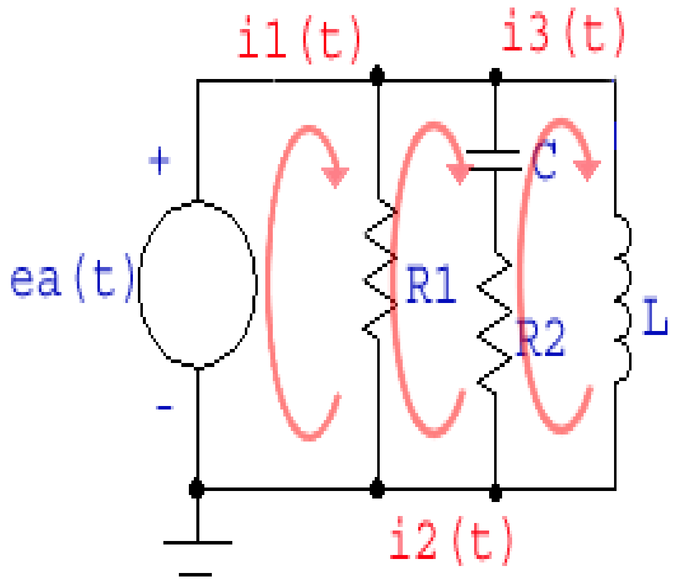
Modeling of mechanical and electro-mechanical systems

Converting a circuit diagram to a mechanical 2 analog uses a similar procedure as electrical to mechanical 1 except that the voltages around a loop summed to zero (instead of the sum of currents at a node) is analogous to the sum of forces at a point being summed to zero .

Start with an electrical circuit. Label all currents. Choose currents so that only one current flows through inductors



Write a loop equations for each loop

$$\sum_{\text{loop } i_1} v = 0 = e_a + (i_2 - i_1)R_1$$

$$\sum_{\text{loop } i_2} v = 0 = (i_1 - i_2)R_1 + \frac{1}{C}\int (i_3 - i_2)\,dt + (i_3 - i_2)R_2$$

$$\sum_{\text{loop } i_3} v = 0 = \frac{1}{C}\int (i_2 - i_3)\,dt + (i_2 - i_3)R_2 - L\frac{di_3}{dt}$$

Re-write the equations using analogs (make making substitutions from the table of analogous quantities), with each electrical loop being replaced by a position

$$\sum_{x_1} f = 0 = f_a + (v_2 - v_1)B_1$$

$$\sum_{x_2} f = 0 = (v_1 - v_2)B_1 + K\int(v_3 - v_2)dt + (v_3 - v_2)B_2$$

$$= (v_1 - v_2)B_1 + K(x_3 - x_2) + (v_3 - v_2)B_2$$

$$\sum_{x3} f = 0 = K\int(v_2 - v_3)dt + (v_2 - v_3)B_2 - M\frac{dv_3}{dt}$$

$$= K(x_2 - x_3) + (v_2 - v_3)B_2 - M \cdot a_3$$

Draw the mechanical system that corresponds with the equations