## Exploring Patterns on Footprints of Chaos

## Takashi Iba and Kazeto Shimonishi

(Faculty of Policy Management, Keio University)

We propose a new method for generating various patterns from chaos, which visualize the history by converting the value into an angle and plotting the circle on the two-dimensional plane. Chaos is one of the dynamical phenomena, which the behavior seems irregular but acts under a deterministic rule. Interestingly, the behavior of chaos is not only irregular, but also have a complex structure in the system. We show the map and movie to demonstrate that the proposed method is able to generates a lot of - — an infinite of -_ various patterns according to the initial values and a control parameter.

In this presentation, we apply the method into the logistic map as follows.

$$
x_{n}+1=a x_{n}\left(1-x_{n}\right)
$$

where $0 \leq x_{n} \leq 1$ and $0 \leq a \leq 4$.

## Proposed Method "Footprints of Chaos"

(1) Drawing a circle with radius $r$
(2) Converting the initial value $x_{0}$ into the angle $\theta_{0}$ and drawing a circle, which is also with the radius $r$ on the point at the distance $d$ and the direction $\theta_{0}$ from the center of the previous circle.
(3) After calculating the value of $x_{l}$ with the equation, converting the value $x_{l}$ into the angle $\theta_{l}$ and drawing the next circle as the same way.



Mapping the Patterns with Changing Control Parameter $a$


Various Patterns on Footprints of Chaos

We would like to show some interesting shapes of patterns generated by the method "Footprint of Chaos," and name it like the patterns in "Life Game" !

Edge of Chaos?

