Bertini_Real

User's Manual

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Manual by
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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

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2 Quick Start

Bertini_Real can be downloaded from http://bertinireal.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:

1. 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.

2. 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.

3. 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