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Fractal for a noncircular orbit constructed as a Koch curve

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Abstract

For noncircular orbits (nco), with f=3 and f=2, a fractal similar to the Koch-curve is constructed. Attraction and repulsion in a Koch boundary, are suggested, such that the fractal noncircular orbit may attract with all sublevels or repulse likewise.

Keywords: noncircular orbit, Koch curve, kinematics at fractal boundary, convex, concave, black hole, boundary layer

Introduction

In the present context, we will construct a fractal for a noncircular orbit, similar to the Koch curve, c.f. Figure 1.

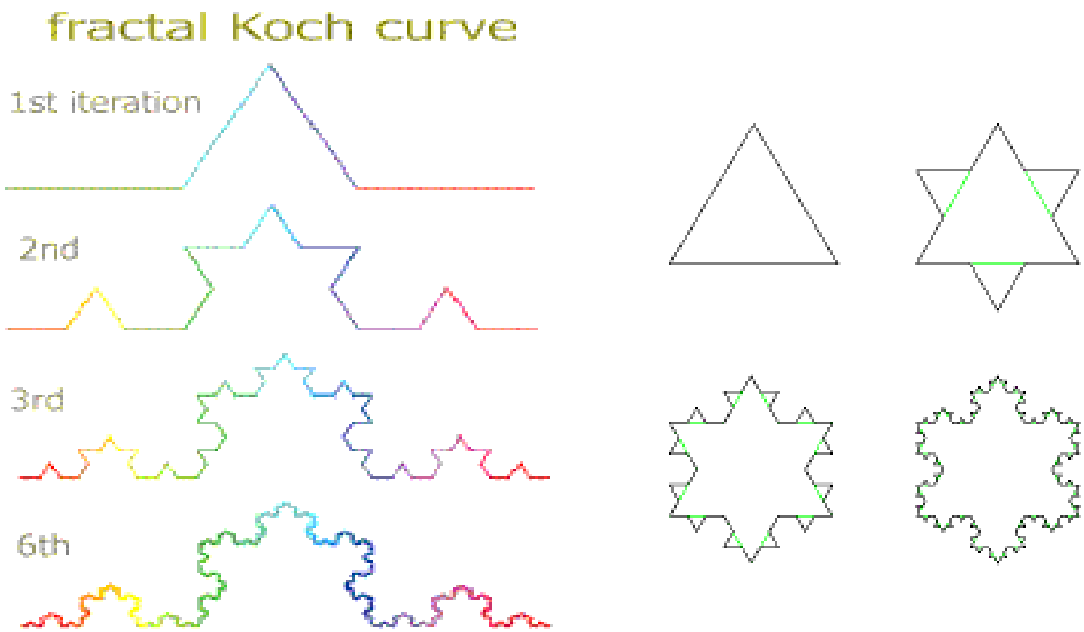

Figure 1. The Koch curve generating a fractal boundary

Here, we will assume the path of a noncircular orbit, Strömberg (2014), such that radius vector is given by

$$r = r_o + r_e \sin(fwt) \qquad (1)$$

It is found that this formulation describes many other motions and phenomena e.g. water waves, light and acoustics where 2nd order effects show, Strömberg (2016).

The noncircular orbits, with f=3, c.f. Figure 2, and f=2, have symmetries and boundary, such that it easily can be cast into the Koch-framework.

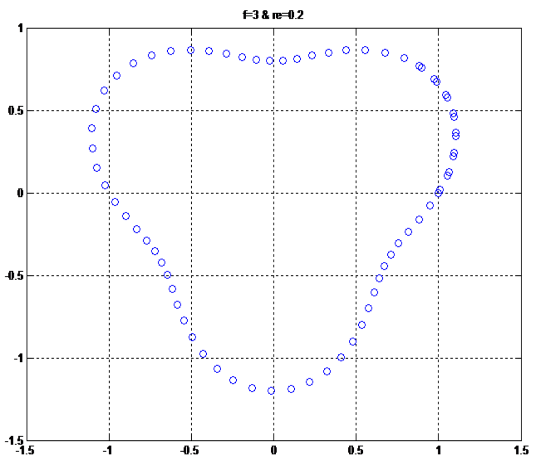

Figure 2. Noncircular orbit with f=3

After deriving the geometry, the kinematics for the new paths will be discussed and different models are proposed. The new level may rule with its curvature, such that kinematics determines an acceleration field which attracts or repels in a neighborhood of the fractal boundary.

