Let $\left\{\begin{matrix} \dot{x} = f(x, y) \\ \dot{y} = g(x, y) \end{matrix}\right\}$ be a non - linear system with fixed point (x^*, y^*)

$$0 = f(x^*, y^*) = g(x^*, y^*)$$

Let $\left\{\begin{matrix} u = x - x^* \\ v = y - y^* \end{matrix}\right\}$ be deviations from fixed point

↓ Change of variable

$$\begin{aligned} \dot{u} &= \dot{x} \quad (x^* \text{ is constant}) \\ &= f(u + x^*, v + y^*) \\ &= f(x^*, y^*) + u\frac{\partial f}{\partial x} + v\frac{\partial f}{\partial y} + O(u^2, v^2, uv) \end{aligned}$$

linear; $f(x^*, y^*)$: 0; $O(u^2, v^2, uv)$: 0; Taylor series expansion

Likewise, $\dot{v} = u\frac{\partial g}{\partial x} + v\frac{\partial g}{\partial y} + O(u^2, v^2, uv)$