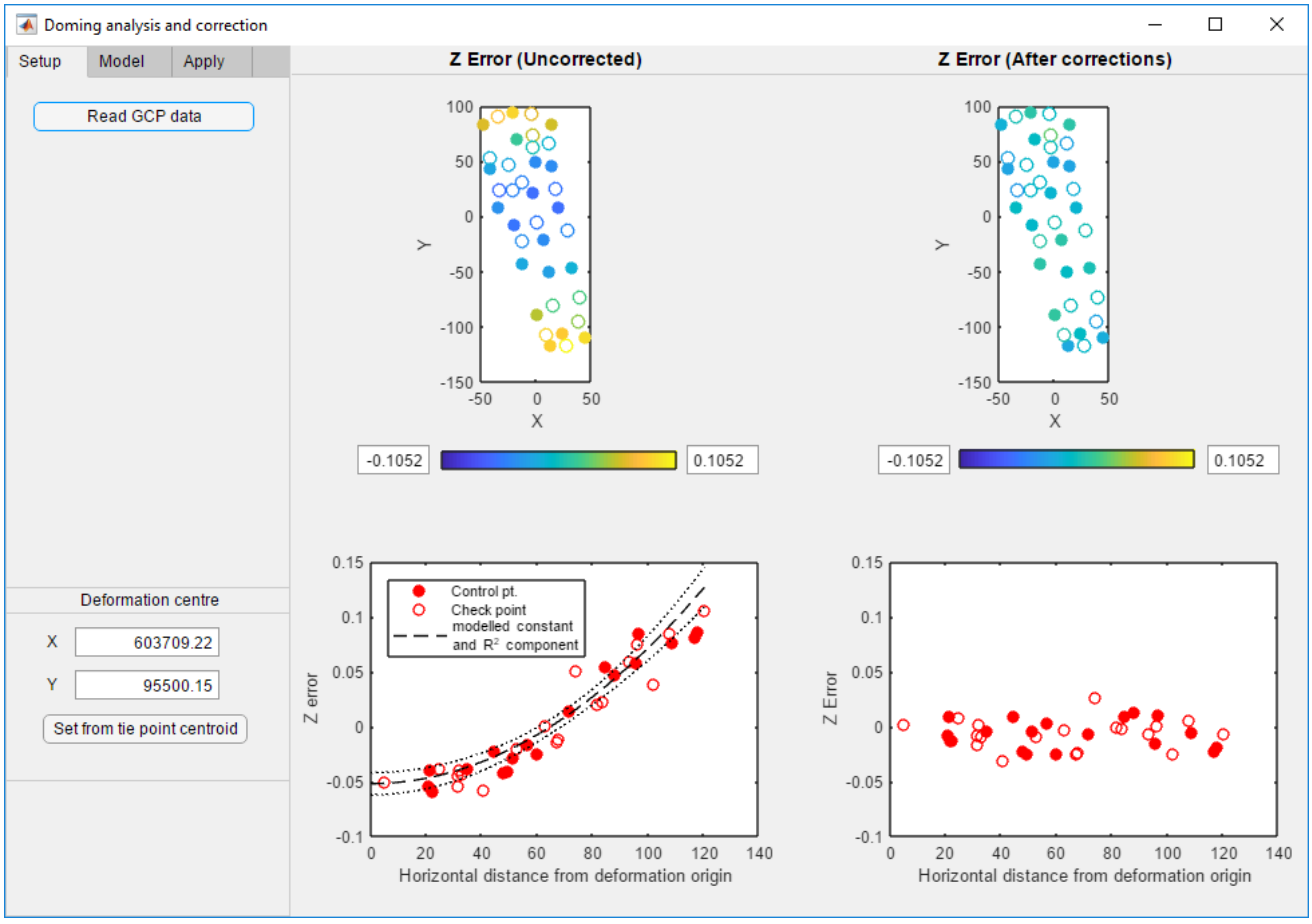
3.1. Setup: Import data

To analyse a photogrammetric survey, first export a 'Reference' text file from Metashape, containing the GCP ('marker') information. To export a reference file from Metashape:

1. In Metashape's Reference pane, locate and click the Export button, then save as type 'Character-separated variables (*.txt)
2. The 'Export CSV' dialog window is then shown and select - Items: Markers, Delimiter: Tab, Columns: Save location, Save errors, Save location accuracy, Save estimated values, Save enabled flag

An example reference file is provided in the associated example data (http://tinyurl.com/sfmgeoref).

Load the reference file into doming_analysis by clicking on the **Read GCP data** button, and navigating to and selecting your file. When the file is loaded, a model will be estimated automatically and, for the example data file, results will appear as below.



