

## 9. CONTINUATION OF PERIODIC ORBITS IN RÖSSLER SYSTEM

The defining equations of the Rössler system are:

$$(9.1) \quad \frac{dx}{dt} = -y - z$$

$$(9.2) \quad \frac{dy}{dt} = x + ay$$

$$(9.3) \quad \frac{dz}{dt} = b + z(x - c)$$

In this section, we have used AUTO bifurcation software to extend the single periodic orbit of the Rössler system. The original single periodic orbit, with parameters  $(a = 0.2, b = 0.2, c = 2.5)$ , was obtained using MATLAB and saved in the **rss.dat** file. Numerical data representing one complete periodic oscillation are contained in the **rss.dat**. Each row in **rss.dat** contains four real numbers, namely, the time variable  $t, x, y$  and  $z$ . The AUTO constant `dat='rss'` then allows for using the data in **rss.dat** where we also specify `IRS=0`. `IRS=0` is the starting point defined in `STPNT` (user-supplied routine in AUTO) is to be used. The resulting bifurcation diagram using AUTO for Rössler system is shown below:

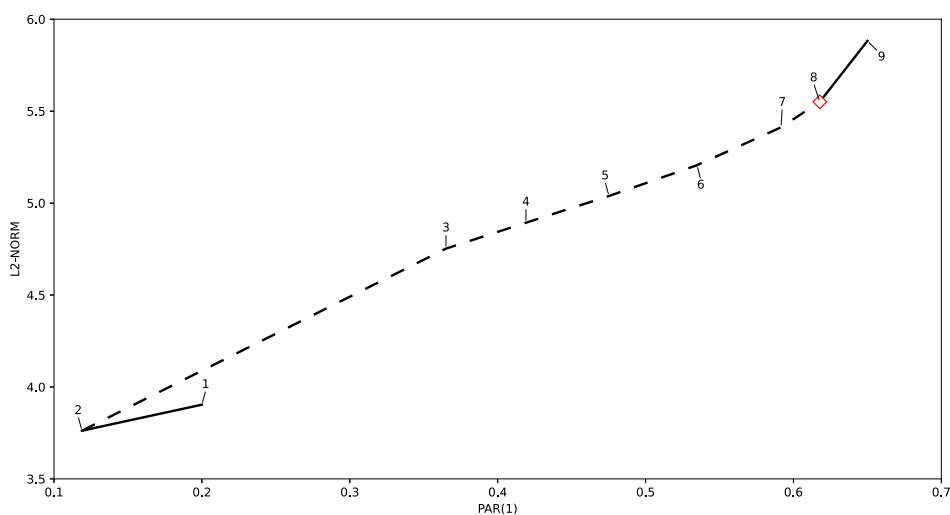


FIGURE 9.1. Bifurcation diagram for Rössler system

The data obtained using AUTO is shown below:

BR	PT	TY	LAB	PAR(1)	L2-NORM	MAX U(1)	MAX U(2)	MAX U(3)	PERIOD
1	1	EP	1	2.00000E-01	3.90368E+00	4.72921E+00	3.08598E+00	3.19932E+00	5.66887E+00
1	2		2	1.18883E-01	3.76199E+00	4.05236E+00	3.18020E+00	1.57055E+00	5.98200E+00
1	3		3	3.65041E-01	4.75249E+00	5.45073E+00	2.37369E+00	6.31114E+00	5.34275E+00
1	4		4	4.19120E-01	4.89328E+00	5.59477E+00	2.09980E+00	7.18322E+00	5.21625E+00
1	5		5	4.75229E-01	5.03853E+00	5.71564E+00	1.80594E+00	8.01084E+00	5.07939E+00
1	6		6	5.34754E-01	5.20595E+00	5.82208E+00	1.47765E+00	8.82928E+00	4.91717E+00
1	7		7	5.91559E-01	5.41196E+00	5.91720E+00	1.12415E+00	9.62913E+00	4.72312E+00
1	8	PD	8	6.17822E-01	5.55078E+00	5.96859E+00	9.24575E-01	1.00694E+01	4.60254E+00
1	9	UZ	9	6.50001E-01	5.88190E+00	6.07598E+00	5.46336E-01	1.09534E+01	4.35532E+00

