Waves in complex media − billards

Simon Chabot

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In this short document, I introduce the little program that I have made. This program is dedicated to the simulation of billards.
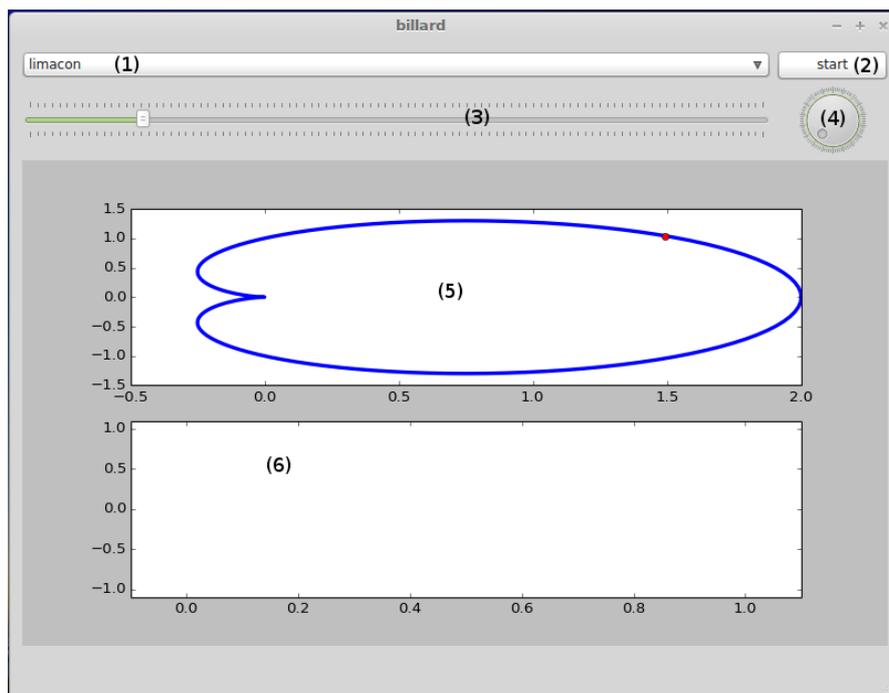
1 What does it look like ?

FIGURE 1: Screenshot of the program

The figure 1 shows what the program looks like. The numbers on this figure refer to :

1. What kind of billard is currently used ;

2. A *start / stop* push button;

3. A horizontal slider to enable the user choosing the initial point;

4. A circular slider to enable the user choosing the initial direction;

5. A plot of the billard with the initial point and the trajectories;

6. A poincarré map.

2 Some pictures
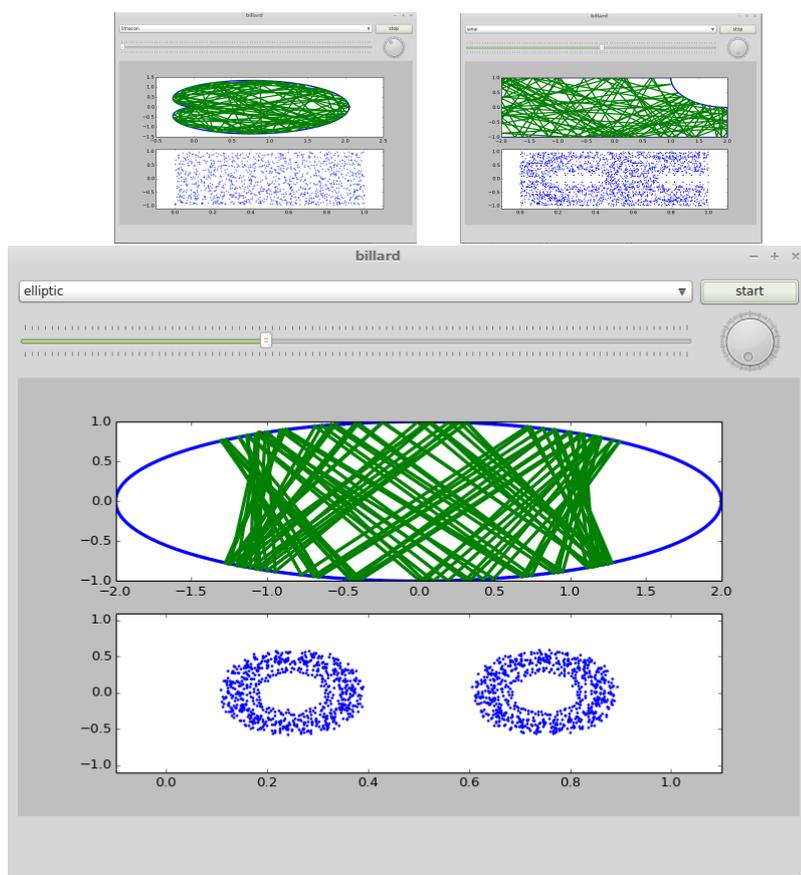
The program currently supports different kind of billards : square, stadium, limacon, elliptic, circle, and sinai.

One can easily add its own billard by writing a simple python function. For instance, the code for the circle billard can be the following one :

```
>>> from numpy import linspace, pi, cos, sin
>>> from shapely.geometry import Polygon
>>> from billard import Billard
```

```
  >>> theta = linspace(0, 2*pi, 150, endpoint=False)
4 >>> x = cos(theta)
  >>> y = sin(theta)
6 >>> circle = Polygon(zip(x, y))
  >>> circle_billard = Billard(circle)
```

3   How to run the program ?

The program is available in two versions : one with a Qt GUI (as shown in the previous pictures) and an other with a CLI.

Both versions requires the following Python libraries [1] :
— Numpy (see `http://www.scipy.org/`), used for all vectors calculations
— Matplotlib (see `http://www.scipy.org/`), used for the plotting part
— Shapely (see `http://toblerity.org/shapely/`), used to perform operator on shapes (polygons etc)
— Descartes (see `https://pypi.python.org/pypi/descartes`), required to combine shapely and matplotlib.

Once those libraries are installed, one can run the CLI version of the program by calling `billard.py`

```
0 $ python ./billard.py
  0) square
2 1) stadium
  2) limacon
4 3) elliptic
  4) circle
6 5) sinai
  Which billard do you want ? (negative number to quit) : 2
```

In this case, a random initial point and direction are chosen, and a simulation with the *limacon* billard is performed.

If one prefers the Qt GUI version, then the PySide library is required (see `http://qt-project.org/wiki/PySide`. When installed, launch `python ./main.py` to have the Qt window opened.

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1. Python 2.7 is assumed to be installed.