Concave and Convex boundaries

First we concern f=3. There are options, such that on the side where the radius is smaller, which is the upper side in Figure 2, the new region may be located outwards, as for a Koch curve, Figure 1, or inwards. Outwards, will result in an 'overall' more circular path, with less eccentricity, however fractal.

Definitions: ccK-nco and cxcK-nco

Next we concern f=2. Since this differs from the triangular Koch-curve, it is optional which side to put the fractal pattern. Choosing the side where the radius is smaller, the new region may be located outwards (as for the Koch curve), or inwards. The latter will result in an even more concave path, with more eccentricity, and fractal. This fractal will be known as concave-concave Koch for nco, abbreviated *ccK-nco*.

When located outwards, it will be convex-concave and this will be abbreviated *cxcK-nco*. Since switching direction first time, the next curvature, may be inwards and outwards, and so on. Here we shall assume that it is always outwards for the lower levels of a cxcK-nco, agreeing with the construction of a Koch-curve.

Other options are the size and shape of the first level. Then this is assumed to multiply, such that a fractal is determined.

Kinematics and inertia on the fractal

For the original noncircular orbit, the acceleration has maximum at the largest radius and there, the direction is inwards. At the minimum radius, the acceleration is outwards with the same value. Assuming a change of 'curvature' for the first level, into a cxcK-nco, we may assume that the direction for acceleration at the new level changes. For the magnitude, compared with the original, there are options. Next, we shall make qualitative assumptions about formations in space characterised by certain boundaries and known as Black holes.

Black hole

Consider a boundary in space given by a fractal of the kind ccxK-nco. A black hole is such that no light is reflected, but instead absorbed. Assume that light at the orbit achieves the acceleration given by the path i.e. the acceleration of the system, in an interaction with sublevels on a part of the fractal. Then, it is possible that it gets an acceleration inwards also at parts where the original nco had an outward acceleration when not considered to be fractal. In characterization of black holes, a very large density is often referred to. Here, it is possible to consider the density in an eccentricity zone from Avd, Strömberg (2015), given by □(t)=□$_0$ exp(2(r_{ecc}/r_0)sin(f□$_0$t)) and modified on the fractal domain.

Eccentricity zone

The eccentricity zone, i.e. the space deviating from a circle, c.f. Strömberg(2016)$_2$, is discussed in Strömberg (2014;2015), in conjunction with tides, when it receives a distributed spatial structure.

With the fractal, parts of the eccentricity zone will consist of several levels in a fine structure. Properties describing fractals e.g. Haussdorf dimension are applicable. The multiplicity of levels where e.g. light could materialize suggests a measure for densification, which could be related to intensity.

Exercise. Draw the fractal for a noncircular orbit, when constructed similar to that of a Koch curve.

Solution. Generate the smaller replicas of a first level of Figure 2, as illustrated in Figure 1.

Conclusion

With the Koch curve fractal as the point of departure, similar formations were derived for noncircular orbits. Different options for the height, width and form of the first disturbance (which then multiplies according to the Koch-rule), was discussed.

The results for attraction and by that, developments of forces, may be general and valid for fractals in nature, to describe e.g. the boundary of an established streamline, densification, growth of surfaces and locations between shadow and light.

A black hole analogy was suggested when considering the fractal as a boundary which can reflect or absorb light. The analogy may be useful to characterize also other boundary layers.

References

[1] Strömberg, L 2014. A Model for Non-circular Orbits Derived from a Two-step Linearisation of the Kepler Laws.” *Journal of Physics and Astronomy Research* 1 (2):13-15

[2] Strömberg L (2015). Motions for systems and structures in space, described by a set denoted Avd. Theorems for local implosion; Li, dl and angular velocities. Journal of Physics and Astronomy Research, 2(3): 070-073.

[3] Strömberg L (2016). Results for noncircular orbits, LAP Lambert Academic publishing Germany. ISBN-13 978-3-659-85218-3.

[4] Strömberg L $(2016)_2$. Halo Phenomena modeled with Distributed and Quantum Optics given by Electrodynamic Singularities on a Noncircular Orbit, *SCIREA Journal of Physics*. Vol. 1 , No. 1 , 2016 , pp. 33 - 40 .