Structure of the port-Hamiltonian system RLC

The PyPHS* development team[1]

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1 System netlist

line	label	dictionary.component	nodes	parameters
ℓ_1	out	electronics.source	('ref', 'A')	{ type voltage
ℓ_2	R1	electronics.resistor	('A', 'B')	{ R ('R1', 1000.0)
ℓ_3	L1	electronics.inductor	('B', 'C')	{ L ('L1', 0.05)
ℓ_4	C1	electronics.capacitor	('C', 'ref')	{ C ('C1', 2e-06)

$\dim(\mathbf{x}) = n_{\mathbf{x}} = 2$;
$\dim(\mathbf{w}) = n_{\mathbf{w}} = 1$;
$\dim(\mathbf{y}) = n_{\mathbf{y}} = 1$;
$\dim(\mathbf{p}) = n_{\mathbf{p}} = 0$;

2 System variables

State variable $\mathbf{x} = \begin{pmatrix} x_{\mathrm{L1}} \\ x_{\mathrm{C1}} \end{pmatrix}$;
Dissipation variable $\mathbf{w} = \begin{pmatrix} w_{\mathrm{R1}} \end{pmatrix}$;
Input $\mathbf{u} = \begin{pmatrix} u_{\mathrm{out}} \end{pmatrix}$;

*https://github.com/A-Falaize/pyphs
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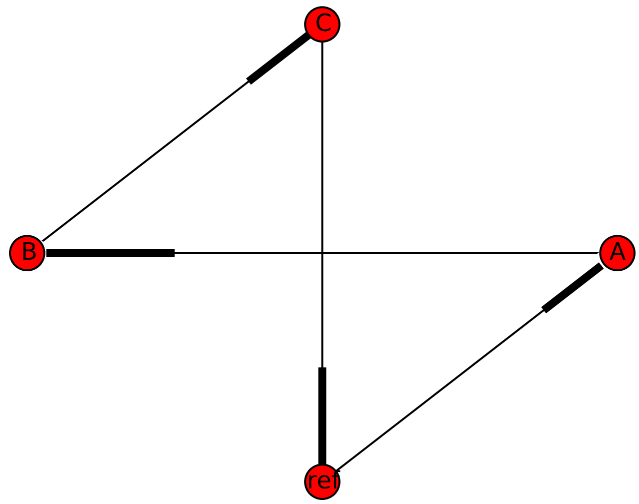

Figure 1: Graph of system `RLC`.

Output $\mathbf{y} = \begin{pmatrix} y_{\text{out}} \end{pmatrix}$;

3 Constitutive relations

Hamiltonian $\mathtt{H}(\mathbf{x}) = \frac{0.5}{\text{L1}} \cdot x_{\text{L1}}^2 + \frac{0.5}{\text{C1}} \cdot x_{\text{C1}}^2$;
Hamiltonian gradient $\nabla\mathtt{H}(\mathbf{x}) = \begin{pmatrix} \frac{1.0}{\text{L1}} \cdot x_{\text{L1}} \\ \frac{1.0}{\text{C1}} \cdot x_{\text{C1}} \end{pmatrix}$;
Dissipation function $\mathbf{z}(\mathbf{w}) = \begin{pmatrix} \text{R1} \cdot w_{\text{R1}} \end{pmatrix}$;
Jacobian of dissipation function $\mathcal{J}_{\mathbf{z}}(\mathbf{w}) = \begin{pmatrix} \text{R1} \end{pmatrix}$;

4 System parameters

4.1 Constant

parameter	value (SI)
C1 :	2e-06
R1 :	1000.0
L1 :	0.05

5 System structure

$$\mathbf{M} = \begin{pmatrix} 0 & -1.0 & -1.0 & -1.0 \\ 1.0 & 0 & 0 & 0 \\ 1.0 & 0 & 0 & 0 \\ 1.0 & 0 & 0 & 0 \end{pmatrix};$$
$$\mathbf{M_{xx}} = \begin{pmatrix} 0 & -1.0 \\ 1.0 & 0 \end{pmatrix};$$
$$\mathbf{M_{xw}} = \begin{pmatrix} -1.0 \\ 0 \end{pmatrix};$$
$$\mathbf{M_{xy}} = \begin{pmatrix} -1.0 \\ 0 \end{pmatrix};$$
$$\mathbf{M_{wx}} = \begin{pmatrix} 1.0 & 0 \end{pmatrix};$$
$$\mathbf{M_{ww}} = \begin{pmatrix} 0 \end{pmatrix};$$
$$\mathbf{M_{wy}} = \begin{pmatrix} 0 \end{pmatrix};$$
$$\mathbf{M_{yx}} = \begin{pmatrix} 1.0 & 0 \end{pmatrix};$$
$$\mathbf{M_{yw}} = \begin{pmatrix} 0 \end{pmatrix};$$
$$\mathbf{M_{yy}} = \begin{pmatrix} 0 \end{pmatrix};$$
$$\mathbf{J} = \begin{pmatrix} 0 & -1.0 & -1.0 & -1.0 \\ 1.0 & 0 & 0 & 0 \\ 1.0 & 0 & 0 & 0 \\ 1.0 & 0 & 0 & 0 \end{pmatrix};$$
$$\mathbf{J_{xx}} = \begin{pmatrix} 0 & -1.0 \\ 1.0 & 0 \end{pmatrix};$$
$$\mathbf{J_{xw}} = \begin{pmatrix} -1.0 \\ 0 \end{pmatrix};$$
$$\mathbf{J_{xy}} = \begin{pmatrix} -1.0 \\ 0 \end{pmatrix};$$
$$\mathbf{J_{ww}} = \begin{pmatrix} 0 \end{pmatrix};$$
$$\mathbf{J_{wy}} = \begin{pmatrix} 0 \end{pmatrix};$$

$\mathbf{J_{yy}} = \begin{pmatrix} 0 \end{pmatrix};$

$\mathbf{R} = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix};$

$\mathbf{R_{xx}} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix};$

$\mathbf{R_{xw}} = \begin{pmatrix} 0 \\ 0 \end{pmatrix};$

$\mathbf{R_{xy}} = \begin{pmatrix} 0 \\ 0 \end{pmatrix};$

$\mathbf{R_{ww}} = \begin{pmatrix} 0 \end{pmatrix};$

$\mathbf{R_{wy}} = \begin{pmatrix} 0 \end{pmatrix};$

$\mathbf{R_{yy}} = \begin{pmatrix} 0 \end{pmatrix};$