intro.genels Generalized one−port elements

1 We can categorize the behavior of one-port elements—electronic, mechanical translational, and mechanical rotational—considered thus far. In the following sections, we consider two types of energy storage elements, dissipative elements, and source elements.

A-type energy storage elements

2 An element that stores energy as a function of its across-variable is called an A-type energy storage element. Sometimes we call it a generalized capacitor because a capacitor is an A-type energy storage element.

A−type energy storage element

generalized capacitor

3 For generalized through-variable $\mathcal{F}$, across-variable $\mathcal{V}$, integrated through-variable $\mathcal{H}$, and integrated across-variable X the ideal, linear constitutive equation is

$$\mathcal{H} = C\mathcal{V} \tag{1}$$

for $C \in \mathbb{R}$ called the generalized capacitance. Differentiating Equation 1 with respect to time, the elemental equation is

generalized capacitance C

A-type energy storage elements considered thus far are capacitors, translational masses, and rotational moments of inertia. As with generalized variables, the analogs among elements are more important than are generalized A-type energy storage elements.

capacitors
masses
rotational inertia

T-type energy storage elements

4 An element that stores energy as a function of its through-variable is called a T-type energy storage element. Sometimes we call it a generalized inductor because an inductor is a T-type energy storage element.

T−type energy storage element

generalized inductor

5 The ideal, linear constitutive equation is

$$\mathcal{X} = \mathrm{L}\mathcal{F} \tag{2}$$

for $\mathrm{L} \in \mathbb{R}$ called the generalized inductance. Differentiating Equation 2 with respect to time, the elemental equation is

generalized inductance L

6 T-type energy storage elements considered thus far are inductors, translational springs, and rotational springs. As with generalized variables, the analogs among elements are more important than are generalized T-type energy storage elements.

inductors
translational springs
rotational springs

D-type energy dissipative elements

7 An element that dissipates energy from the system and has an algebraic relationship between its through-variable and its across-variable is called a D-type energy dissipative element. Sometimes we call it a generalized resistor because a resistor is a D-type energy dissipative element.

D−type energy dissipative element

generalized resistor

8 The ideal, linear constitutive and elemental equation is

$$\mathcal{V} = \mathrm{R}\mathcal{F} \tag{3}$$

for $\mathrm{R} \in \mathbb{R}$ called the generalized resistance.

generalized resistance R

9 D-type energy dissipative elements considered thus far are resistors, translational dampers, and rotational dampers. As with generalized variables, the analogs among elements are more important than are generalized D-type energy dissipative elements.

resistors
translational dampers
rotational dampers

Sources

10 An ideal through-variable source is an element that provides arbitrary energy to a

ideal through−variable source

system via an independent (of the system) through-variable. The corresponding across-variable depends on the system. Current, force, and torque sources are the through-variable sources considered thus far.

ideal across−variable source

11 An ideal across-variable source is an element that provides arbitrary energy to a system via an independent (of the system) across-variable. The corresponding through-variable depends on the system. Voltage, translational velocity, and angular velocity are the across-variable sources considered thus far.