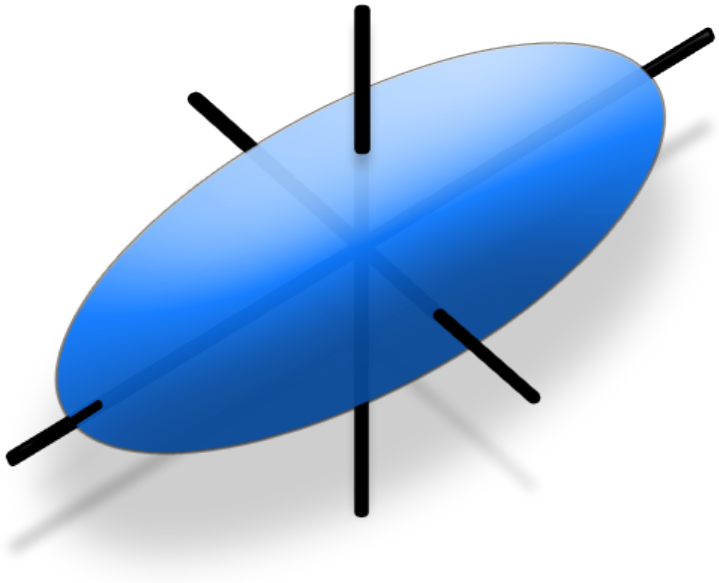
EllipseFit 3
User Manual



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Introduction

EllipseFit is an integrated program for geological finite strain analysis. It is used for determining two and three-dimensional strain from oriented photographs, and is designed for field and laboratory based structural geology studies. The graphical interface and multi-platform deployment also make it ideal for introductory or advanced structural geology laboratories. I use the software to teach structural geology at SUNY New Paltz, where hundreds of students have used it in laboratory and field studies. EllipseFit is currently implemented for Windows 32, Macintosh 10.5+, and Linux (Ubuntu) 64 bit platforms.

EllipseFit is suitable for determining two and three dimensional strain using various objects including center points (Fry type analysis), lines, ellipses, and polygons. Polygons include ooids, pebbles, fossils, or particles of any initial shape. Dirringer and Vollmer (2013), for example, used EllipseFit to calculate strain from a population of deformed graptolites using the polygon method. The analysis of strain from deformed populations of initially random polygons is therefore widely applicable to many rocks in thin section, hand sample, or on suitable outcrops. EllipseFit provides routines for digitizing polygons directly as vector based polygons, or indirectly by using a flood filling method. In both cases EllipseFit calculates the first and second order polygon moments and converts them to equivalent ellipses (e.g., Steger, 1996). The mean ellipse, which EllipseFit calculates (e.g., Shimamoto and Ikeda, 1976), has been shown to be mathematically equivalent to the applied strain (Mulchrone and Choudhury, 2004). Given three or more oriented sections from a sample, EllipseFit then can calculate the three dimensional strain using the method of Shan (2008).

Version 3 has numerous improvements over version 2, but has had more limited testing. This release was spurred in part by the upcoming 2014 Structural Geology and Tectonics Forum, to be held at the Colorado School of Mines in June 2014, where I will be giving a strain analysis workshop with Paul Karabinos and Matty Mookerjee. Additional releases are planned in the near future in preparation for the workshop, along with documentation and tutorials. Version 2 is stable and has been widely used, including for a strain workshop at the 2012 Structural Geology and Tectonics Forum at Williams College. No updates are planned for version 2 however.

Version 1 was written in the early 1980s in C++ for Macintosh, in part based on earlier code that evolved from a Fortran program written (on punch cards) for Win Means at SUNY Albany. Version 2 was written in cross platform RealBasic, however licensing, cost, performance issues, and concerns about the closed software system led me to abandon that language. Version 3 is fully rewritten, with tens of thousands of lines of code, in Free Pascal, a professional open source compiler that runs on over 40 operating systems. This allows improved code with better speed and extensibility, and the potential to port to other platforms. I am simultaneously developing several programs using common graphics and matrix libraries, which also eases maintenance.

Installation

On Macintosh OS X, double click the disk image file (.dmg), and drag the EllipseFit application to your Applications folder, or other desired location.

On Windows, unzip the zip file (.zip) using the “Extract All” option, and drag the EllipseFit folder to any desired location. The EllipseFit folder contains the EllipseFit application (EllipseFit.exe), and a “Resources” folder which is required.

On Linux unpack the gzip file (.tar.gz), and copy the EllipseFit folder to any desired location. The EllipseFit folder contains the EllipseFit application (ellipsefit), and a “Resources” folder which is required. An application icon (ellipsefit.png) is included in the Resources folder if desired for

installation.

After installing a new version it is recommended that you reset the preferences using the “Reset Preferences” command in the Help menu. This will clear any options that may have changed and set them to default values. The preferences are stored in the file EllipseFit3.xml, which is located in the folder EllipseFit in your operating system's application preferences folder. To deinstall simply delete the EllipseFit application folder, and optionally delete the preference folder. No other files are installed on your computer.

Documentation

This file will be expanded into a full user manual with documentation and a tutorial, however, some of the algorithms have not yet been published and are the subject of papers in preparation. I am releasing the program publicly with the hope that the structure and tectonics community will find it useful, and ask forgiveness for the lack of documentation, as well as respect for publication priority.