Total Time 0.358E-01

FIGURE 9.2. AUTO Data for Rössler system

Plots for the numerical data representing one complete periodic oscillation are contained in the `rss.dat` are shown below:

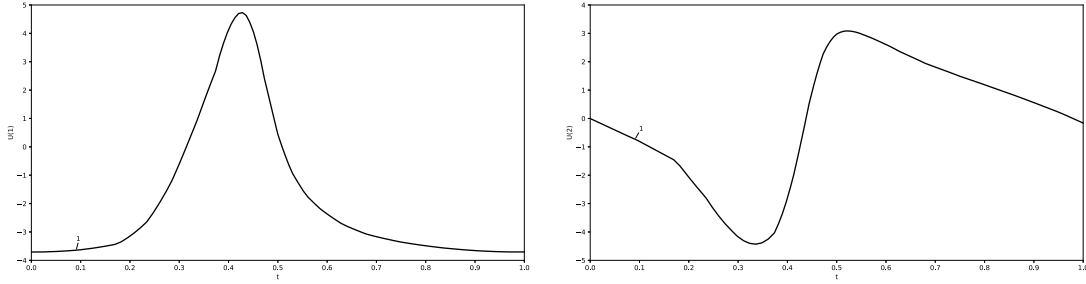


FIGURE 9.3. Single period for  $t$  vs  $x$  (left) and Single period for  $t$  vs  $y$  (right)

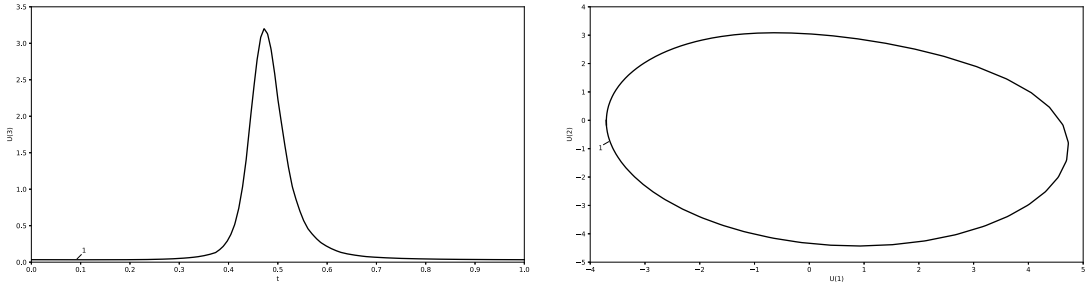


FIGURE 9.4. Single period for  $t$  vs  $z$  (left) and Single period for  $x$  vs  $y$  (right)

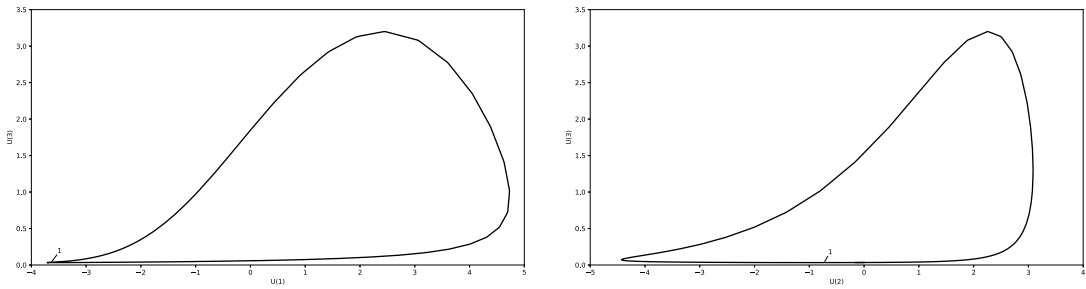


FIGURE 9.5. Single period for  $x$  vs  $z$  (left) and Single period for  $y$  vs  $z$  (right)

Continuation of a single period for the Rössler system using AUTO is shown below:

