Transmuting

The transmute function can change the representation of a system from one type to another, and can show the mathematical process, as well (for many cases). The plan is that this function will eventually enable (one of many examples) going from a differential equation to a netlist of a circuit, in a couple of lines of code.

This is a collection of various system representations, stored in the in_n variables.

```
syms s t y(t) Y

in_1 = (s+1)/(s^3+3*s^2+3*s+2);                                      % Symbolic s-domain.
in_2 = exp(-2*t)+exp(t);                                             % Symbolic t-domain.
in_3 = tf(1,[2,3,4]);                                                % Transfer function.
in_4 = ss([-1.5, -2; 1, 0], [0.5; 0], [0, 1], 0);                    % State space.
in_5 = zpk(0, [1-1i 1+1i 2], -2);                                    % Zero-pole-gain func.
in_6 = ODE(diff(y(t),2)+3*diff(y(t))+2*y(t) == 0, [0.1, 0.05]);      % Differential eq.
in_7 = [1,2,3];                                                      % Characteristic eq.
```

Try inserting any of these inputs into the transmute function, and try changing `type_in` and `type_out`.

- `'sd' = Symbolic s-domain.`
- `'td' = Symbolic t-domain.`
- `'tf' = Transfer function.`
- `'ss' = State space.`
- `'zp' = Zero-pole-gain.`
- `'de' = Differential equation.`
- `'ce' = Characteristic equation.`
- `'ec' = Electric circuit.`

```
ELAB.transmute(in_6, 'de', 'td', true)
```

```
Diff. equation
```

$$\frac{\partial^2}{\partial t^2}\ y(t) + 3\,\frac{\partial}{\partial t}\ y(t) + 2\ y(t) = 0$$

```
Laplace transform:
```

$$2\,Y - \frac{s}{10} + 3\,Y\,s + Y\,s^2 - \frac{7}{20} = 0$$

```
Solve for tf:
```

$$\frac{2\,s+7}{20\,s^2+60\,s+40}$$

```
In s-domain
```

$$\frac{2\,s+7}{20\,s^2+60\,s+40}$$

```
Partial fraction decomp:
```

$$\frac{1}{4\ (s+1)} - \frac{3}{20\ (s+2)}$$

```
Inverse Laplace:
```

$$\frac{e^{-t}}{4} - \frac{3\,e^{-2\,t}}{20}$$

```
ans =
```

$$\frac{e^{-t}}{4} - \frac{3\,e^{-2\,t}}{20}$$

This is a map of how the transmute function converts one form to another. Dashed lines have not yet been fully implemented.