Example Data Files

The included example files and images can be used to determine input data formats. These are simple files that can be generated using a text editor or spreadsheet. EllipseFit 3 will read comma separated (csv), tab separated (tsv), and Open Document (ods) formats. The header line indicates the type of data required in each column. The included example files are named to indicate their contents (this is not required, EllipseFit will examine the headers to determine the available data, and extra columns are ignored):

E2 - Ramsay and Huber 1983.csv
E2 - Ramsay and Huber 1983.jpg
Example ellipse data and thin section photomicrograph (from Ramsay and Huber, 1983). This can contain (X, Y) coordinates for Fry-type analyses, or complete ellipse data including (X, Y, A, B, R, Phi) axes data.

E3 - Hossack 1968.csv
Example ellipsoid data (from Hossack, 1968) with (A, B, C) axes data for Flinn and Nadai graphs.

ES - Owens 1984.csv
Example ellipse section data (fron Owens, 1984) for calculating the three-dimensional strain ellipsoid from three or more faces using Shan's (2008) method. The strikes and dips of each section must be included.

LA - Ragan 1985 F10.1a.csv
LA - Ragan 1985 F10.1a.png
Example line angular shear data and image (from Ragan 1985) for analytical Wellman-type analysis (Vollmer, 2011). Each data point requires the endpoints of two lines that originally had a constant angle. This is an analytical solution to the classic multiple brachiopod problem illustrated in a number of structural geology texts.

LS - Ragan 2009 T14.9.csv
Example line stretch data for lines with known initial and final lengths, such as boudins and folds. EllipseFit does not yet provide digitizing of this type of data. Please contact me if this would be of interest. Note that the LS data is from fold flattening index example (Ragan, 2009), which is mathematically related.

I am happy to take emails with questions and suggestions, either at the university or at the gmail

address used on my website. Please forgive me if I am slow in answering email, I will try to respond in as timely a fashion as possible.

License

EllipseFit 3 software and accompanying documentation are Copyright © Frederick W. Vollmer 2014. They come with no warrantees or guarantees of any kind (see Legal Notice). The software is freeware and may be downloaded and used without cost, however the author retains all rights to the source, binary code and accompanying files. It may not be redistributed or posted online. It is requested that acknowledgment and citation be given for any usage that leads to publication (see Citation).

Citation

In return for free use, I request that any significant use of the software in analyzing data or preparing diagrams be cited and acknowledged in publications, presentations, or other works. An acknowledgement could be, “I thank Frederick W. Vollmer for the use of his EllipseFit 3 software.”

Appropriate references include (see References):

Vollmer (2010) discusses ellipse and ellipse fitting techniques, including Shan's method, and their implementation in EllipseFit.
Vollmer (2011a) discusses methods for contouring finite strain on the unit hyperboloid and the use of hyperboloidal stereographic, equal-area and other projections for strain analysis.
Vollmer (2011b) discusses best-fit strain from multiple angles of shear and an analytical solution to the Wellman diagram.

A suitable references to the software and this documentation, are:

Vollmer, F.W., 2014. EllipseFit 3.0.3. http://www.frederickvollmer.com/ellipsefit/.
Vollmer, F.W., 2014. EllipseFit 3.0.3 User Manual. http://www.frederickvollmer.com/ellipsefit/.

Registration

Please consider registering the software, registration is free and helps me determine the software usage and justify the time spent in it's upkeep.To register, simply send an email to me at vollmerf@gmail.com with your user name, affiliation, and usage. I will send you one email in reply with my thanks, and will not place you on a mailing list. For example, send me an email with something like:

User:	Frederick Vollmer
Affiliation:	SUNY New Paltz, Geology Department
Usage:	Undergraduate structural geology course and research

Legal Notice

This software and any related documentation are provided "as is" without warranty of any kind, either express or implied, including, without limitation, the implied warranties or merchantability, fitness for a particular purpose, or non-infringement. The entire risk arising out of use or performance of the software remains with you.

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History

3.0.3 – 13 May 2014
- Added transforms to image to rotate, flip, strain, unstrain, etc. To strain or unstrain both image and data, transform the image first. This calculates the origin offset in the new bitmap. Then transform the data at (X0, Y0) = (0.0, 0.0) with "Rectify" checked.
- Added transform data to Wellman-type data.
- Changed default bootstrap resamples from 300 to 5000.
- Rewrote ellipse standard error and confidence interval methods. Changed from using resample trials to calculate standard error and Student T for confidence interval, to use resampled data for both. Non-bootstrap MRL uses analytical error and Student T following Mulchrone (2005).
- Added option to save bootstrap resample ellipses.
- Added option to plot 95% confidence regions on Polar and Rf/Phi graphs using analytical error.
- Fixed bug that was swapping A and B radii while digitizing polygons.

3.0.2 – 21 April 2014
- Fixed bug in fill ellipse routine causing hangs at high thresholds.
- Fixed bug causing crash when opening page size dialog.
- Added strain map.
- Added synthesize data to create data sets.
- Added transform data to strain, unstrain, shear, etc., data.
- Changed names of digitize routines to reflect the objects, e.g., center points, ellipses, polygons, instead of the results (e.g., polygon moment ellipse).
- Changed names of graphs to more common specific names attributing authors, Fry, Flinn, etc., instead of generic names.
- Internal change in form communication, from flags and timers to messages.
- Numerous additional fixes and changes.

3.0.1 – 6 April 2014
- Fixed bug effecting symbol colors in svg graphics.
- Cleaned up the polar graph.
- Fixed cursor status strings on graphs.
- Fixed up contouring preferences.
- Added axial ratio Flinn type graph.
- Added octahedral Nadai-Hsu type strain graph.
- Added ellipse digitizing with polygon fill and moments.
- Fixed file save warning.
- Numerous internal changes.

3.0.0 – 24 March 2014
- First public release.

3.0.0.28 - August 1, 2012
- Initial prerelease version.