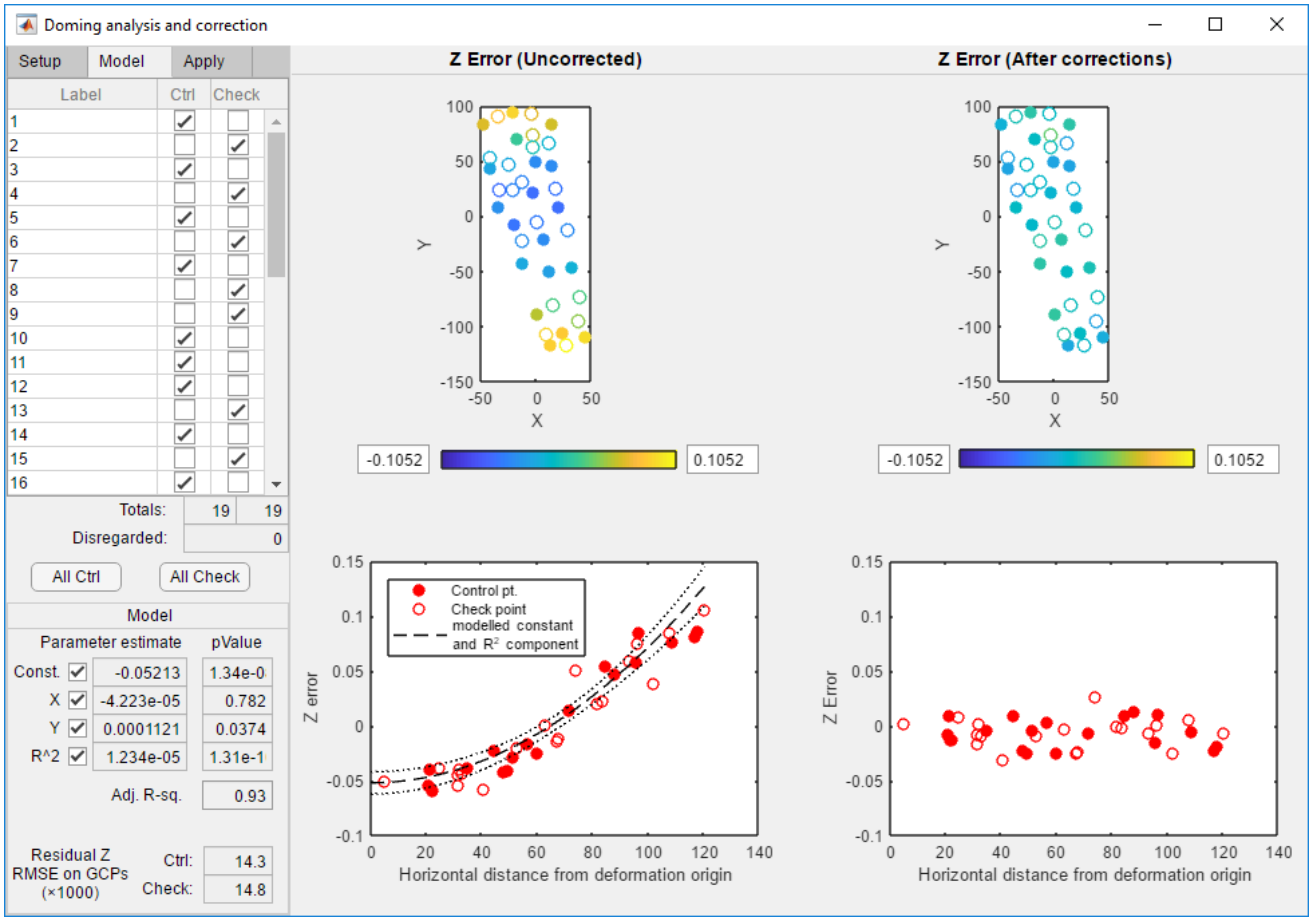
Upper plots: *Z*-error by colour in plan view, before (left) and after (right) modelling and subtraction of the estimated systematic *Z*-error component. Filled symbols are control points, used for defining the systematic model, open symbols are check points that were not used in the modelling, but have subsequently had the model corrections applied to them. Note that, by default, the colour ranges for the plots are symmetric and identical. You can change the colour range by editing limits given in the adjacent text boxes.

Lower plots: *Z*-error against the horizontal (radial) distance from the centre of the deformation model either before (left) or after (right) removal of the modelled systematic doming component. The left plot also shows the doming (R^2) component of the model with its associated 95% confidence bounds. A good model will

successfully account for the systematics to leave only residual random error (representative of the precision) in the right-hand plot.

3.2. Model: Adjust model data and parameters

Opening the model tab enables you to assess model performance and edit model inputs and parameters.



The table shows the GCP data that have been imported and enables individual GCPs to be selected as a control or check point, or to be removed from the analysis entirely. To remove a point from analysis, click on the checked check box. The point can be reconsidered at any later time, simply by checking the appropriate Ctrl or Check box. NOTE: Matlab tables (such as this) are very slow, so updates are not quick!