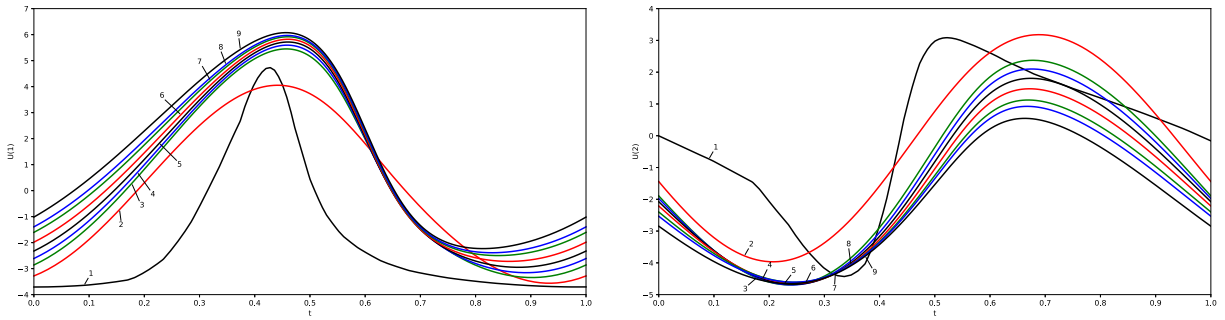


FIGURE 9.6. All period for  $t$  vs  $x$  (left) and all period for  $t$  vs  $y$  (right)

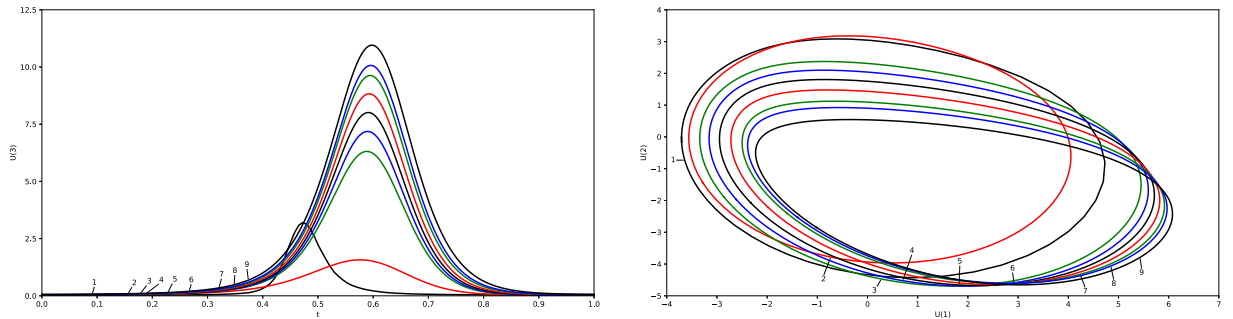


FIGURE 9.7. All period for  $t$  vs  $z$  (left) and all period for  $x$  vs  $y$  (right)

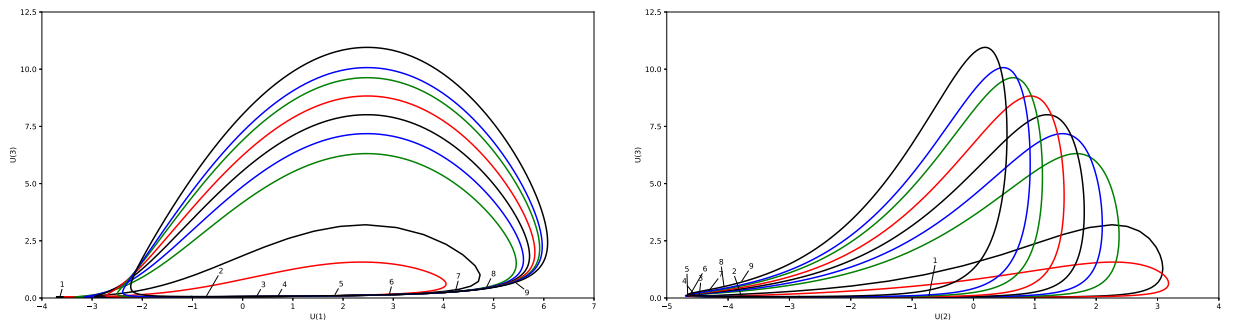


FIGURE 9.8. All period for  $x$  vs  $z$  (left) and all period for  $y$  vs  $z$  (right)