Source: The Princeton Companion to Applied Mathematics, Nicholas J. Higham, Princeton University Press, 2015.

Second-order ODEs also arise in electrical networks. Consider the flow of electric current $I(t)$ in a simple RLC circuit composed of an inductor with inductance L, a resistor with resistance R, a capacitor with capacitance C, and a source with voltage v_s, as illustrated in figure 8.

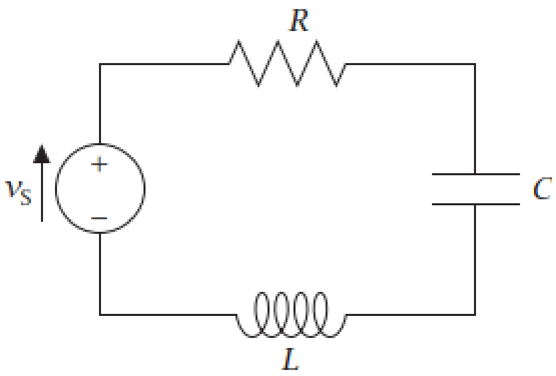

Figure 8 A simple RLC electric circuit.

The Kirchhoff voltage law states that the sum of the voltage drops around the circuit equals the input voltage, v_2. The voltage drops across the resistor, inductor, and capacitor are RI, $L\dfrac{dI}{dt}$, and $\dfrac{Q}{C}$, respectively, where $Q(t)$ is the charge on the capacitor, so

$$L\frac{dI}{dt} + RI + \frac{Q}{C} = v_s(t).$$

Since $I = \dfrac{dQ}{dt}$, this equation can be rewritten as the second-order ODE

$$L\frac{d^2Q}{dt^2} + R\frac{dQ}{dt} + \frac{1}{C}Q = v_s(t).$$