Fractal dimension estimation using box counting

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Abstract

Numerical estimations of fractal dimensions is key in studies of data where the dimension can not be derived mathematically. Here, I present a Python implementation of the most common estimation technique of box counting, and analyze its performance for the dimension estimation of the Koch curve where the fractal dimension can be derived analytically.

Koch curve

The Koch curve is one of the earliest fractal curves that have been described. It is based on the Koch curve, which appeared in a 1904 paper titled "On a continuous curve without tangents, constructible from elementary geometry" by the Swedish mathematician Helge von Koch.

Box counting

Python implementation

```
def koch(x0, y0, rho, phi, order):
    global xtrace, ytrace

    x1, y1 = x0 + rho * np.cos(phi), y0 + rho * np.sin(phi)
    if order:
        x, y = x0, y0
        for angle in [0, np.pi/3, 5*np.pi/3, 0]:
            x, y = koch(x, y, rho / 3.0, phi + angle, order - 1)
    else:
        xtrace.append(x1)
```

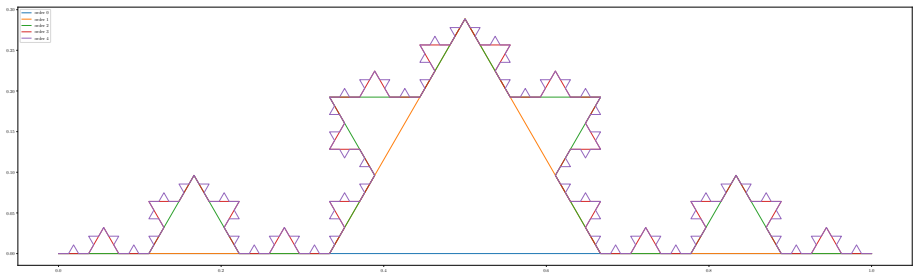

Figure 1: Iterative Koch curve construction depicted by the first steps from order 0 to the 4th order.

```
            ytrace.append(y1)

    return (x1, y1)
```

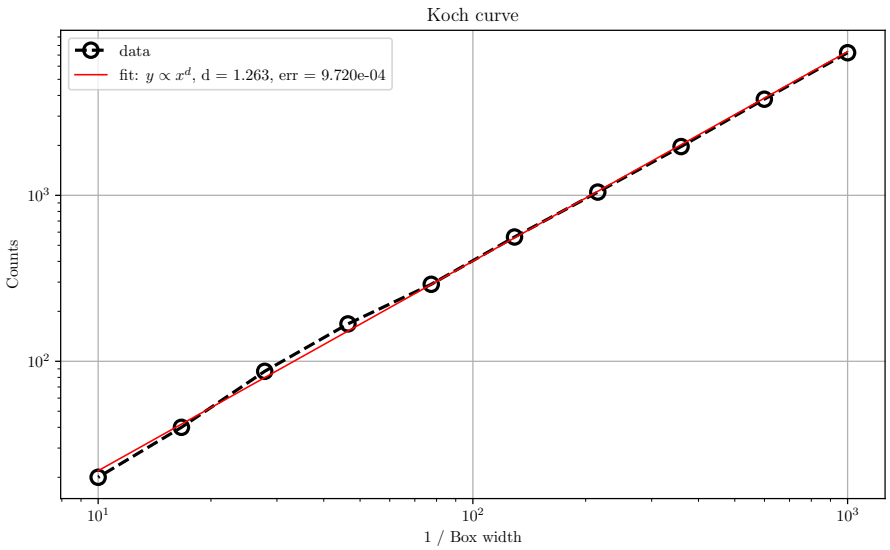

Figure 2: Power-law regression of ..

Conclusion

This study of the Koch curve and its fractal dimension .. (see Fig. 2).