

Project IV: Displaying and Manipulating Yin Sets in \mathbb{R}^3

due 2019 DEC 18, 13:15

In this project, you are supposed to develop a software in C or C++ for viewing and manipulating three-dimensional (3D) Yin sets. Your software should have a graphical user interface (GUI) that loads a data file of a 3D Yin set, displays the Yin set after parameters of the ray tracer have been specified, and provides further manipulations such as rotating and translating the Yin sets.

The requirements on your software are as follows.

- (A) The source code must compile on Ubuntu 18.04; you cannot submit an *exe* file.
- (B) The input data file is supposed to describe the boundary of a Yin set, of which each orientable compact surface is described by
 - a $3 \times n_p$ array p of floating-point numbers with each column denoting the coordinates of a single vertex;
 - a $3 \times n_t$ array T of unsigned integers: in each column the three ordered indices into p denote an oriented triangle while the outward normal of the Yin set at the triangle is determined by the right-hand rule.
- (C) Disjoint Yin sets can be added to the scene one by one, with each Yin sets represented by a pair (p, T) as in (B).
- (D) By using the mouse or by specifying several parameters, the user can rotate and translate the Yin sets as well as zoom-in and zoom-out on the Yin sets.
- (E) Your GUI should provide an transparency option to different parts of the boundary of Yin sets so that holes inside a 3D solid can be displayed.

The student is encouraged to learn fundamental concepts of ray tracing. A good starting point is the book *Fundamentals of Computer Graphics*, 4th edition, by Steve Marschner and Peter Shirley. In your final presentation, you should explain how the concepts of ray tracing interact with the mathematics of Yin sets.