## **The Lorenz Equations**

The Lorenz equations are a system of nonlinear odes that pioneered the study of chaos. The Lorenz equations are given by

```
\dot{x} = \sigma(y - x), \qquad \dot{y} = x(r - z) - y, \qquad \dot{z} = xy - \beta z,
```

where  $\sigma$ ,  $\beta$  and r are constants. Edward Lorenz studied the solution for  $\sigma = 10$ ,  $\beta = 8/3$  and r = 28, and the result is now known as the Lorenz attractor, an example of what is now more generally known as a strange attractor.

Compute the Lorenz attractor and plot z versus x and y. Remove the transient before plotting.

Show the reference solution for this problem

## Script @

Reference Solution





```
1 sigma=10; beta=8/3; r=28;
2 x0=1; y0=1; z0=1; tspan=[0 100];
3 ntrans=20;
4 options = odeset('RelTol',1.e-6);
5 [t,xyz]=ode45(@(t, xyz) lorenz_eqs(xyz, sigma, beta, r), tspan, [x0, y0, z0], options);
6 x=xyz(ntrans:end,1); y=xyz(ntrans:end,2); z=xyz(ntrans:end,3);
7 plot3(x,y,z);
8 xlabel('$x$','Interpreter','latex','FontSize',14 );
9 ylabel('$y$','Interpreter','latex','FontSize',14 );
10 | zlabel('$z$','Interpreter','latex','FontSize',14 );
11 | title('Lorenz Equations','Interpreter','latex','FontSize',16);
12
function dxyzdt = lorenz_eqs(xyz,sigma,beta,r)
14 x=xyz(1); y=xyz(2); z=xyz(3);
15 | dxyzdt=[sigma*(y-x); x*(r-z)-y; x*y-beta*z];
16 end
17
```

8 ► Run Script

## **Assessment: All Tests Passed**

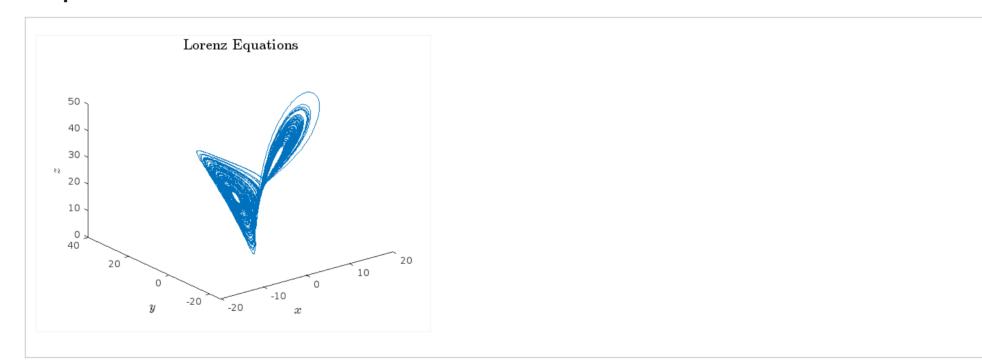
Submit

Test x.

Test y.

Test z.

## Output



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