Input impedance and admittance

We here introduce a generalized version of the familiar impedance and admittance of electrical circuit analysis in which steady-state system behaviour can be expressed algebraically instead of differentially. We begin with generalized input impedance.

Consider a system with the source shown. The source can be across or through-variable.

The "ideal" source specifies either V_{in} or F_{in}, and the other variable depends on the system.

For the input $V_S(t) = V_{in}(s)e^{st}$, the resulting particular solution for the through variable $F_{in}(s)e^{st}$ is defined by the transfer function $Y(s)$:

We define $Y(s)$ to be the input admittance.

Similarly, for input $F_S(t) = F_{in}(s)e^{st}$, the resulting particular solution for the across variable $V_{in}e^{st}$ is defined by the transfer function $Z(s)$:

Impedance of ideal elements

The impedance and admittance of a single ideal one-port element is defined by its elemental equation.

Generalized capacitors Elemental eq.:
transfer function:

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Generalized inductors Elemental eq.: $L \frac{di_L}{dt} = v_L$ $\Rightarrow$
transfer function:

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Generalized resistors Elemental eq.:
transfer function:

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