Structure of the port-Hamiltonian system
dlc

The PyPHS* development team[1]

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November 17, 2016

1 System netlist

line	label	dictionary.component	nodes	parameters
ℓ_1	in	electronics.source	('ref', 'n1')	type voltage
ℓ_2	D	electronics.diodepn	('n1', 'n2')	v0 ('v0', 0.026) mu ('mu', 1.7) Is ('Is', 2e-09) R ('Rd', 0.5)
ℓ_3	L	electronics.inductor	('n2', 'n3')	L ('L', 0.05)
ℓ_4	C	electronics.capacitor	('n3', 'ref')	C ('C', 2e-06)

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

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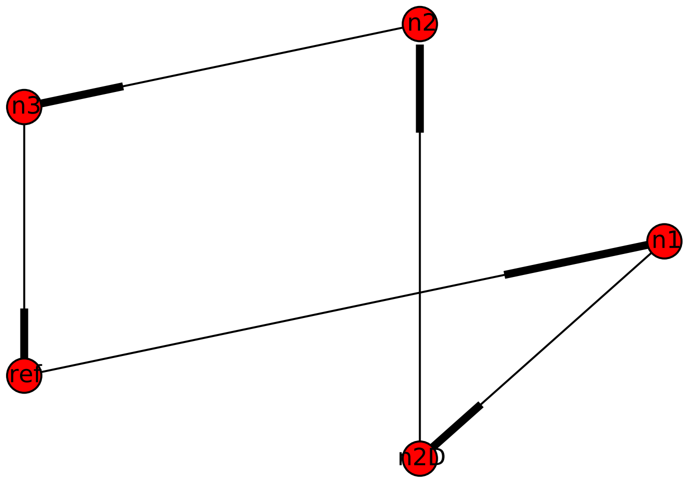

Figure 1: Graph of system `dlc`.

2 System variables

State variable $\mathbf{x} = \begin{pmatrix} x_{\mathrm{L}} \\ x_{\mathrm{C}} \end{pmatrix}$;

Dissipation variable $\mathbf{w} = \begin{pmatrix} w_{\mathrm{DR}} \\ w_{\mathrm{D}} \end{pmatrix}$;

Input $\mathbf{u} = \begin{pmatrix} u_{\mathrm{in}} \end{pmatrix}$;

Output $\mathbf{y} = \begin{pmatrix} y_{\mathrm{in}} \end{pmatrix}$;

3 Constitutive relations

Hamiltonian $\mathtt{H}(\mathbf{x}) = \frac{0.5}{\mathrm{L}} \cdot x_{\mathrm{L}}^2 + \frac{0.5}{\mathrm{C}} \cdot x_{\mathrm{C}}^2$;
Hamiltonian gradient $\nabla \mathtt{H}(\mathbf{x}) = \begin{pmatrix} \frac{1.0}{\mathrm{L}} \cdot x_{\mathrm{L}} \\ \frac{1.0}{\mathrm{C}} \cdot x_{\mathrm{C}} \end{pmatrix}$;
Dissipation function $\mathbf{z}(\mathbf{w}) = \begin{pmatrix} \mathrm{Rd} \cdot w_{\mathrm{DR}} \\ \mathrm{mu} \cdot \mathrm{v0} \cdot \log\left(1 + \frac{w_{\mathrm{D}}}{\mathrm{Is}}\right) \end{pmatrix}$;
Jacobian of dissipation function $\mathcal{J}_{\mathbf{z}}(\mathbf{w}) = \begin{pmatrix} \mathrm{Rd} & 0 \\ 0 & \frac{\mathrm{mu} \cdot \mathrm{v0}}{\mathrm{Is} \cdot \left(1 + \frac{w_{\mathrm{D}}}{\mathrm{Is}}\right)} \end{pmatrix}$;

4 System parameters

4.1 Constant

parameter	value (SI)
mu :	1.7
C :	2e-06
L :	0.05
v0 :	0.026
Is :	2e-09
Rd :	0.5

5 System structure

$$\mathbf{M} = \begin{pmatrix} 0 & -1.0 & -1.0 & -1.0 & -1.0 \\ 1.0 & 0 & 0 & 0 & 0 \\ 1.0 & 0 & 0 & 0 & 0 \\ 1.0 & 0 & 0 & 0 & 0 \\ 1.0 & 0 & 0 & 0 & 0 \end{pmatrix};$$
$$\mathbf{M}_{\mathbf{xx}} = \begin{pmatrix} 0 & -1.0 \\ 1.0 & 0 \end{pmatrix};$$
$$\mathbf{M}_{\mathbf{xw}} = \begin{pmatrix} -1.0 & -1.0 \\ 0 & 0 \end{pmatrix};$$
$$\mathbf{M}_{\mathbf{xy}} = \begin{pmatrix} -1.0 \\ 0 \end{pmatrix};$$
$$\mathbf{M}_{\mathbf{wx}} = \begin{pmatrix} 1.0 & 0 \\ 1.0 & 0 \end{pmatrix};$$

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