

Bertini_Real

User's Manual



need a sweet picture here

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1 Introduction

Welcome to Bertini_real, software for real algebraic geometry. This manual is intended to help the user operate this piece of numerical software, to obtain useful and high-quality results from decomposing real algebraic curves and surfaces.

Bertini_real is compiled software, links against a parallel version of Bertini 1 compiled as a library, and requires Matlab and the Symbolic Computation toolbox. It also requires several other libraries, including a few from Boost, and an installation of MPI. All libraries should be compiled using the same compilers.

1.1 Contact

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1.2 License

Disclaimer

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation or any other organization.

2 Quick Start

Bertini_Real can be downloaded from <http://bertini-real.com/download.html>. Use of Bertini_Real depends on Bertini, which itself has several important dependencies (see section 3). Once installed, you can run Bertini_real on an input file from the command line. After navigating to the working directory of the input file, the flow of Bertini_real is as follows:

- Run Bertini on an input file using the “tracktype: 1” setting. This is done by typing in the command line: 'bertini ' with an input file named 'input'. Bertini will produce a Numerical Irreducible Decomposition that will be used by Bertini_real.
- Run Bertini_Real on the same input file. Similarly, just type 'bertini_real' in the command line. Bertini_Real will provide a cellular decomposition of the real portion of a one- or two-dimensional complex algebraic set.
- Visualize the results of Bertini_real in MATLAB. Enter MATLAB and call gather_br_samples, which parses the output results of Bertini_real into a .mat file, and then call Bertini_real_plotter, which will plot the curve or surface in MATLAB (N.B. The MATLAB executable must be on the path to the input file for Bertini_real to run).

3 Compilation and Installation

3.1 Installation

Before installing Bertini_real, you must first be sure to have several libraries and dependencies that the software requires.

First, you must install Bertini (as a library). The Bertini source code can be found at <https://bertini.nd.edu/download.html>. Download the Bertini source code using the `./configure && make && make install` process.

Bertini itself has the following dependencies: a C++ compiler capable of the C++ 11 standard, an MPI (such as MPICH2), Boost ≥ 1.53 , MPFR, and GMP. Instructions specifically for Mac users are listed below. If on Linux, use the package manager provided (e.g. apt-get). Unfortunately, Windows users are unsupported at this time, except possibly through Cygwin or a virtual machine. If interested in porting Bertini and Bertini_real to windows, please contact Dr. Brake at dbrake@nd.edu. Bertini_real also is dependent on MATLAB. Once Bertini and all the necessary dependencies are installed, navigate to the directory containing Bertini_real and install Bertini_real via the `./configure && make && make install` process.

3.2 Installation of Bertini/bertini_real on MacIntosh

If you are using a Mac, we encourage the use of Homebrew (<http://brew.sh>) to install these packages. After installing Homebrew itself, installing the previously listed dependencies becomes simple. In terminal, just type, “brew search ____” to list packages related to ____, where ____ is your search (for example, GMP, Boost, or MPICH2). To download via Homebrew, type in terminal, “brew install ____”.

- 4 Using Bertini_Real
- 5 Troubleshooting
- 6 Visualization
- 7 3D Printing

A Output Formats

A.1 .curve

(num_variables total) num_vertices num_edges

num_V0 num_V1 num_midpts num_newpts

indices of V0

indices of V1

indices of midpoints

indices of added_points

projection excluding the homogeneous 0 coordinate.

A.2 .edge

A.3 .vert