Model panel: The model of vertical error, ε_Z, is of the form

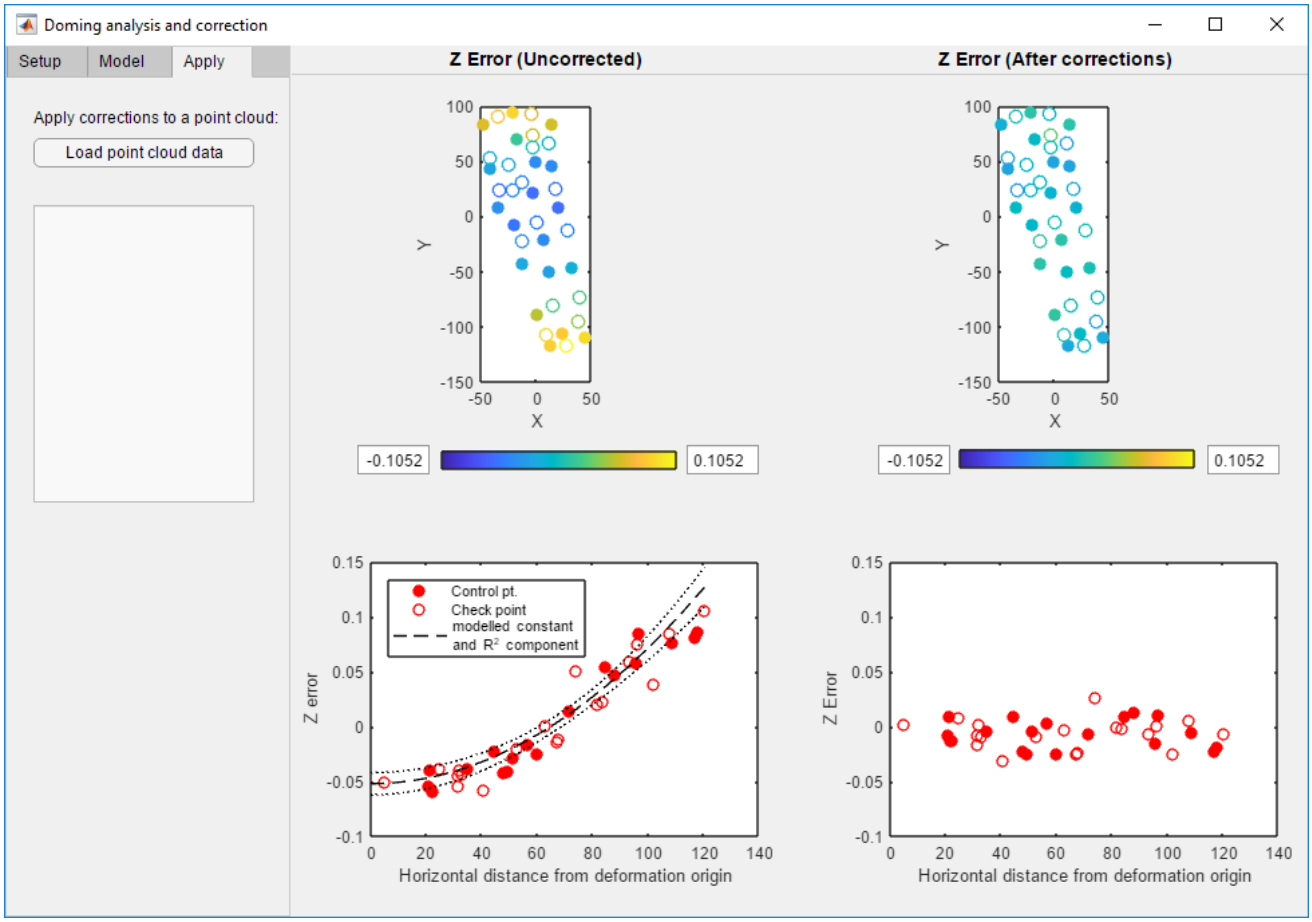
$$\varepsilon_Z = a + bX' + cY' + dR^2$$

where X' and Y' are point coordinates with respect to the deformation centre, $R = (X'^2 + Y'^2)^{0.5}$, and a, b, c, and d are the fitted parameters representing the constant, X, Y and R^2 terms respectively. The individual check boxes enable individual parameters to be removed from the model. The estimated parameter value and associated p-value for the estimate are given for each parameter.

Changing the model parameters or changing the status of a GCP will cause the model to be automatically recalculated, and the results (including the plots) will be updated.

3.3. Apply: Apply modelled corrections to point cloud data

When an appropriate model has been identified, it can be applied as a correction to other point cloud data (e.g. a dense point cloud) via the Apply tab.



A point cloud to correct is loaded using the **Load point cloud data** button. Select the file you want to correct for systematic error – the data must be in text format, with either 3 columns (X, Y, Z) or 9 columns (X, Y, Z, r, g, b, nX, nY, nZ). NOTE – reading and writing large text files can be slow… An example excerpt of a dense point cloud file is provided in the example data (http://tinyurl.com/sfmgeoref).

Citations, feedback and bug reports

Feedback and bug reports are welcome; please send to: m.james@lancaster.ac.uk
I will endeavour to do my best, but I cannot guarantee answering all emails. Apologies in advance.

This software is associated with the paper:

James et al. "Mitigating systematic error in topographic models for geomorphic change detection: Accuracy, precision and moving beyond off-nadir imagery" (submitted to Earth Surf. Proc. Landforms, October 2019).

Mike James, Lancaster University, 08 October 2019